THÜNEN

Building Organic Bridges

Volume 2
Germany – India

Proceedings of the 4th ISOFAR Scientific Conference
at the Organic World Congress 2014

13–15 October 2014 in Istanbul, Turkey

Gerold Rahmann and Uygun Aksoy (Editors)

Thünen Report 20

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International Society of Organic Agriculture Reserach

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IFOAM INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

'Building Organic Bridges' with Science

FOREWORD

Plants and animals or in a broader sense, mother-nature, has been serving mankind from time immemorial. If you consider agriculture, as cultivation or domestication of plants and animals then you may start evaluating the impact of mankind since the last 12,000 years. Today, still, agriculture provides food for all living organisms, and fibre and in some cases fuel for human beings. The World today nurture more than 7.2 billion as of April 2014 even if the ecological footprint has exceeded one.

According to UN databases[1], in 1980, out of 4.4 billion, rural population was 1.53 times more than the urban population. Those who were the producers were more than the consumers. In 2015, the rural/urban population ratio is estimated as 0.85 revealing that more will consume and less produce. If this ratio is dissected according to the regions of development: rural/urban population ratio is 0.27 in more developed regions, 1.05 in less developed and 2.30 in least developed regions of the World. Urban growth rate peaked (2.24 %) between 2000 and 2005. Rural growth rate that was 1.13 % between 1985 and 1990 is estimated to be 0.05 % between 2015 and 2020 and then at negative rates. By 2035, 61.7 % of the population will live in urban areas where as 38.3% in rural. So, less people in more and less developed regions of the world will try to supply food for more and more consumers or urban and peri-urban areas in developed regions will become more intensified for adequate agro-food production. Additionally, there are other major issues as changing life styles and consumption habits as higher calories and high consumption of animal products. Relationship between health especially of non-transmissible diseases and nutrition is a bottom-line for many, and new evidences strengthening these relationships appear through research as technology advances. Consumers in more developed regions of the world are becoming concerned about long-distance transfers of agricultural products, energy consuming distribution channels, loss of diversity, erosion of traditional foods or processing techniques. Agricultural land is threatened by intensification, urbanization, non-agricultural activities e.g. mass tourism, mining and climate change. How can agricultural production counteract these diverse issues and still be sustainable?

Organic agriculture rooting on health, ecology, fairness and care principles as defined by IFOAM is practiced in 164 countries according to 2012 data[2]. 88 countries possess a legislative framework for organic agriculture. How many have mutual recognition? Are there any derogations and why? The market size has reached to 63.8 billion US dollars. In all 164 countries data at least on production are collected. The product flows are still towards enlarging organic markets in more developed regions of the world e.g. US or Germany. Domestic markets are enlarging. Who consumes more organic and how much they spend? Why do the consumers prefer organic food/do they also prefer organic non-food products? Are they healthier? What are the health aspects? What are the quality attributes or is it the vital quality that makes it different than conventional systems? In which as-

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[1] Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects, 2014: The 2010 Revision and World Urbanization Prospects: The 2011 Revision Monday, April 14, 2014; 7:13:02 AM

[2] Willer, H. an d J. Lernoud (Eds.), 2014: The World of Organic Agriculture. Statistics and Emerging Trends 2014. FIBL-IFOAM Report. Frick and Bonn

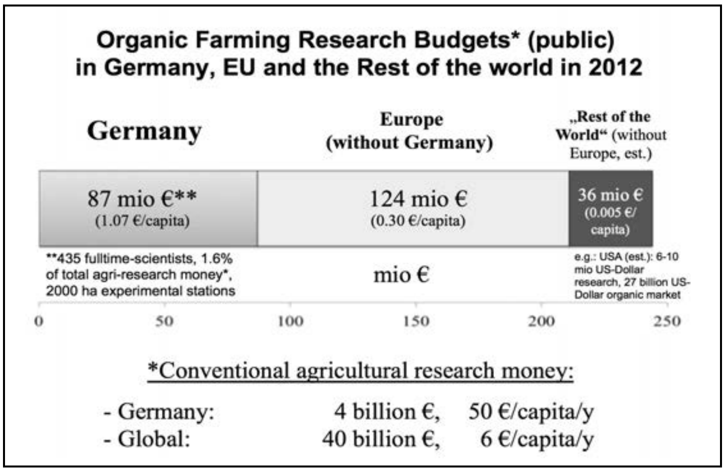
pects are organic more sustainable? Does sustainability of agricultural land differ from non-agricultural organic certified areas? How does organic system contribute to climate change?

Organic management systems aim for finding solutions to these and many other questions through research. The research objectives should derive from real-time or envisaged problems, and outcomes should find paths for quick implementation. Science is needed not only to prove its merits to the general public and lobby but also to put forward solutions to site specific problems. These can be exemplified as: Finding solutions for soil fertility management under arid conditions? How to increase yields; by developing high yielding varieties better adapted to organic conditions, by decreasing losses or by managing the value chains? What are the tools that organic farmers have in preserving animal health, which breed are resistant?

Research and innovation contributes to diversity, to competitiveness and to sustainability. In this respect, scientific meetings are major tools to establish fora to exchange results and experiences. Compared to conventional agriculture, the number of researchers and research projects and available funding is more limited in research on organic food and farming and the concept is much younger. These peculiarities enhance the importance of communication and interchanging among stakeholders. The IFOAM Organic World Congress is the unique opportunity for researchers, policy makers, extension specialists, practitioners and other stakeholders for exchanging knowledge and experiences; to share results and reversely to bring problems to the attention of world-wide research community.

The 18th IFOAM Organic World Congress held on 13-15 October, 2014 in Istanbul-Turkey targets to **'build organic bridges'**. The Scientific track will contribute to bridging not only scientists but also institutions and disciplines, and to linking more developed and less developed, rural and urban, research to extension, plant to animal, farm practices to world-wide problems and producer and consumers. Organic is a management system that requires a diversity of inputs from different disciplines, therefore, an international Congress is the best medium to blend them.

The Scientific Track is organized with special efforts of the co-organizers, International Society for Organic farming Research (ISOFAR; www.isofar.org) and EGE University (Turkey; www.ege.edu.tr). Organic e-prints (www.orgprints.org) acted as the hub for collection, revision and maintaining of all the papers. There were 568 manuscripts and abstracts received for the Scientific Track. Abstracts were not evaluated since the authors were obliged to submit full papers. About 96 reviewers - 37 from Turkey and 59 from all over the world (ISOFAR network) - contributed to the review process (double-blind: 1 reviewer international, 1 reviewer Turkish, final assessment and decision by the scientific board).



Source: compiled by Rahmann

At least, 300 papers have been accepted. They are from 51 countries and represent the countries, were 87 % of the global organic farm land and 75 % of the global organic farms are located (see table below the foreword). It is obvious, that organic farming is practiced world wide (but less the 1 % of the total farm land is managed organically), the organic markets are mainly in the western world (Europe, North America, Japan: 94 %) and the research is mainly done in Europe (publication share in web of science: 84 %, at the 4th ISOFAR congress: 69 %).

The global balance between organic production, consumption and research is not "fair" and "healthy" and has to overcome; a huge challenge for the organic world. The science can help, but the resources for organic farming research is in all regions of the world not sufficient to overcome the challenges and much less compared to the production, market or farmers numbers. Even in Europe, where organic farming research has left niches and became respected and reputable, the overall public funding for research is less than 1% of total public funded agricultural research, despite organic farm land has a share above 4% of the total farm land. This is not fair and politicians and decision makers in all countries on the world need to re-allocate the public research fund in direction to organic farming (see Figure).

All accepted papers are presented oral or as poster in 24 sessions and will try to help to

- bridge the gap between poor and rich areas of the world
- bridge the gap between scientific knowledge and practice
- bridge the gap between new and old technology

This 4th ISOFAR scientific congress will also bridge the knowledge presented in the 3rd ISOFAR Congress in 2011 in South Korea with the one to be organized in 2017. This Book of Proceedings will further help to disseminate and archive the accumulated vast information on organic agriculture.

We wish to express our sincere thanks to all who have contributed in organization of the 18th Organic World Congress (www.owc2014.org), namely IFOAM (www.ifoam.org) and BUĞDAY (www.bugday.org), and to those who delivered presentations or participated in the Congress, prepared manuscripts, reviewed, supported, and many others. Special thanks go to MILENA MATTERN and SYLVIA FENNERT from the Thuenen-Institute (www.ti.bund.de) who spent a lot of time to make the lay-out of this Proceeding and to the president of the Thuenen-Institute and therefore the German government, who gave the generous and valuable donation for printing and the facilities to do the work.

The papers are ordered by countries (country of the first author), not by sessions or disciplines. These decisions are made to make the proceedings affordable (all volumes can be purchased individually) and to merge and bridge the world and not split by disciplines and sessions. You find search facilities (indexes) to find all papers by discipline, eprint-number, keywords or sessions in each volume. A download of the full proceeding is possible under the webpage of ISOFAR (www.isofar.org) and as individual papers under organic eprints (www.orgprints.org). Due to the fact that all papers together comprise 1,300 pages, the printed Proceedings are split into four volumes. These proceedings comply all submitted, accepted for oral or poster presentation and revised manuscripts, but does not imply that they are all presented. The content of the papers are in responsibility of the authors and do not need to comply with the editors opinion.

Prof. Dr. GEROLD RAHMANN (Thuenen-Institute, Germany)
Prof. Dr. UYGUN AKSOY (EGE University, Turkey)

October 2014

Table: Comparison of the World of Organic Farming: Production, consumption, research and the representation of the countries on the 4th ISOFAR scientific congress 2014

Region / country	Organic farm land 2012 (ha) [1]	share on total (%)	Producers [1] (certified farms)	Share (%)	Sales [1] (million Euro)	share	4th ISOFAR papers [2]	share	Scientific publications [3]	share
Africa	1,073,657	3%	540,988	30%	1,000	1%	24	8.0%	221	4%
USA and Canada	2,790,162	7%	16,659	1%	23,000	48%	10	3.3%	459	8%
Latin America	6,857,611	11%	315,889	18%	1,000	1%	6	2.0%	245	4%
Asia	3,706,280	10%	619,439	35%	2,000	4%	49	16.3%	509	9%
Europe	10,637,128	29%	291,480	16%	21,000	44%	206	68.0%	4,676	84%
- only EU27	*9,518,234*	*26%*	*236,803*	*13%*	*19,000*	*40%*	*183*	*61.0%*	*4,330*	*78%*
Oceania	12,185,843	33%	14,138	1%	1,000	2%	5	1.7%	274	5%
World (Total)	37,245,686	100%	1,789,359	100%	48,000	100%	300	100%	5,569	100%
Data from participating countries (4th ISOFAR scientific congress 2014)										
Argentina	3,796,136	2.7%	1,699	0.1%	n.d.		1	0.3%	21	0.4%
Australia	12,001,724	2.9%	2,129	0.1%	942	2.0%	4	1.3%	169	3.0%
Austria	542,553	19.7%	11,575	0.6%	1.065	2.2%	7	2.3%	58	1.0%
Bangladesh	6,810	0.1%	9,335	0.5%	n.d.		2	0.7%	12	0.2%
Belgium	59,220	4.3%	1,274	0.1%	435	0.9%	4	1.3%	17	0.3%
Bolivia	32,710	0.1%	9,837	0.5%	n.d.		1	0.3%	4	0.1%
Brazil	687,040	0.3%	14,437	0.8%	n.d.		3	1.0%	113	2.0%
Bulgaria	25,022	0.8%	978	0.1%	7	0.0%	3	1.0%	3	0.1%
Canada	841,216	1.2%	3,718	0.2%	1.904	3.9%	6	2.0%	107	1.9%
China	1,900,000	0.4%	n.d.		791	1.6%	8	2.7%	209	3.8%
Colombia	34,060	0.1%	4,775	0.3%	n.d.		1	0.3%	7	0.1%
Denmark	162,173	6.1%	2,677	0.1%	901	1.9%	15	5.0%	109	2.0%
Estonia	133,779	14.8%	1,431	0.1%	12	0.0%	2	0.7%	5	0.1%
Ethiopia	140,475	0.4%	122,359	6.8%	n.d.		1	0.3%	13	0.2%
Finland	188,189	8.2%	4,114	0.2%	120	0.2%	8	2.7%	53	1.0%
France	975,141	3.6%	23,135	1.3%	3.756	7.8%	15	5.0%	109	2.0%
Germany	1,015,626	6.1%	22,506	1.3%	7.590	15.7%	58	19.3%	187	3.4%
Ghana	19,893	0.1%	3,464	0.2%	n.d.		1	0.3%	15	0.3%
Greece	309,823	3.7%	21,274	1.2%	58	0.1%	6	2.0%	45	0.8%
Hungary	124,402	2.9%	1,433	0.1%	n.d.		6	2.0%	4	0.1%
Iceland	8,246	0.4%	39	0.0%	n.d.		1	0.3%	4	0.1%
India	1,084,266	0.6%	547,591	30.6%	46	0.1%	16	5.3%	94	1.7%
Indonesia	74,034	0.1%	8,612	0.5%	n.d.		1	0.3%	9	0.2%
Iran	43,332	0.1%	6,120	0.3%	n.d.		4	1.3%	29	0.5%
Iraq	n.d.		n.d.		n.d.		1	0.3%	n.d.	
Italy	1,096,889	8.6%	42,041	2.3%	1.720	3.6%	19	6.3%	101	1.8%
Japan	9,401	0.2%	2,137	0.1%	1.000	2.1%	1	0.3%	52	0.9%
Kenya	4,969	0.0%	12,647	0.7%	0	0.0%	1	0.3%	36	0.6%
Luxembourg	3,720	2.8%	96	0.0%	68	0.1%	1	0.3%	n.d.	
Morocco	17,030	0.1%	120	0.0%	n.d.		1	0.3%	4	0.1%
Netherlands	47,205	2.5%	1,672	0.1%	761	1.6%	8	2.7%	120	2.2%
New Zealand	133,321	1.2%	1,365	0.1%	205	0.4%	1	0.3%	105	1.9%
Nigeria	9,473	0.0%	597	0.0%	n.d.		14	4.7%	64	1.1%
Norway	55,500	5.4%	2,725	0.2%	160	0.3%	7	2.3%	43	0.8%
Philippines	96,317	0.8%	3,010	0.2%	n.d.		1	0.3%	37	0.7%
Poland	609,412	3.9%	23,430	1.3%	120	0.2%	2	0.7%	26	0.5%
Portugal	201,054	5.8%	2,434	0.1%	21	0.0%	6	2.0%	20	0.4%
Slovenia	32,149	6.6%	2,363	0.1%	38	0.1%	1	0.3%	10	0.2%
South Korea	19,312	1.0%	13,376	0.7%	343	0.7%	2	0.7%	18	0.3%
Spain	1,621,898	6.5%	32,195	1.8%	965	2.0%	8	2.7%	150	2.7%
Sri Lanka	19,496	0.8%	403	0.0%	n.d.		3	1.0%	8	0.1%
Sweden	480,185	15.4%	5,508	0.3%	885	1.8%	4	1.3%	98	1.8%
Switzerland	123,000	11.7%	6,060	0.3%	1.411	2.9%	15	5.0%	71	1.3%
Syria	19,987	0.1%	2,458	0.1%	n.d.		1	0.3%	11	0.2%
Tanzania	115,022	0.3%	145,430	8.1%	n.d.		1	0.3%	14	0.3%
Tunisia	178,521	1.8%	2,396	0.1%	n.d.		1	0.3%	7	0.1%
Turkey	442,582	1.8%	2,396	0.1%	n.d.		7	2.3%	73	1.3%
Uganda	228,419	1.6%	188,625	10.5%	n.d.		4	1.3%	11	0.2%
UK, Great Britain	638,528	4.0%	4,650	0.3%	1.882	3.9%	10	3.3%	88	1.6%
USA	1,948,946	0.6%	12,941	0.7%	21.038	43.6%	4	1.3%	77	1.4%
Vietnam	23,400	0.2%	4,385	0.2%	n.d.		2	0.7%	20	0.4%
Sum	32,381,606	100%	1,339,972	100%	48.244	100%	300	100%	2.660	100%
Share of World	87%		75%		99%		100%		48%	

[1] Data from IFOAM/FibL survey "Statistics of the Organic World". 2013; [2] Number of papers accepted for the 4th ISOFAR organic congress 2014.
[3] Papers found in scientific journals with impact factor, search done in June 2014 in the Web of Science with the keywords „organic farming" and „organic agriculture" with Endnote® software; n.d.: no data

Scientific board (coordinators)

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Prof. Dr. UYGUN AKSOY, EGE-University, Turkey

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Content

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Structure and development of scientific journal publications on organic agriculture: A scientometric review

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Key words: organic farming research, organic agricultural science, scientific publishing, scientometrics, bibliometrics, literature review

Abstract

By means of basic scientometric indicators 2,801 peer-reviewed articles on organic agriculture (ORG) obtained from the so-called 'Web of Science' are compared with the general agricultural literature (AGR) (136,712 articles). Apart from development and publication growth we review bibliometric data on author, institution, country and language to produce insights on the structure of international publishing on ORG.

Introduction and objectives

In view of increasing global importance of organic agriculture there are also growing research activities worldwide concerning organic farming (Willer 2009). Tendencies of an institutionalization of organic research as well as increased networking and coordination of research agendas can be observed (Lange et al. 2005) especially at European level (Niggli et al. 2008, Schmid et al. 2009) but also globally (Willer 2009). Repeated efforts have been made to describe an original 'organic research' approach but still, the term 'organic research' remains hard to define (e.g. Watson et al. 2008).

Agricultural science in general as well as research on organic farming produce a continuously growing number of scientific journal articles (Watson et al. 2008, Siegmeier and Möller 2013). Traditionally, in organic agriculture, research focus and knowledge transfer are particularly directed towards practitioners (Bull 2007, Lange et al. 2005, Lockeretz 2002) and so-called 'grey literature' is of great importance. Peer-reviewed articles predominantly serve the publication within the research community in order to establish or raise the scientific reputation. In this context peer-reviewed articles have been assigned a potential for de-ideologization that could lead to an approximation with the science mainstream and an increased appreciation for organic agriculture (Lockeretz 2002). In addition, evaluation and performance assessment of researchers and institutions increasingly include and focus on peer-reviewed output. Therefore journal papers gain in importance also for 'organic research' and its funding. This article analyzes bibliometric characteristics in order to obtain insight into the structure and distribution of ORG literature and its status within AGR literature in general. The study illustrates the development of ORG papers published in scientific journals over the past 35 years (1977-2011). The goal is to identify possible trends in publication growth and publication dynamic by means of scientometric indicators.

Material and methods

The present study is based on the analysis of articles listed in the International Science Citation Index (ISI) of Thomson Reuters ('Web of Science'). A topic search (TS) within title, abstract and keywords for "organic farm*" OR "organic agriculture" was conducted for the years 1977-2011 and all languages. An analogous search was run with the terms "farm*" OR "agriculture". The main set of 136,712 agricultural articles (AGR) and the subset of 2801 articles (2,05 %) relating to organic farming (ORG) were analyzed and compared in regard to publication growth and dynamic by means of the scientometric indicators *mean annual percentage rate* (MAPR) and *doubling time* (2T) (Vinkler 2010). In order to display structure and distribution of the organic agricultural literature we also reviewed bibliometric data on author, institution, country and language of all articles.

Development and dynamic

First journal publications on ORG appeared in the 1970s. For the period 1977-1990 sporadic numbers are listed in ISI with a maximum of 5 articles/year and no ISI entry in 1985. Since 1991 at least 10 articles and since 2001 a minimum of 100 articles have been published annually (Fig.1). With 325 papers in 2011 ORG publications comprised 2,8 % of all newly published AGR papers that year (peak: 3 % in 2009).

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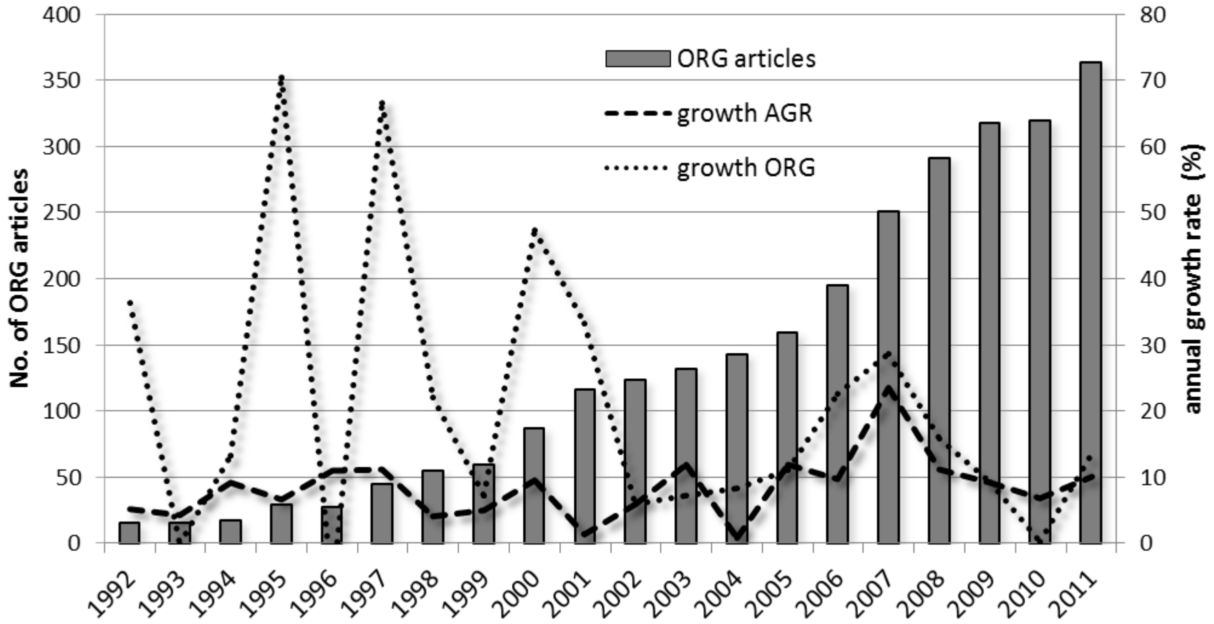

Figure 1: Articles on organic farming (ORG) listed in the ISI (1992-2011) and publication growth rates for general agricultural (AGR) and ORG articles

The publication growth rate over the past 20 years (MAPR1992-2011) is 20.2 % for ORG articles. This rate of a relatively young sub-field can hardly be directly compared with the established agricultural sciences in general (MAPR1992-2011 = 8,4 %) (Fig.1), which produced more than 12,700 articles in 2011. The length of cumulative doubling of a field of publication within a defined time span (2T) provides a logarithmized and therefore relatively un-biased indicator for the comparison of corpi of literature significantly differing in quantity (Vinkler 2010). Doubling times of ORG and AGR publications are very similar (Tab.1).

Table 1: Doubling times of the organic and general agricultural literature

	Doubling time (2T)		
	1992-2011	**2002-2011**	**2007-2011**
organic farming (ORG)	6.5 yrs	3.4 yrs	1.9 yrs
agriculture (AGR)	5.8 yrs	3.3 yrs	1.9 yrs

Structures and stakeholders

The distribution of scientific publications is generally characterized by exponential patterns ('Bradford's Law of Scattering'; Vickery 1948). This is also true for the analyzed AGR and ORG literature: Two authors each published more than 20 articles, 4 authors 15-19 articles, and already 18 authors are listed with 10-14 articles on ORG. The distribution of publications according to country of origin, author affiliation (Tab.2), and journal follows the same pattern.

English is the prevailing language in AGR and ORG literature (90 % and 89 %). Papers in German make up a share of 3 % (AGR) and 6 % (ORG). The only other languages with more than 1 % of agricultural articles listed in ISI are French and Portuguese (<2 %). On one hand English is the predominant language in global science, on the other hand English speaking countries are dominating agricultural publications. The US, Great Britain, Canada, Australia and India are involved in the publication of roughly 50 % of all AGR articles; institutions in the US alone account for about 25 % of all AGR papers in this study.

The geographic distribution of ORG articles is also lead by the US (444 articles; ~16%), followed closely by European countries (Germany ~13%; Denmark ~7%; England ~6%; Netherlands ~6%; Italy ~5%; Sweden ~5% and Spain ~4%). While the US dominate the agricultural sciences (AGR *and* ORG) according to the total count of articles, it is European universities which are particularly active in publishing ORG articles. Organizations like Wageningen UR or SLU in less populous countries (Netherlands and Sweden) bundle resources and expertise in a 'quasi-monopoly' for agricultural publications. In the special case of relatively small Denmark there are several protruding institutions involved in ORG publications (Tab.2). Although, it has to be noted that in 2008 the Danish Institute of Agricultural Science (DIAS) has merged with the Aarhus University. Furthermore, Denmark has the highest share of ORG articles in total AGR articles of a country (8.2 %) followed by Austria (7.1), Switzerland (5.8) Sweden (5.7), Greece (4.8), Germany (4,7), Finland (4.5), Wales (4.4), Netherlands (3.6), Cech Republic (3.5), Italy (3.5), Turkey (3.1), Spain (2.5), Brazil (2.4), Norway (2.4) and Poland (2.1).

Table 2: Institutions with most journal articles on organic farming (1977-2011)

Institution	No. of ORG-articles	Share; N=2801	No. of AGR-articles (rank[a])	ORG-share in AGR-articles (rank[b])
Aarhus Univ., Denmark	132	4,71 %	953 (18)	13,85 % (6)
Wageningen UR, Netherlands	122	4,36 %	2395 (3)	5,09 % (13)
SLU, Sweden	100	3,57 %	1114 (10)	8,98 % (7)
Univ. Copenhagen, Denmark	78	2,78 %	1018 (13)	7,66 % (10)
Univ. of California, US	77	2,75 %	2863 (2)	2,69 % (16)
DIAS, Denmark	72	2,57 %	262 (140)	27,48 % (2)
USDA-ARS, US	68	2,43 %	3817 (1)	1,78 % (20)
FIBL, Switzerland	62	2,21 %	113 (-)	54,87 % (1)
AgResearch, New Zealand	48	1,71 %	1703 (4)	2,82 % (16)
Boku Vienna, Austria	46	1,64 %	263 (139)	17,49 % (5)
Univ. Kassel, Germany	42	1,50 %	211 (196)	19,91 % (4)
Univ. Göttingen, Germany	41	1,46 %	502 (48)	8,17 % (8)
INRA, France	41	1,46 %	1663 (5)	2,47 % (18)
Agr. Acedemy, Bulgaria	38	1,36 %	751 (28)	5,06 % (14)
Thuenen Inst./FAL, Germany	35	1,25 %	167 (-)	20,96 % (3)
EMBRAPA, Brazil	35	1,25 %	601 (40)	5,82 % (12)
Washington State Univ., US	33	1,18 %	554 (45)	5,96 % (11)
Univ. Fed. Sta. Maria, Brazil	32	1,14 %	891 (20)	3,59 % (15)
Univ. Bonn, Germany	31	1,11%	399 (76)	7,77 % (9)
Cornell Univ., US	30	1,07%	1281 (8)	2,34 % (19)

[a] rank among all institutions contributing to the 2801 articles on organic farming
[b] rank among the 20 institutions listed

Discussion and conclusion

Despite the publication growth in the young and innovative ORG sub-field its dynamic over the past 10 years hardly differs from the established agricultural sciences in general. However, some smaller or younger journals are not listed in the ISI (e.g. Organic Agriculture, Journal of Organic Systems) and 'grey literature' has not been considered in this study. Furthermore, the relatively unspecific topic search produces unproportionately more hits in AGR than ORG that are not strictly corresponding to agriculture but rather belong to e.g. medical science or biology. On the other hand, the limitation to title search (TI) did only partially represent the 'organic literature'. Search results and bibliometric data from ISI in general have to be interpreted carefully.

The results show that different institutions engage to different degrees in ORG publication. However, it is impossible to evaluate to what degree organic farming is merely a topic of conventional agricultural research or to what degree professionalized 'organic research' publishes in peer-reviewed journals. For this purpose content analytical steps and above all a clear definition of "organic research" would be necessary, which might be difficult to map in an ISI-search.

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Online Decision Trees to support the Control of Gastrointestinal Worms in Ruminants

REGINE KOOPMANN[1], MICHAELA DAEMMRICH[1], HARM PLOEGER[2]

Key words: endoparasites, gastrointestinal strongyles, ruminants, pasturage, Animal Health, Organic Husbandry

Abstract

Control of gastrointestinal worms is crucial to any pasture system for ruminants. To support the farmer's foresighted planning of pasturage and to avoid excessive deworming in Germany we created four decision trees and put them online. They are freely accessible at www.weide-parasiten.de. There is one decision tree for young first season cattle in intensive dairy husbandry, one decision tree for young cattle in suckling-cow management and one decision tree for sheep and goats, respectively.

Introduction

Grazing on pasture is the most appropriate husbandry system for ruminants. But all ruminants with access to pasture are exposed to gastrointestinal parasites. In the course of foresighted animal health care it must be prevented:

- that parasitic disease occurs.
- that lower performance reduces the economic success of the farmer.
- that pastures get that much contaminated with parasite eggs that subsequent grazing is only possible if a large amount of pharmaceuticals get administered.
- that an unnecessary amount of medicine is applied.

Furthermore, only the epidemiological optimal deworming agent should be used and the farmer should only treat at the right moment. This aids environmental protection and also serves to delay the spread of anthelmintic resistance in worm populations.

Pasture for all ruminants is an important point in sustainable husbandry and animal welfare. In the consumer's perception of animal welfare grazing has a central role. At the same time more grazing for the animals means more opportunities to become infected and ill. This problem is particularly relevant in case of parasitic infections.

But skillful planning of pasture management can often meet the two demands. Within the operating plan for the management of pastures the farmer can match measures that are important for parasite prophylaxis (e.g. provide surfaces that do not contain worm larvae at turn out) together with other aspects of management (e.g. the time of mowing). However, the cost of this planning and the sustainable parasite control must be visibly worthwhile for the farmer (Besier 2012).

Therefore a management tool should be created to represent scientific knowledge about the somewhat complicated parasite problems in a way that the farmer has the option to involve parasite prophylaxis at the beginning of his pasture planning. In addition, suggestions for sustainable parasite control and efficient medication should be offered.

Methods

For this task, a decision tree has been proven to be suitable (Ploeger et al 2008). For young cattle in intensive production in the Netherlands a decision tree is already online for several years (www.parasietenwijzer.nl). On this site there is also an English version available for young cattle as well as one for horses.

Results

During the last years four decision trees have been built, one for first season cattle in intensive dairy husbandry, one for young cattle in suckling-cow management and two for lambs in intensive sheep and goat husbandry, respectively.

At “www.weide-parasiten.de” these decision trees are free to access (see Figure 1).

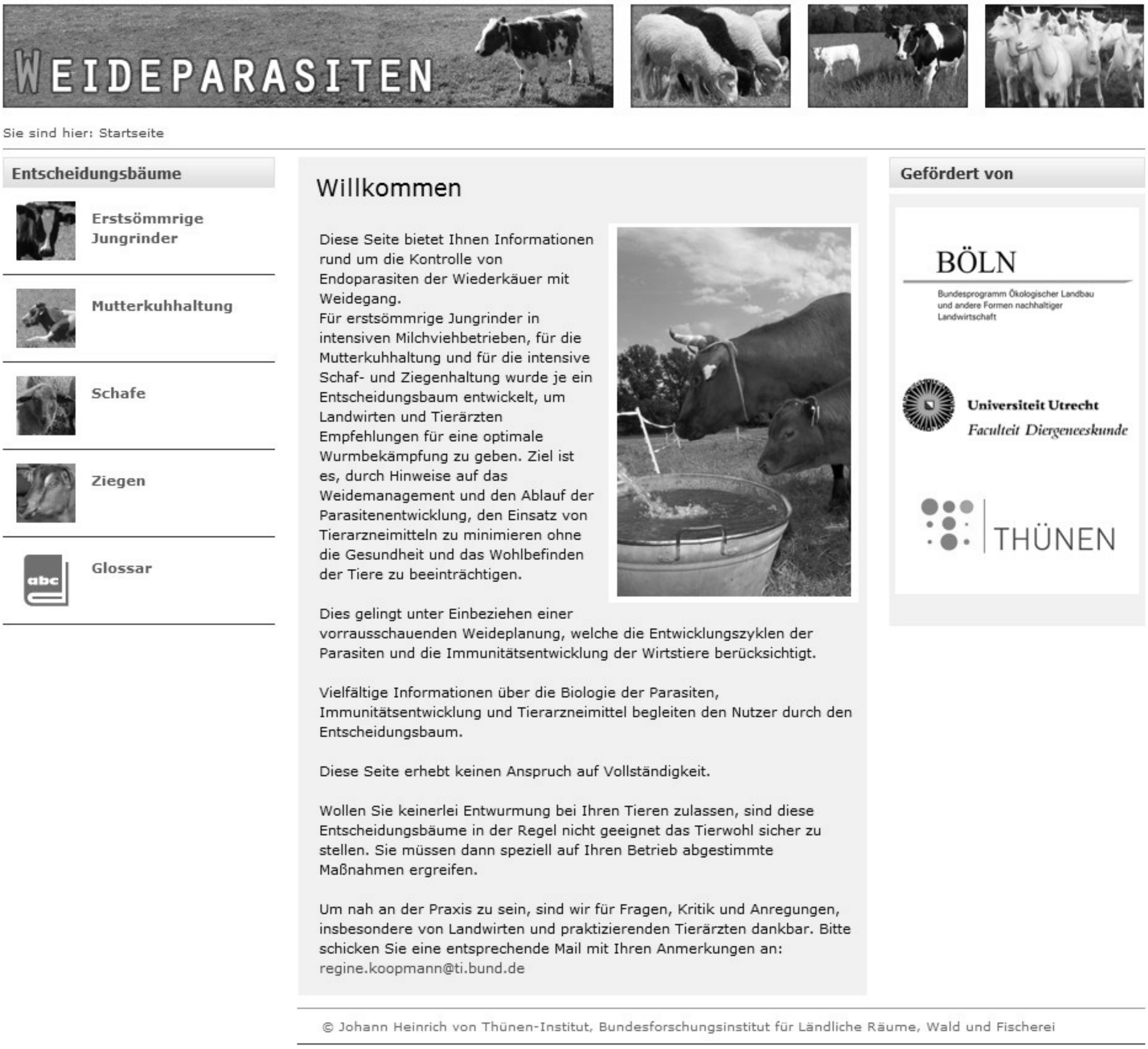

Figure 1: Screenshot of the home site of www.weide-parasiten.de

Questions about the pasturage of ruminants (capital letters in the navigation scheme), that need to be answered with Yes / No, make you navigate through the decision tree. After passing through the navigation scheme you will end up at one recommendation (digits in the navigation scheme), which initially has the safety of the animals in focus (see Figure 2).

Depending on the answers, you will get the recommendation to wait and watch your animals carefully, to monitor the egg count of the herd or to treat with long acting or short acting anthelmintic drug.

German law does not allow mentioning pharmaceuticals by user's name. But if you click at "Anthelminthika" you will find a list of allowed pharmacologically active substances. All of them need a veterinarian prescription. The European regulations on organic farming let anthelmintic treatments explicitly free of restriction in the number of treatments (EC 889/2008, Article 24, No. 4). However, the withdrawal periods have always to be doubled. In EC substances which have no registration and no value for their “Maximal Residue Limit” in meat, milk or eggs, are not allowed to be used in production animals. This concerns as well phytotherapeuticals or other alternatives in use for deworming. Therefore these are not mentioned in the decision trees.

By trial and error the farmer can follow the various paths through the navigation scheme of the decision trees. He can make out which pasture conditions must be met in order to reduce his drug use and not to endanger the health of his animals and his economic success.

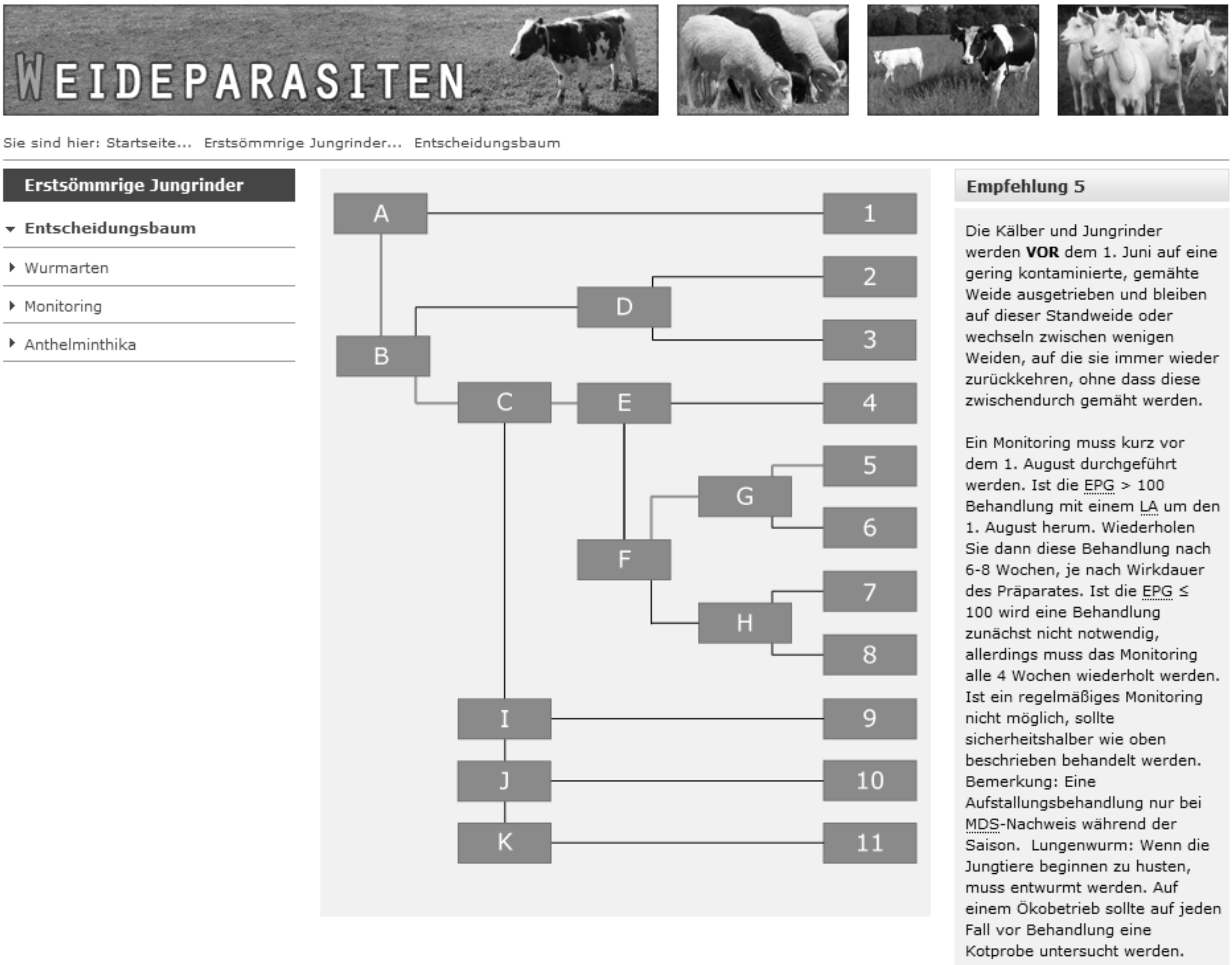

Figure 2: Screenshot of recommendation No. 5

Of course, decision trees are just a tool and recommendations may sometimes be too strict to prevent disease. For instance, in cattle a threshold of 100 strongyle eggs per gram feces (EPG) is used before it is advised to treat. Such a threshold may be too conservative. But it has to keep in mind that such thresholds are set as well to prevent too much contamination of pasture with worm eggs, thereby keeping pastures relatively safe for grazing by animals. Another problem of the decision tree may be the search for a laboratory which is able and willing to count eggs (McMaster method) instead of using more qualitative techniques to check samples for worm eggs.

In addition to the decision trees the website offers various biological and technical informations about roundworms in ruminants (see Figure 3).

In the coming years, the pages will be updated regularly. Through communication with users and professionals we want the site to be constantly improved.

Ultimately, the authors hope that a suitable grazing will be offered to all ruminants, also to those in adolescence. By foresighted pasture measures, regular monitoring for worm eggs in feces, supplemented by scheduled deworming if necessary, gastrointestinal parasites are manageable in organic farming.

The project was funded by the German Federal Agency for Agriculture and Food, Federal Organic Farming scheme.

Figure 3: Screenshot with information about sustainable parasite control

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Minimisation strategies for copper pesticides in organic potato cultivation

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Key words: plant protection, copper, potato

Abstract

It can be stated that, now and in future, any successful copper minimisation strategy must be based on the implementation of all preventive measures, the further reduction of copper application rates, and the development of alternative pesticides. First results of the EU CO-FREE project (Innovative strategies for copper-free low input and organic farming systems: www.co-free.eu) have shown, that the high safety effect of copper-based products is difficult to achieve using alternative products. This paper describes short-, medium- and long-term measures for the implementation of copper minimisation strategies in organic potato production.

Introduction

Current application of copper pesticides in German potato production:

Late blight (Phytophthora infestans (Mont.) De Bary) regularly causes high yield and quality losses in organic potato cultivation. More than 70% of German organic potato producers have blight-related yield losses ranging from 15 to 20 %, depending on the growing region (Kühne et al 2013). Currently, copper-based pesticides are the only effective agents for direct control of the disease. Since the 1980s, organic farming associations in Germany have limited copper use to 3 kg per ha per year. Farmers in the Demeter Association may not use any copper in potato cultivation and thus have higher yield losses. Copper pesticides are not used routinely, but only when there is a risk of late blight infection and when yield and quality losses are expected. In the middle of the year, farmers do not use more than 1.5 to 2 kg copper per ha per year. In some regions and during dry years, copper treatments are often omitted entirely. In the early stages of infection or during high disease pressure, however, the maximum rate of 3 kg/ha/year is generally applied.

Material and methods

Two new copper-free pesticides against late blight in potatoes (variety Ditta) were tested at the Federal Research Centre for Cultivated Plants in Dahnsdorf, Germany (Brandenburg state) . The products, COFREE-1 (of microbiological origin) and COFREE-2 (of plant origin), were preventively applied six times at intervals of 7 to 10 days. The start of treatment was 04 June 2012 (Table 1). Potatoes treated with the two products were compared with untreated controls (UC) and with potatoes treated with copper hydroxide (300g Cu/l) using a randomised, single-factor block design with four replicates and a plot size of 6x34 m per treatment. The test site was certified for organic farming according to EU guidelines (control no.: D-BB-043-4143 A; soil type: sandy loess sL, mean annual precipitation: 526 mm). The Öko-SIMPHYT forecast model was used for treatment timing.

Results

The time course of late blight infestation in experimental plots treated with the different products is shown in Figure 1. It is clear that copper application delayed the time when 60% of the leaf area was destroyed by leaf blight by about 6 days (black bar). In this stage of tuber development, yields of about 0.9 t per hectare and day can be made (Möller 2002). The surplus was statistically significant ($P < 0.1$) and was 6 tons/ha higher than in untreated controls (UC) (Figure 2).

The new copper-free products do not yet achieve satisfactory yield stability. They delayed infestation of 60% of leaf area for only about two days and achieved yield increases of up to 4 t/ha, but this was not statistically significant.

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Table 1: Regimen for application of copper-based (copper hydroxide (Cuprozin fl) = 300g Cu/l) and copper-free pesticides. UC – untreated controls, COFREE-1 (of microbiological origin), COFREE-2, (of plant origin)

Date of treatment	Variant 1 UC	Variant 2	Variant 3	Variant 4
04 JUNE 2012	-	COFREE-1	COFREE-2	-
15 JUNE 2012	-	COFREE-1	COFREE-2	-
27 JUNE 2012	-	COFREE-1	COFREE-2	copper hydroxid, 2,5 l/ha = 750 g Cu/ha
05 JULY 2012	-	COFREE-1	COFREE-2	copper hydroxid, 2,5 l/ha = 750 g Cu/ha
12 JULY 2012	-	COFREE-1	COFREE-2	-
20 JULY 2012	-	COFREE-1	COFREE-2	copper hydroxid, 2,5 l/ha = 750 g Cu/ha
				Total = 2250 g Cu/ha

Discussion

First results of the field experiments performed in the framework of EU COFREE project have shown that the high safety effect of copper-based pesticides is difficult to achieve using copper-free alternatives (COFREE-1 and COFREE-2). Some of the most important and effective measures to prevent yield losses due to late blight are pre-sprouting seed potatoes, choosing a resistant variety, and ensuring a good supply of nutrients. With pre-sprouting, the start of yield formation can be earlier than about 10 days, late blight infection is delayed to a later time, and the potential yield losses are reduced. Table 2 shows the most important short-, medium-and long-term measures to reduce copper pesticides in potato production. This approach is based on the "Strategy document on copper as pesticides with special consideration of organic farming" (Palm et al. 2010), which is available on the JKI website (http://kupfer.jki.bund.de). The main points of this document are summarized in Table 2.

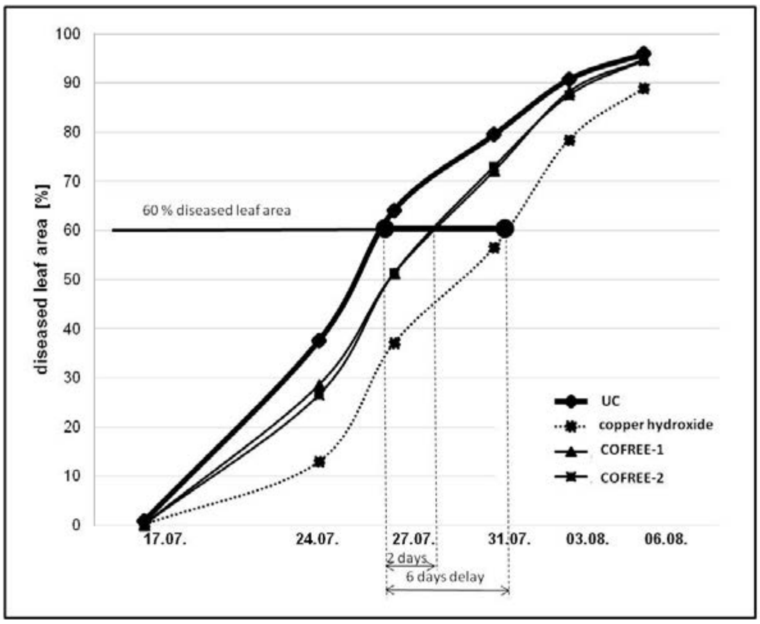

Figure 1: Time course of leaf area infected with late blight (Phytophthora infestans) in field experiments with the potato variety Ditta in 2012. UC = untreated controls, copper hydroxide 2250 g Cu/ha, COFREE-1 and COFREE-2 (copper-free agents of microbiological and plant origin)

Table 2: Copper minimisation strategy measures outlined in the "Strategy document on copper as pesticides with special consideration of organic farming" (Palm et al. 2010)

Short-term measures
Cultivation measures; Presprouting; Optimisation of the N supply; Physical separation of early and late varieties; Field design according to the main wind direction (the more vulnerable, the further downwind); Elimination of diseased plants; Variety selection; Use of eco-SIMPHYT forecast model; Optimisation of application technology; Check application of phosphonates; Use of pesticides with low copper formulations; Copper-based treatment of tubers; Strengthen plant protection consultation
Medium-term measures
Development of new plant protection products and plant strengtheners; Investigate the influence of crop rotation; Basic research on the epidemic curve; Knowledge transfer
Long-term measures
Development of new plant protection products and plant strengtheners; Breeding tolerant varieties; Knowledge transfer

A successful copper minimisation strategy must be based on the future implementation of all preventive measures, the further reduction of copper application rates, and the development of alternative pesticides. Their further use in organic farming required a listing in Appendix II on plant protection agents of the EC organic regulation.

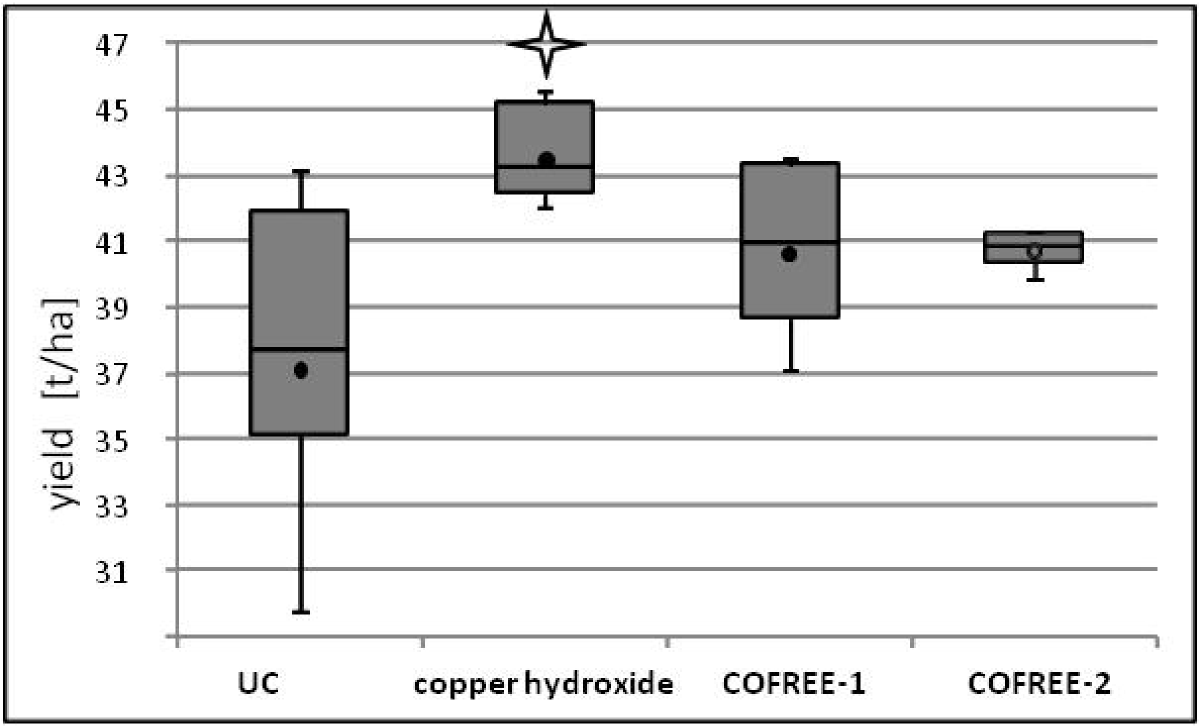

Figure 2: Yields of Ditta potatoes, in t/ha, in 2012. * Statistically significant difference to the untreated control (UC) (Simulate, P < 0.1). UC = untreated control, copper hydroxide 2250 g Cu/ha, COFREE-1 and COFREE-2 (copper-free agents of microbiological and plant origin)

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Improvement of animal health indicators in German organic dairy farms through 'Stable Schools'

Solveig March[1], Jan Brinkmann[1], Christoph Winckler[2]

Key words: stable schools, dairy cattle, animal health, knowledge exchange

Abstract

In this study we initiated four regional stable schools focusing on animal health with in total 19 German organic dairy farms. A modified stable school approach was used, i.e. providing the farmers with detailed information on the health status of each farm. The participating farmers showed a positive attitude towards this concept. Accordingly, the compliance regarding implementation was high. More than two thirds of all 123 recommendations given by the stable school groups to host farmers were implemented. The degree of implementation was similar to the level achieved in other intervention studies using a face-to-face advice. Across all farms, cleanliness of the cows improved significantly over the two years monitoring period. In nine farms which had implemented measures regarding udder health, the somatic cell score improved significantly and milk yield increased as compared to the control peer farms. However, treatment incidence for mastitis and antibiotic drying-off remained unchanged.

Introduction

Production diseases such as mastitis, metabolic disorders and lameness, play a considerable role in organic dairy farming (e.g. Ivemeyer et al. 2012) and prevention is crucial to maintain herd health and welfare. In general, there is no lack of scientific knowledge about possible risk factors of production diseases, but rather on knowledge transfer and preventive concepts.

Motivation of farmers to implement corrective measures may be achieved through the stable school concept, which aims at common learning in farmer groups. It has previously been successfully implemented in Danish organic dairy farms to promote animal health and reduce the use of antibiotics (Vaarst et al. 2007). This concept has been adapted from farmer field schools and developed and used e.g. by FAO in Asia and Africa.

Material and methods

Total duration of the pilot study was 36 months. After an initial data collection during winter 2010/11 which aimed at objectively assessing the health state of the farms, 4 regional stable schools with in total 19 farms willing to actively participate were started (average herd size 57 cows, range 23-178). All farms had loose housing systems (11 cubicle-housed, 8 straw yard systems) and participated in a milk recording scheme.

Information on the current health status of the farms was provided to the farmers and served as basic information for regular meetings of the stable schools (modified from Vaarst et al. 2007). This information comprised analyses of milk recording data and treatment records as well as animal based parameters assessed in the herds (e.g. body condition, locomotion, cleanliness and leg injuries). The host farmer defined the agenda together with the facilitator, who guides the process but does not provide problem-related input, whereas the group members analyse and suggest changes regarding the farm-specific situation.

After a 1-year cycle when all members of a group had met once at each farm, a halftime evaluation was carried out. At these 2nd farm visits the implemented measures were evaluated and all indicators of herd health assessed again to evaluate changes and to update the farm-specific information fed back for the next stable school cycle. At the end of the winter housing period 2012/13 a final assessment of health state was carried out in order to evaluate the effectiveness of this tool in terms of improving herd health. Furthermore, we assessed the implemented measures due to the stable school process in the course of the whole project period.

Analyses were carried out at farm level and the analysed data comprised four 12-month-periods. Incidences of treatments were obtained as number of cases per cow and year. Data of monthly milk recordings were calculated as herd average in the respective period. The average of the first two 12-month-periods was used

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as a baseline before stable schools meetings started in April 2011 (start of intervention). Results from the first farm visit for additional health indicators directly assessed in the herds were also taken as baseline. The development of herd health was subsequently monitored for two years.
Across all 19 farms, mixed models for repeated measures were used to analyse the effect of time after starting stable schools meetings. Furthermore we used mixed models for repeated measures to analyse the effect of group (G: intervention vs. control group) and year (time after intervention/ start of stable school process), as well as their interaction (G*Y=group*year) on the parameters of dairy health, considering farms implementing measures recommended by their colleagues to improve udder health as intervention group (I) vs. the remaining farms as control group (C).

Results

Recommendations and subsequent implementation of measures
In the two cycles of stable school meetings with in total two meetings on each project farm, in total 123 measures which had been recommended by the peer farmers to improve herd health were regarded useful by the host farmers after the group discussions. The most common topics addressed were metabolic health and feeding strategies (in total 45 recommendations for 16 farms), in particular possibilities to avoid subclinical ketosis in the early lactation (14 recommendations for 4 farms), and udder health (30 recommendations for 8 farms). Other areas were calf and young stock health (13 recommendations for 6 farms), fertility, lameness and claw health, and aggressive behaviour, especially of horned cows. Out of all recommendations given by the group members, slightly more than two thirds were implemented within the project period (completely or at least partly). The degree of implementation was similar to other intervention studies, which partly required considerably more input of the advisors/ scientists (e.g. Green et al. 2007). Further 36 measures, mainly dealing with udder health and rearing of youngstock, were implemented by the project farmers without having been explicitly discussed during the group meetings.

Development of selected herd characteristics and health parameters
Across all farms, average herd size increased significantly (56.9->58.9->61.5 cows/ herd, $p<0.008$), while mean milk yield and herd age did not change over the two years period. We also found a significant reduction of the percentage of cows with dirty udders (65.9->44.6->39.9%; $p<0.001$) and bellies (38.8->27.6->31.4%; $p<0.001$).

In the intervention farms which had implemented measures to improve udder health recommended by their colleagues (I), milk somatic cell score (SCS) significantly improved (interactions group*year: $p=0.003$) whilst treatment incidence for mastitis and also the percentage of animals with antibiotic dry-off treatments stayed unchanged (Table 1). At the same time the percentage of cows with a fat-protein-ratio≥1.5 in the first 100 days in milk decreased and milk yield increased in I-farms.

Discussion

In this study, levels of SCS were comparable with results from other European studies (Gay et al. 2007, Ivemeyer et al. 2012). In comparison with control farms, udder health significantly improved on farms that had implemented measures: a reduction of SCS was found, whereas milk somatic cell count slightly deteriorated in the control group. Comparable effects have been found in a study to improve udder health in Switzerland (Ivemeyer et al. 2008). Contrary to findings of Ivemeyer et al. (2012), the treatment incidence of mastitis remained unchanged in both groups of farms, but on average it was markedly lower than reported in other studies on organic dairy farms (March et al. 2011, Bennedsgaard et al. 2010).

The present findings provide evidence for improvements of health in commercial dairy farms in response to the stable school approach. The self-determined and farmer-owned approach appears to be highly motivating thus leading to a high implementation rate of measures.

Table 1: Development of selected parameters during 2 years after initiation of the stable school process (I=9 intervention farms, which actually implemented recommended measures to improve udder health1; C=10 control farms); mean (sd) and level of significance for the effects group (G: I vs. C), year (Y: 2009/ 10, 2011, 2012), as well as their interaction (G*Y)

		2009/ 2010 Initial situation	*2011*	*2012*	*p*
SCS (Somatic Cell Score)[1]	I	3.36 (0.30)	3.24 (0.38)	3.10 (0.40)	*G: 0.507* *Y: 0.466* ***G*Y: 0.003***
	C	3.06 (0.54)	3.06 (0.42)	3.20 (0.52)	
Treatment incidence Mastitis (%)[2]	I	10.3 (8.4)	7.9 (7.7)	9.0 (11.7)	*n.s.*
	C	12.7 (11.6)	12.0 (12.4)	11.8 (12.7)	
Dry-off-treatments with antibiotics	I	29.5 (30.3)	22.8 (25.8)	26.5 (27.3)	*n.s.*
	C	20.8 (22.2)	19.9 (25.3)	21.2 (29.0)	
Percentage of cows with FPR[3] ≥ 1.5 in first 100 DIM[4]	I	16.3 (8.7)	14.0 (13.5)	10.6 (5.4)	*G: 0.167* *Y: 0.929* ***G*Y: 0.047***
	C	17.7 (9.2)	18.6 (9.1)	21.6 (10.4)	
Milk yield (kg/ laktation)	I	6,343 (1,626)	6,349 (1448)	6,637 (1,818)	*G: 0.458* *Y: 0.762* ***G*Y: 0.015***
	C	6,999 (1,319)	7,060 (1,379)	6,838 (1,478)	
Herd age (years)	I	5.6 (0.4)	5.6 (0.2)	5.6 (0.3)	***G: 0.004*** *Y: 0.065* *G*Y: 0.053*
	C	4.9 (0.4)	5.2 (0.4)	5.1 (0.5)	

[1] Only SCS used for analysis of variance in order to obtain normal distribution; denoted SCS is equivalent to a Somatic Cell Count (SCC) of 303,000, 279,000 and 267,000 cells/ ml milk (Intervention farms) and 225,000, 244,000, 257,000 cells/ ml milk (Control farms), respectively.
[2] Repeated application of drugs connected to the same diagnosis with a maximum lag of seven days between treatments was counted as one event.
[3] Milk fat-protein ratio; [4] Days in milk.

Suggestion to tackle with the future challenges of organic animal husbandry

Since less a lack of scientific evidence but a lack of implementation of improvement measures is likely to account for sustained health problems in organic animal husbandry, approaches that increase the motivation of farmers to implement measures should be emphasized. Stable Schools provide a promising approach. Farmers appreciate to work together and to learn from each other. Apart from tackling animal health issues, stable schools may also be used to focus on other challenges of organic farming such as the reduction of surgical interventions, e.g. disbudding.

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Differences in feeding practices on organic and conventional dairy farms – data from a farm network

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Key words: methane, feeding, dairy farming, dairy cattle, on-farm, greenhouse gas

Abstract

More than half of the methane (CH_4) emissions in Germany can be attributed to enteric fermentation of dairy cattle. Enteric CH_4 production is influenced by feedstuff quality. In a network of 44 dairy farms the mean diets of the dairy cows differed considerably between organic and conventional farms and between regions. Feeding also proved to be very farm specific. On average, organic dairy cows received significantly less concentrates (13.9 % of the total diet on a dry matter basis) and maize silage (7.2 %) and more pasture (29.5 %) and hay (11.8 %) than conventional dairy cows (24.1, 30.9, 5.5, and 3.1 %). No difference was found between organic and conventional feedstuff quality. Since hay produces relatively more and concentrates produce relatively less CH_4, organic dairy cows are, on average, expected to release slightly more enteric CH_4 per kg fermentable organic matter than conventional ones.

Introduction

Feeding influences CH_4 production in the rumen. Organic and conventional feeding practices of dairy cattle are expected to differ due to specific regulations that are in place for organic farming. E.g., dairy cows must have access to pasture, and soybean extract, a very common concentrate in conventional dairy feeding, may not be fed. It is unknown how the actual feeding practices and their potential effects on CH_4 emissions from enteric fermentation are in organic farming in comparison to conventional farming. The joint project "Climate Effects and Sustainability of Agricultural Systems – Analyses in a Network of Pilot Farms" determined feeding practices and feed qualities on a total of 44 dairy farms in four German regions in the course of three years.

Material and methods

All feedstuffs were sampled and analyzed for the years 2008-2010 on the pilot farms of the network (22 organic and conventional, each). Feedstuffs were characterized for their crude contents by Weende analysis. Energy and protein contents were calculated according to GfE (2001). The average diets fed to the lactating and dry cows were collected via interviews with the farmers. The diets were then calculated from the animals' energy demands while considering the average winter and summer diets, feed qualities from the laboratory analysis, average milk yields from milk recordings and cow weights. Access to pasture was also recorded from the interviews with the farmers. Energy corrected milk (ECM) yield per cow and year was calculated according to DLG (2001) as [kg ECM cow^{-1} a^{-1}].

Results and discussion

As expected, the average diets of the dairy cows differed between organic and conventional dairy farms (Table 1). On average, organic farms used less ($p \leq 0.001$; Table 1) concentrates (13.9 % of the total diet on a dry matter (DM) basis) than conventional farms (24.1 %). Nevertheless, individual organic farms fed as much as 31.5 % concentrates (data not shown). Organic dairy cows were fed significantly less maize silage (7.2 %) than conventional cows (30.9 %), while organic cows received far more ($p \leq 0{,}001$) pasture (29.5 %) than conventional ones (5.5 %). On a total of 13 conventional farms, dairy cows had no access to pasture at all (data not shown). No difference was found between organic and conventional use of grass silage (28.9 % and 28.4 %). Also, the other roughages and feedstuffs used were not fed significantly different on organic (20.4 %) and conventional farms (11.7 %).

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Table 1. Average diets of the dairy cows (including both lactation and dry period) on the organic (o; n=22) and conventional (c; n=22) pilot farms (means of the years 2008-2010). The sum of the columns 3, 4, 5, 8, 9 is 100 % per row.

	1	2	3	4	5	6	7	8	9
	Milk yield (ECM)	No. of years analyzed	Concentrates	Maize silage	Other roughage + feedstuffs [1]	Hay [2]	Straw [2]	Grass silage	Pasture
	[kg cow^{-1} a^{-1}]	[n]	Share in diet [% of DM]						
Mean organic	6,382^{a}	1.9	13.9^{a}	7.2^{a}	20.4	11.8^{a}	0.8^{a}	28.9	29.5^{a}
Mean conventional	8,660^{b}	1.9	24.1^{b}	30.9^{b}	11.7	3.1^{b}	3.2^{b}	28.4	5.0^{b}

[1] Category "Other roughage and feedstuffs" consists of spent grains, maize cobs, chicoree roots, freshly cut feedstuffs such as rape or grass, whole plant silage, hay, haylage, potatoes, carrots, wet pulp, soybean pulp und straw.
[2] Also included in column 5.
[a, b] Means that are significantly different (t-test; $p \leq 0{,}05$) have different letters.

Figure 1 shows the regional comparison of the feeding regime between organic and conventional farms. Organic farms with low milk yields and a high percentage of hay in the diet were found in East and South Germany. Those were largely farms that did not use advisory services for dairy feeding (data not shown). The low percentage of concentrates in dairy rations is typical for the organic farms in the alpine region. The conventional farms in that region feed more hay than conventional farms in the other regions, and the use of maize silage is of lower importance than in other regions.

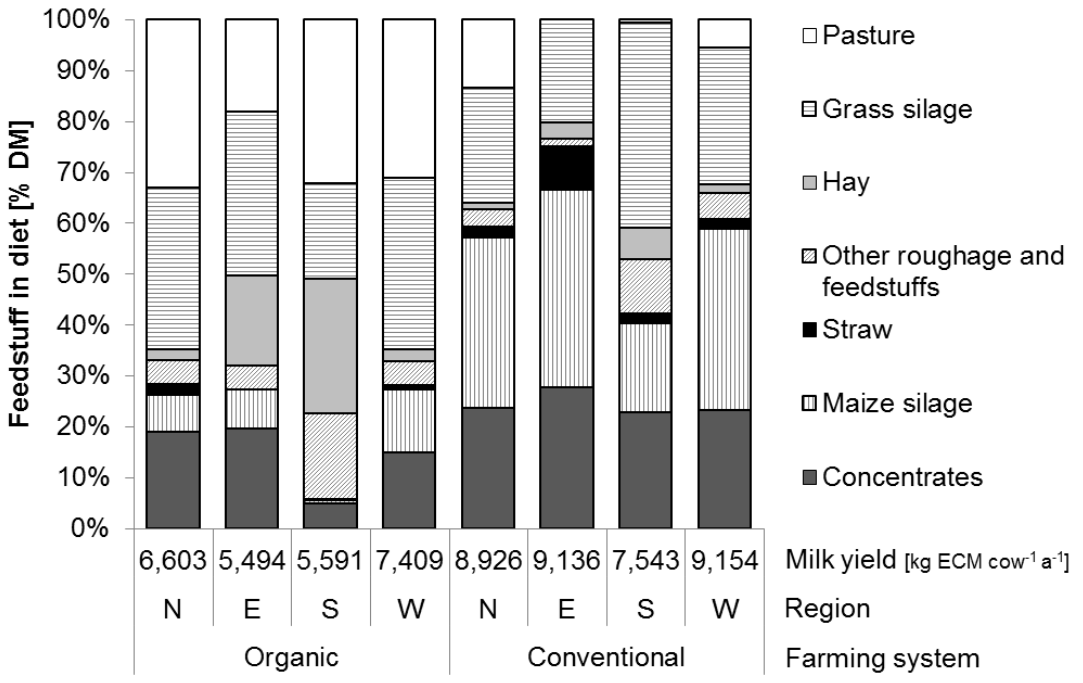

Figure 1. Means (2008-2010) of the average annual diets of the dairy cows (including both lactation and dry period) and milk yields on the organic (n=22) and conventional (n=22) pilot farms by region (North, East, South, West). Table 1 details the feedstuffs summarized in category "Other roughage + feedstuffs".

In all regions feed intake during grazing was significantly higher on the organic compared to the conventional farms. In the coastal region of North Germany grazing was of higher importance in conventional farming than in conventional farming in the other regions. Due to the small number of analyzed farm pairs (5-6 pairs per region) these means are highly influenced by the individual farm management. However, a more variable diet composition in organic farms is obvious in all regions (Table 1). The diets and feed qualities must be considered when calculating enteric CH_4 production. When comparing farming systems, feeds should also be assessed for the primary energy use for their production. The feedstuff qualities varied more or less, but no statistically significant difference was found between organic and conventional feedstuffs nor of feedstuffs between regions (data not shown). For this reason, Table 2 summarizes feedstuff qualities for all farms. Hay and straw had the lowest energy (NEL) contents (5.55 and 4.01 MJ NEL kg^{-1} DM) and the highest crude fiber (XF) contents (307.59 and 476.49 g kg^{-1} DM). In comparison to grass silage, maize silage displayed lower XF contents and only half the crude protein (XP) contents at slightly higher NEL contents. Pasture and maize silage had comparable XF contents (216.49 and 213.58 g kg^{-1} DM), but XP contents were far higher in pasture samples than in maize silage (185.01 vs. 77.57 g kg^{-1} DM).

Readily degradable feed components reduce CH_4 production per kg fermentable organic matter, while feedstuffs high in crude fibre increase it. Kirchgeßner et al. (1994) take crude nutrients into account when calculating CH_4 emissions from enteric fermentation (CH_4 [g] = (63 + 79 XF + 10 NfE + 26 XP – 212 XL) [kg], see Table 2 for abbreviations). Using this formula for the feedstuffs in Table 2 yields the following results: Hay 91.6, straw 103.5, pasture 82.6, grass silage 86.9, maize silage 82.2, concentrates 73.1 g CH_4 kg^{-1} DM. Although the diets were quite different with respect to the share of pasture and maize silage, respectively, no overall difference between organic and conventional CH_4 output from enteric fermentation can be anticipated from these feeds, since CH_4 emission per kg feedstuff is very similar. Organic dairy cows received more fiber rich hay that produces relatively more CH_4 and conventional dairy cows were fed more readily degradable concentrates that produce relatively less CH_4. Hence, it can be expected from the combination of diet and feed quality that organic dairy cows produce slightly more CH_4 from enteric fermentation per kg feed consumed (DM) than conventional dairy cows.

Table 2. Feed qualities (XF=crude fibre, NfE=nitrogen-free extracts, XP=crude protein, XL=crude fat, NEL=net energy lactation) of feedstuffs (means of all farms; 2008-2010).

Feedstuff	[n]	XF	NfE	XP	XL	NEL
		[g kg^{-1} DM]				[MJ kg^{-1} DM]
Hay	119	307.59	486.21	112.12	16.37	5.55
Straw	60	476.49	434.88	29.63	10.71	4.01
Pasture	19	216.49	478.16	185.01	33.35	6.90
Grass silage	237	268.16	444.80	153.63	26.92	6.21
Maize silage	100	213.58	641.21	77.57	28.59	6.45
Concentrates	252	97.83	588.27	219.63	43.49	7.90

Conclusions

Since organic and conventional dairy farms differed in feeding concentrate, maize silage and pasture and since feedstuff qualities were farm specific, both the diet and the feed quality should be considered for calculating enteric CH_4 emissions.

When assessing farms or systems with respect to their global warming potential, primary energy use for feed production, milk yield per year and per cow life and all emissions over the animal's total life should be analyzed to conclude over greenhouse gas emissions from milk production.

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Reversion from organic to conventional agriculture in Germany

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Key words: Abandonment, Germany, organic agriculture, reversion

Abstract

Organic farming has become increasingly important in Germany in recent years. This is reflected in the positive trend shown by the total number of organic farms. Analyses which are based on official agricultural statistics show, however, that there is an underlying counter-trend of farms that leave the organic sector by reverting back to conventional methods. Between 2007 and 2010 1,258 German organic farms returned to conventional agriculture.

Introduction

The number of organic farms in Germany nearly doubled within the last decade. What is not shown by official statistics is the dynamic hidden behind this pure net increase. In practice an underlying counter-trend can be recognized: farms leave the organic sector and turn back to conventional methods.

But literature shows only few studies concerning the abandonment of organic farming (e.g., Schneeberger et al. 2002, Sauer and Park 2009, Läpple 2010). Heinze and Vogel (2012) examined reversion behavior of German organic farms between 2007 and 2010. Latest results for Germany are provided by Kuhnert et al. (2013).

This paper aims to offer an overview on how many and what types of farms actually abandon organic farming in Germany. Probit-estimations are used to identify indications for determinants of reversion from organic to conventional agriculture.

Material and methods

Analyses are based on micro data of the official statistics on German agriculture, which are available for scientific research in the Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder. Data of the farm structure surveys 2003 and 2007, as well as the agricultural censuses 1999 and 2010, have been linked over the years, so that farms can be tracked over the entire period at an individual operational level. Hence, the panel allows detailed longitudinal analysis of the agricultural sector and provides comprehensive information concerning land use, livestock and structural conditions of German farms.

Descriptive statistics are used to give an overview of farms abandoning organic production methods. Moreover, probit-estimations reveal first determinants for the reversion from organic to conventional agriculture. For this purpose farm characteristics and regional factors of 2007 serve as independent variables to explain production methods applied in 2010.

Results

According to publications of official statistics, the number of organic farms in Germany rose from 13,838 in 2007 to 16,532 farms in 2010. This corresponds to an increase of 19 percent. While standard publications do not disclose any information on the underlying gross trends, micro data analyses of Heinze and Vogel (2012) show that 1,258 farms which were operating organically in 2007 had returned to conventional methods by 2010. This means that between 2007 and 2010 an annual average of 419 organic farms gave up organic methods in order to become conventional. Moreover, 792 farms were not in the data set anymore in 2010 for several reasons (farm left the market, farm dropped beneath the threshold of coverage, farm merged with another one, farm transferred its headquarters to another state).

Regional analyses of reversion reveal that there are widespread differences across Germany: the highest share can be found in the administrative region of Cologne, where almost every fifth organic farmer returned to conventional agriculture between 2007 and 2010. But also in Thuringia, the eastern parts of Bavaria, Saxony and Hesse as well as the western regions of Rhineland-Palatinate and Baden-Wuerttemberg, more

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than one out of ten organic farms became conventional by 2010. In absolute terms most reverting farms could be found in the administrative regions of Oberbayern (196 farms), Freiburg (100 farms) and Kassel (71 farms). Exceptionally low reversion rates prevail in the city states (0%) and in the former administrative region of Dessau in Saxony-Anhalt (1.9%), where, however, the total number of organic farms is rather small.

Probit-estimations of the data set were carried out separately for eastern and western Germany, as there are still differences in farm structure between the regions more than 20 years after the German reunification. The results show that experience gathered in organic farming and a higher share of organically cultivated land on the farm negatively impacted reversion to conventional farming. The existence of organically reared livestock shows a negative influence on abandoning organic farming methods, too. A higher share of grassland, however, increases the likelihood of reversion. In western Germany, additionally, a higher number of people employed on the farm, as well as the fact that the farm is run on a subsidiary basis, positively impacts reversion. In eastern Germany a higher share of organic farms in the district has a negative influence on reversion (for detailed results see Heinze and Vogel, 2012).

Discussion

In conclusion it can be stated that despite of the growing organic sector in Germany, there does exist an underlying counter-trend of organic farms reverting to conventional methods. For the organic sector it is relevant to know the differences between farms that continue organic farming and farms that leave the organic sector. In this regard probit estimations reveal first indications: Experience gathered in organic farming positively impacts on the continuation of organic farming. A larger share of fully converted land and the existence of organically-reared livestock also decrease the likelihood of reversion to conventional methods, while a higher proportion of permanent grassland shows a negative impact on the continuation of organic farming.

However, analyses could not consider economic factors due to a lack of data. In addition it remains unclear, if farmers revert permanently or if they get back to organic farming at some point in the future. Further research is required here.

Note

Previous analyses will be extended until the conference by including recent data of the farm structure survey 2013, which will be released in spring 2014. Hence, analyses cover a period from 1999 until 2013. Moreover, probabilities of occurrence and duration until reversion back to conventional agriculture will be estimated for German organic farms for the first time by using event history analysis (for methodological background information see, e.g., Blossfeld et al. 2007 and Läpple 2010).

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The Evaluation of the German Programme for Organic Food and Farming Research: Results and Pointers for the Future

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Key words: research for organic food and farming, research programme evaluation

Abstract

The paper reports the results of the evaluation of the research programme of the German Federal Scheme for organic Agriculture. The main aim of the evaluation was to assess the relevance and impact of the research in relation to program goals. Recommendations presented are relevant to other applied research programmes targeted at the development of specific sectors.

Introduction

In 2001, the German Federal Government established the Federal Scheme for Organic Agriculture (BÖL). The goal was to improve the professionalism of organic farming in Germany; to support sustained growth in production of organic food; and to stimulate a corresponding growth in the market for organic food. BÖL was managed by the Federal Agency for Agriculture and Food (BLE) on behalf of the Federal Ministry for Food, Agriculture and Consumer Protection (BMELV). The scheme as a whole comprised three elements: marketing and consumer information; administrative measures; and a programme of research and development. This contribution reports on an evaluation of the research element commissioned by BMELV in 2010.

The BÖL research programme was initially established for only a two year period, and renewed three times with the current programme running to 2015. Our evaluation focused on all research initiated and completed in the period 2003 to 2010, but not on the extension to cover other forms of sustainable agriculture from 2011 onwards. The overall aim of the evaluation was to assess the relevance and impact of the research in relation to the BÖL's goals, the effectiveness of the deployment of the research funding resources, and the efficiency of programme management. Recommendations relate to continuation and improvement of the programme. We believe these are relevant to other applied research programmes targeted at the development of specific sectors.

Methods

The evaluation process comprised three major components: the research programme as a whole in the context of the wider BÖL; individual research projects; and the management processes used to implement the research programme. These three core elements were supported by an examination of the programme's guidance documents and background programme information.

The evaluation of the programme as a whole was based an impact model we developed for this purpose using our experience of evaluating Organic Action Plans (Lampkin et al., 2008). This clarified the four levels of effects of the research investment (programme level resources; project-level activities; the primary research users in the sector; and wider society) and indicators for the assessment of the research were established.

Data from the programme's project database were analysed to assess the distribution of resources over time, by topic as well as by research provider. An online survey of over 100 project leaders, interviews with 30 stakeholders and 12 administrative and management employees of the programme were conducted. Results and impact of the funded research projects were evaluated by external experts for 83 randomly selected projects in three categories of 'crop and soils research', animal research, and socio-economic and supply-chain research'. The experts were invited to a workshop to discuss the findings in each thematic area. An advanced draft of the final report was subject to external review to obtain feedback on the validity of the conclusions.

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Results

Using indicators of the programme level activity and participants' activities, this evaluation showed that the research programme has contributed significantly to strengthening organic research capacities in Germany. In comparison with programmes with similar aims in other European countries, the BÖL research programme is broad and financially well resourced, with a total spend of 75 million in the period 2002 – 2010. It was the largest single research programme dedicated to organic farming and food in Europe. If annual funding in Europe for research in organic agriculture is seen in relation to the agricultural area of the respective country, it shows that Germany (0.47 Euro/ha) spends less than Denmark (2.09 Euro/ha) and Sweden (1.09 Euro/ha), but more than France and UK (0.16 and 0.08 Euro/ha).

78% of research funds were primary research, 4% was spent on 37 projects that reviewed existing knowledge (status-quo projects), and the remaining funds (18%) were spent on knowledge transfer. The breakdown of in primary research in thematic areas was for plant and soil, 41%; livestock, 18%; food processing, 10%; marketing, 8%; farm management, 4%; nature conservation, 2%; interdisciplinary projects, 9%.

A total of 140 institutions received funding with universities and colleges receiving nearly 30% of the funds, followed by federal institutes (23%) and advisors/producer organisations (15%). There was a concentration of funds on six institutions that specialise in organic agriculture research (leading over 20 projects each and together receiving more than 35% of the total funding). At the other end of the scale, over 40% of the grant recipients initiated only one project and received a total of about 7% of the funding. However, compared to the general/conventional agricultural research in Germany, a diverse group of beneficiaries (e.g. advisors, farmer organisations etc.) were given a chance to become involved in research.

The evaluation found the relevance of the research to the organic sector's needs to be a major strength of the programme: 83% of projects rated as highly relevant to practice. Projects generally were innovative in how they integrated various actors and approaches along supply chains, with actors from agriculture playing an important role in identifying research themes. Other groups (e.g. food processing) were less well represented. Engagement with sector users declined in later years. However, the research prioritisation and resourcing processes were assessed as mainly reactive, with little evidence of processes converting the needs and aspirations of research users into coherent programme targets of strategic importance to the development of the sector. This hinders explicit (sub-) programme management and the identification and exploitation of synergies between projects.

Plant and soil research and related transfer activities accounted for 46% of all funds. This funding pattern remained steady from 2001 to 2010 and has clearly strengthened institutions that specialise in organic farming. Our analysis of the processes leads to the conclusion that research programming was sub-optimal as the combination of factors determining research activities described above is self-reinforcing and intrinsically conservative.

More than 1000 events held stimulated knowledge transfer in the organic sector. The knowledge and technology transfer clearly is a strengths, the activities relied mainly on direct interaction between researchers or intermediaries (e.g. advisors) and primary users, particularly farmers. Contact was mostly direct and temporary in terms of effect, for example conferences and workshop-type events. Some examples exist for communications that synthesised the results of a research projects at the programme level and focused these on users' needs in a more permanent way.

The systematic publication of high quality and complete final project reports through the international open-access archive Organic Eprints (http://www.orgprints.org/) is a special strength of the programme. These provide a full record of the research and that is easily accessible. The output of general publications at, on average, 10 per project is also high. The output of peer-reviewed publications appears at first glance to be adequate (1.5 per project) but the evaluation revealed that many of these are peer-reviewed conference proceedings in German. On average 0.5 doctoral theses per project were initiated, suggesting a lasting effect in the academic and research community through education. There is some uncertainty about the international scientific impact of these publications. The role of academic publications is not specifically mentioned in the programme documentation, although the programme aims to influence knowledge in and outside Germany. This is a gap particularly in relation to the programme's stated long-term goal of promoting a wider and more professional organic sector in Germany and Europe.

Overall, our results show that programme financial resources were deployed effectively. Withe exception of only a few projects, all funded projects had been independently assessed as worthy of funding at the proposal stage. A particular highlight is the high satisfaction of project participants in the support and work provided by the programme managers in the BLE.

The BÖL had the clear sector specific goal at the outset of boosting organic farming to 20% of the farmed area by 2010. Between the introduction of the programme and 2010, the number of organic farms (+49%), the organically managed land area (+ 81%) and the market for organic products (+188%) increased. The evaluation was able to gather some evidence suggesting that many research projects contributed to achieving the overall programme objectives, but the extent cannot be determined due to the complexity of the interrelationships and interactions with other measures.

Conclusions and recommendations

Based on the results of the evaluation and against the background of the decision to extend of the programme in 2011 to cover other forms of sustainable agriculture, we made nine recommendations for the development of the programme.

It was recommended to develop a clear programme strategy that identifies research goals and develops a programme structure to associate them with timelines, impact ways and financial plans. This recommendation is central and leads to three further recommendations about securing supporting external advice through the Programme's Advisory Council; targeting of funding to support the development of human and institutional research capacities to deliver the strategy; and the development of a distinct knowledge transfer strategy that sets out the way impact is to be generated from the research. Impact plans set out in the context of a wider programme-level knowledge transfer strategy would set out how specific research outputs are delivered to their primary and secondary users, and if and how these users should be supported in this process using the full range of outputs and mechanisms (such as publications, models, management plans, education and training, germplasm) and target groups (including producers, consumers, policy-makers, educational institutions).

Three recommendations address the quality of the research and scientific impact. This includes the further development of the project selection process; better and more flexible structuring of projects (timeframe and project design); and more emphasis on international scientific impact and knowledge exchange through academic publishing. Our assessment of final reports indicates that the scope for academic publishing is significant. Academic publishing supports the quality of research in general and therefore supports other recommendations.

Lastly, two recommendations are focused on management. It is recommended that the research outputs at project and programme level be systematically recorded and monitored; and that the BLE as a research management organisation be further developed building on its experience as a learning organisation in driving research-based innovation.

We believe that these findings and especially the concluding recommendations are not only relevant to the continuing BÖLN research programme, but are also relevant to applied research programmes targeted at the development of specific sectors. In this chapter you write your understanding, what the results shall tell the Organic sector. This chapter should not exceed 1000 letters (incl. spaces). If you are selected for an oral contribution, this will be the main content of your speach.

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Do you like organic wine? Preferences of organic consumers

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Key words: consumer behaviour, price as quality cue, mixed logit model

Abstract

The market share of organic wine is remarkably lower than the market share of organic food in general. The objective of this paper was to analyse the wine preferences of consumers of organic food in Germany in order to identify how demand for organic wine could be increased. Choice experiments and structured interviews were conducted with 600 consumers of organic food. In the choice experiments, the participants clearly preferred organic wine over conventional wine. However, preferences for organic wine were lower among people with a high interest in wine, i.e. people who place high importance upon vintage, grape variety and winery. We conclude that targeted marketing activities are needed to convince these people about the quality of organic wine. Interestingly, medium-priced wine (4.99 € and 6.99 €) was preferred over low-priced wine (2.99 €). It is therefore recommended to avoid a low-price strategy for organic wine.

Introduction

In Germany, the market share of organic wine is clearly lower than the market share for organic food and drink in general. While organic food had a market share of about 4% in 2008, the share of organic wine in the total wine market was only 0.6%. It thus seems that among organic consumers, the share of conventional wine consumption is higher than the share of conventional food consumption in other food categories. Studies from Switzerland suggest that reasons for this fact might be a limited availability of organic wine, strong preferences for specific varieties and qualities, origins and wineries or a bad image of organic wine, particularly with respect to taste (Mann et al. 2012; Stolz and Schmid 2008).

Compared to other food and beverages, wine is characterised by a wide range of products not only in specialised shops but also in supermarkets. This is not only the result of the big number of producers but also of widely diverging consumer preferences (Goldstein et al. 2008; Barreiro-Hurlé et al. 2008). Wine is a luxury good, and taste is of superior relevance (Lockshin et al. 2006). Taste in turn depends on many different factors, such as brand, country of origin, grape variety, vintage and terroir. All these indicators may serve as keys for the assessment of wine quality at the place of purchase. Nevertheless, the large number of factors impacting on vine quality makes reliable judgements for most consumers extremely difficult (Lockshin et al. 2006). It seems that many consumers thus use 'price' as a quality indicator and higher priced wine is perceived to be of higher quality than cheaper wine (Lockshin et al. 2006; Goldstein et al., 2008). This behaviour has particularly been observed among consumers who have limited knowledge about wine (Gergaud and Livat, 2007). Price as a quality indicator seems to be of higher relevance, when less other quality cues are available, price differences and quality differences are higher and consumers' knowledge on prices is better (Zeithaml, 1988).

Given the low market share of organic wine, this contribution aimed to reveal organic consumers' preferences for different wine attributes and to investigate how to better motivate consumers to buy organic wine.

Material and methods

We combined choice experiments with a questionnaire in a computer-based survey. Choice experiments are used to identify consumer preferences for specific product attributes and are based on Random Utility Theory (Louviere et al. 2000). In this research organic consumers were asked for their preferences regarding wine. The tested attributes were 'production method' (organic/conventional), 'country of origin' (France, Germany, Italy, Spain) and 'price' (2.99€/4.99€/6.99€/8.99€). The participants could choose between three types of wine – additionally they had the so-called no-choice option like in real purchase situations. This procedure was used, since forced choices had been found to be biased in favour of certain attributes (Dhar and Simonson 2003). Each of the 600 test persons completed 4 choice tasks for white and 4 for red wine.

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Afterwards, the participants answered a questionnaire on their usual purchase behaviour for wine and other personal characteristics such as socio-demographics and attitudes towards wine. The target group of this study were consumers of organic food who buy wine. Participants were recruited in front of supermarkets and interviewed immediately on the spot.

The purchase decisions of consumers in the choice experiments were analysed with Mixed Logit Models (Hensher et al. 2005). These models not only allow analysing mean preferences for product attributes but also revealing preference heterogeneity. In this study separate models were estimated for red and white wine according to the following utility function:

$$U_i = V_i + \varepsilon_i = \beta_{PR} PRICE + \beta_{QUPR} QUPRICE + \beta_{ORG} ORGANIC + \beta_{FRA} FRANCE + \beta_{ITA} ITALY + \beta_{SPA} SPAIN + \varepsilon_i$$

As outlined above, the common assumption of a strictly decreasing price utility function might not apply for wine. Therefore, we tested the assumption that price serves as a quality cue by including price as an additional square term (QUPRICE) indicating an inversed U-shaped utility function.

Additionally, the test persons' attitudes towards wine and food were analysed for their impact on preferences for organic wine. Eight attitude dimensions were extracted by means of factor analysis from the attitude statements in the questionnaire (principal component analysis, varimax rotation, extraction eigen value > 1). These dimensions were a) interest in wine, b) preference for organic food, c) doubt in low priced wine, d) price orientation, e) pleasure in wine, f) preference for local food, g) orientation by country of origin and taste, h) orientation by shape of bottle and label. These factors were integrated as covariates for the attribute 'organically produced'. Additionally, socio-demographic variables (gender, age, education and income) were tested for their influence on preferences for organic wine.

Results

The results of the Mixed Logit Models show that test persons preferred organic over conventional wine (significant positive coefficient for 'organically produced'). However, preferences differed between participants (significant standard deviation for 'organically produced'). Two out of eight attitude dimensions had a significant impact on the preference for organic wine (significant interaction terms): As expected, preferences for organic wine were higher the higher the preferences for organic food were. Interestingly, high 'interest in wine' resulted in below-average preferences for organic wine. 'Interest in wine' comprised favourable attitudes towards certain wine attributes such as vintage, grape variety and winery. Interestingly, none of the other attitude dimensions and socio-demographic characteristics had a significant influence on the probability of choosing organic wine.

Both price terms were significant. This proved the hypothesis that the price-utility function had the form of an inversed 'U'. Wine in the middle price range (4.99€ and 6.99€) exhibited a higher purchase probability than low priced wine (2.99€). However, for high priced wine (8.99€), the purchase probability decreased.

As expected, with regard to country of origin differences existed between red and white wine. While for red wine, no significant differences between preferences for wine from Germany, France or Italy could be identified, white wine from Germany was clearly preferred over white wine from other origins.

Table 1: Influence of production method, country of origin and price on the purchase decision for wine (Mixed Logit Models)

	Variable	Red wine	White wine
Attributes	Organically produced (Reference: conventionally produced)	1.77**	2.12**
	Country of origin: France Italy Spain (Reference: Germany)	- 0.15 - 0.09 - 0.67**	- 1.52** - 1.33** - 2.59**
	Price Squared Price	1.27** - 0.12**	1.22** - 0.12**
Standard deviations	Organically produced France Italy Spain Price	1.02** 1.06** 0.97** 1.36** 0.38**	1.59** 1.28** 1.03** 1.51** 0.49**
Interaction terms	Interest in wine x organically produced	- 0.20*	- 0.31*
	Organic production as purchase criterion x organically produced	0.80**	0.77**
Further information	Log-Likelihood McFadden Pseudo-R-Square	- 1,660 0.22	- 1,348 0.27

* *P*<0,05; ** *P*<0,001;

Discussion and conclusions

The results of this study partly contradict the findings of earlier research on organic wine preferences. A Swiss study (Mann et al. 2012) found that wine from conventional production was preferred over organic wine. Also, people who stated to have better knowledge on wine exhibited higher preferences for organic wine. In our study, by contrast, the opposite was found: organic wine was preferred over conventional wine and higher interest in wine resulted in below-average preferences for organic wine. Hoffmann and Szolnoki (2010) found higher preferences for organic wine among people with higher income: In our study none of the socio-demographic characteristics had a significant impact. However, an important and probably decisive difference between the studies was that our study only focused on organic food consumers and not consumers in general.

Based on our results, we conclude that organic consumers generally prefer organic wine. However, organic production is only one among several criteria which determine the purchase decision for wine. Price turned out to serve as a quality indicator so that medium priced wine (4.99€ and 6.99€) was preferred over low priced wine (2.99€). That is why marketing policies aiming at addressing new consumers should not follow a low price strategy. Instead, quality attributes should be promoted. Consumers turned out to be willing to pay adequate prices for good wine. Preferences for organic wine seemed to be lower among people with higher interest in wine. This might point towards a bad image of organic wine among people who are interested in wine. This problem should be addressed by intensive communication at the point of purchase, such as presentations and tastings. However, the reason might also be a limited product range and a lack of varieties of offered organic wine.

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Searching for inconsistencies in organic market data – a guide on how to apply quality checks for statistics

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Key words: Statistics, organic market data, data quality, data inconsistencies

Abstract

This contribution emerged as part of the collaborative project "Data network for better European organic market information" carried out in the 7th Framework Programme of the EU. To overcome current inconsistencies in organic market statistics in Europe, we generated and applied plausibility checks and equations to organic market data from 39 countries. Thereby we detected inconsistencies, were able to identify their sources and elaborated strategies to harmonise organic market data. We recommend to harmonise data collection and sampling methods, to align nomenclatures and to clearly define product categories to improve organic market data in Europe.

Introduction

Up to now, organic market data collection has been inconsistent throughout European countries; data from different organisations and/or countries is hard to compare, because very different sampling methods, product categories, and nomenclatures have been used. Interpretations based on incomplete and inconsistent data might lead to wrong decisions and misinvestments of companies or policy divisions.

The objective of this contribution is the identification of inconsistencies in organic market data which is currently available throughout Europe. Therefore plausibility checks were applied to data collected through a standardized survey. The survey was led by the Research Institute of Organic Agriculture (FiBL, Switzerland) and the Agricultural Market Information Company (AMI, Germany) (cf. Willer and Schaack 2013). Plausibility checks were conducted one by one for the survey responses from data collectors in 39 countries in Europe.

Material and methods

The quality of organic market data was checked by plausibility equations; some important ones are listed in Figure 1. These plausibility checks have been generated based on the experiences of the project 'Organic Marketing Initiatives and Rural Development' (cf. Hamm and Gronefeld, 2004) and adjusted to the needs of this data analysis. All checks have been carried out with Excel software. For some of the checks formulas were entered in an additional column in Excel and exceptional results were highlighted through the 'conditional formatting' function. The remaining plausibility checks, mainly comparisons between two years or countries with similar production conditions were carried out through a thorough, manual search. The findings were distributed among the partners responsible for the survey execution in each country. Especially those six countries which participate in the project's case studies were asked to investigate the origin and causes of the inconsistencies. The outcome of these investigations will increase the awareness of data collectors and will feed in the upcoming case studies.

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1. Comparison between two years (e.g. 2010-2011) for area, production, and sales data
2. Comparison between countries with similar farming conditions
3. Organic production (share in %) < organic area (share in %)
4. Organic yield < conventional yield
5. Organic area < total area
6. Imports < Sales
7. Domestic organic consumption = organic sales, sold as organic + organic imports – organic exports
8. Market share (volume) = organic consumption / total consumption × 100
9. Import share of organic human consumption = organic imports for human consumption / organic human consumption × 100
10. Export share of organic sales from domestic production = organic exports for human consumption / organic sales as organic for human consumption × 100
11. Degree of self-sufficiency = sales of organic as organic for human consumption / organic human consumption × 100

Figure 1: Plausibility checks to determine inconsistencies and mistakes

Results and conclusions

The extent of the results depends on the details and the amount of available data in the respective country. Due to a lack of organic market data in many countries, more complex equation models to validate data consistency (e.g. domestic organic consumption = organic sales, sold as organic + organic imports – organic exports) could not be applied in most of the countries. Since especially area data was widely available, most inconsistencies were detected in this type of data. Consequently, most inconsistencies were found through comparisons of area data between two years or countries with similar production conditions. Furthermore, a lot of unrealistic values (e.g. negative numbers) were detected, when carefully scanning the data of each respective country. Below some examples for different types of comparisons to reveal inconsistencies are shown:

- Example for a comparison of area data between two years:

  Peas, fresh: 108.2 ha (2010) and 0.8 ha (2011)

- Example for a comparison of production data between two years:

  Pork: 12,540.0 t (2010) and 5,400.0 t (2011)

- Example for a comparison of yields (organic yield < conventional/total yield):

  Strawberries: 5.83 t/ha (organic) > 3.29 t/ha (conventional)

The inconsistencies that could be revealed were grouped according to data type and also according to data origin. Figure 2 is an example for the presentation of the inconsistencies resulting from descriptive statistics. In this figure inconsistencies in organic area data are shown, summed up depending on the status of EU membership. Further figures include yield, production, and sales data, that is analysed on a country specific level (i.e. for all 39 countries, if data was available) and also aggregated into country groups based on the status of EU membership. Thus it is possible to show the number of organic data collected, the number of possible comparisons that could be conducted for each plausibility check, the number of inconsistencies found through the application of these plausibility checks, separately for each country and data type. For area (cf. Figure 2) and sales data, most data is available from EU15 member states and hence the number of possible comparisons is also higher than for the other country groups.

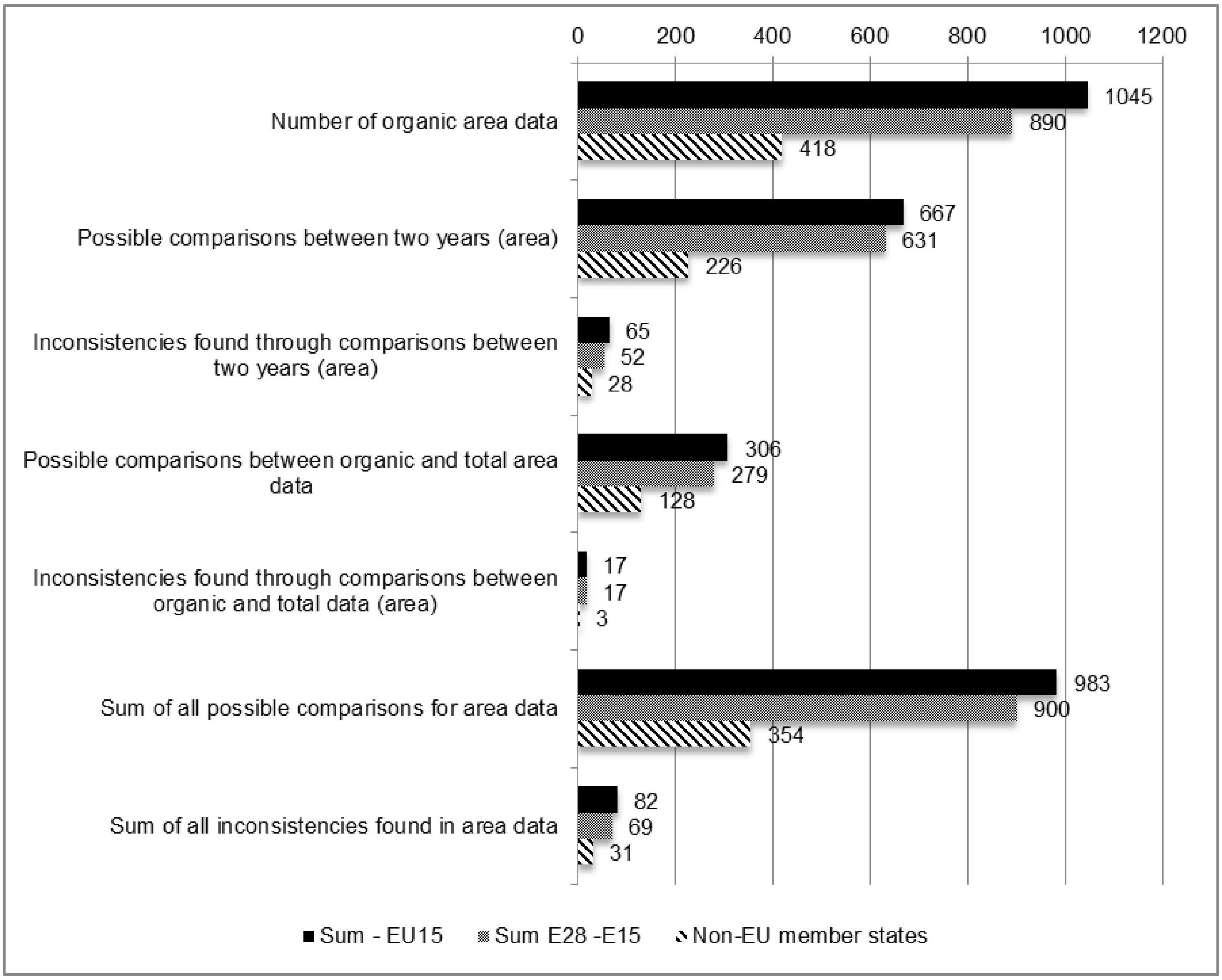

Figure 2: Inconsistencies in organic area data

Concerning organic production and yield data, more data is available from the group of 13 countries, which have joined the EU since May 2004. In this group of countries, especially Bulgaria, Croatia, Czech Republic and Poland delivered a great amount of data (Figure 3).

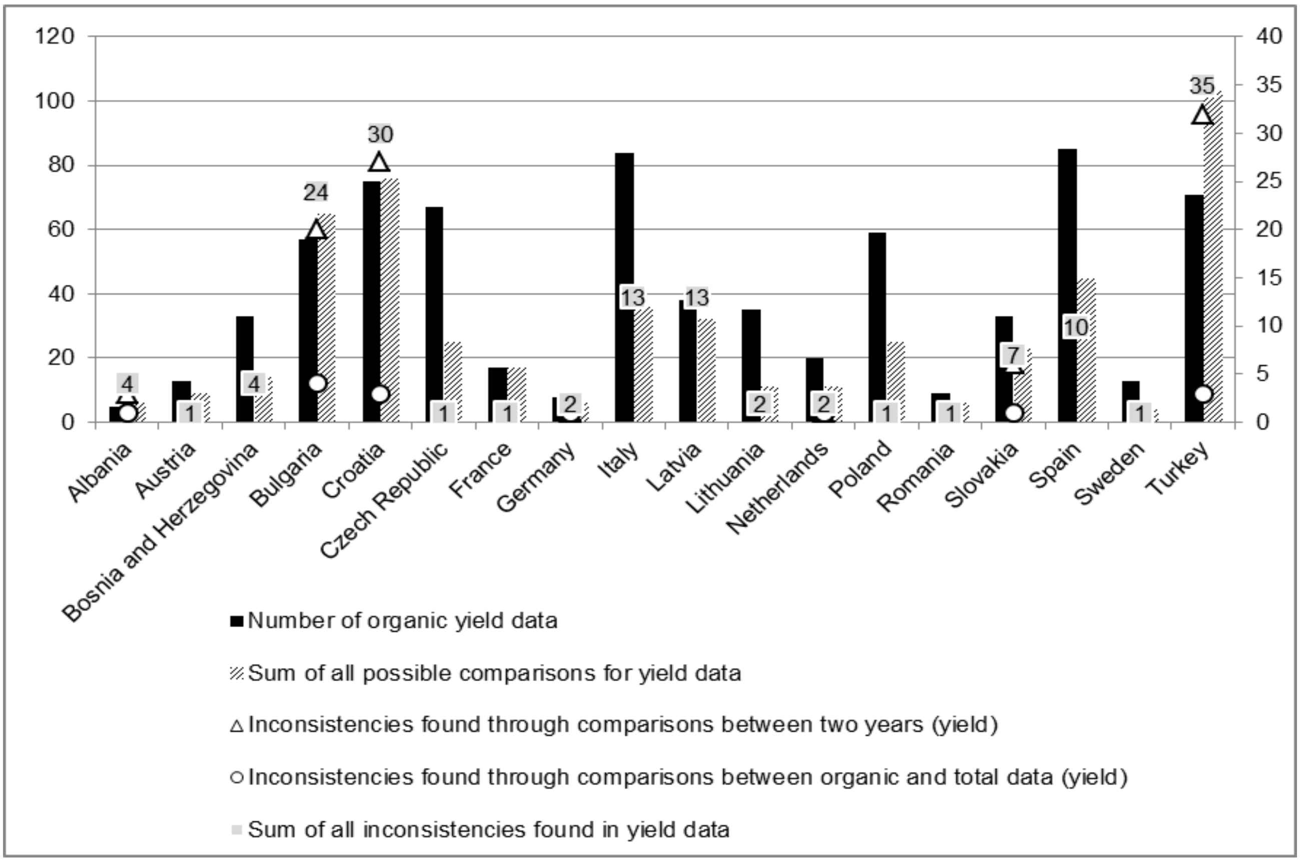

Figure 3: Inconsistencies in organic yield data

Most mistakes in organic market data stem from heterogeneous nomenclature and varying definitions of product categories. Inconsistencies in data from two subsequent years often occur because data from different sources was used. Therefore, it is very important to harmonise data collection methods, product categories, and nomenclature to ensure coherence and comparability. Likewise, inconsistencies might result from the estimation of numbers from organic market experts; these tend to be higher than the actual numbers and lack transparency and traceability.

Discussion

Further steps resulting from the outcome of the data plausibility checks are the compilation of a guideline for organic market data collectors, the exchange of opinions and experiences within the organic data network, and the revision of current organic market data reports. The following issues will be addressed: recommendations for consistent data collection and sampling, ideas for a harmonised nomenclature, clear definitions of product categories, and presentation of the data quality check procedure.

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Farmers taking responsibility for herd health development – Stable Schools as a tool for dairy health and welfare planning in Europe

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Key words: Stable Schools, dairy, health, welfare, Europe

Abstract

Achieving and maintaining a high herd health and welfare status is an important aim in organic livestock farming. The varying farming systems across and within countries call for models that are relevant for different farming types and that can be integrated into local practice. In stable schools, farmers take responsibility for health and welfare planning by identifying issues, setting goals, and acting to improve the health situation based on farm-specific data e.g. milk production. This paper reviews the results from intervention studies that used the "farmer field school" approach for animal health and welfare planning, providing an overview of on-going activities and their implementation into advisory situations in selected European countries. Research studies with stable schools as an intervention tool showed improvements regarding the specific project aim on the majority of the participating farms. Farmers and facilitators were convinced of the approach and benefits for dairy herds. Farmers' attitude and attention towards theirs herds and their ownership of the process appear to be crucial success factors for herd health and welfare situations. In some European countries this method has been implemented in advisory practice and in other regions there are promising opportunities.

Background

Achieving and maintaining a high herd health and welfare status is an important aim in organic livestock farming. Continuous development is needed within the farm to reach this goal. The different conditions between countries call for models that are relevant for different farming types that can be integrated into local practice (Vaarst et al., 2011b). Beside environment and herd conditions, farmers themselves play a critical role. Several studies have shown the impact of farmers' attitude towards their animals, their goals and motivation in relation to productivity, health and welfare (e.g. Breuer et al., 2000; Waiblinger et al., 2002) and the success of interventions (Ivemeyer et al., 2008). Farmers themselves emphasize the importance of observing, monitoring, and handling of animals (Dockès & Kling-Eveillard, 2006). However, increasing herd sizes and economic pressure across Europe increase the challenges to these skills and there is a demand for tools that help farmers to deal with these.

A set of common principles for active animal health and welfare planning in organic dairy farming have been developed within the ANIPLAN project group of seven European countries (Vaarst & Roderick, 2008). A central principle is that health and welfare planning is a farmer-owned process of continuous development and improvement which may be achieved in many different ways, but common features are that the process needs to be farm-specific, allow for the involvement of external person(s) and knowledge, be based on organic principles (where relevant), be written, and acknowledge good aspects in addition to targeting the problem areas in order to stimulate the learning process (Vaarst et al., 2010). The farmer field school (FFS) concept for farmers' learning, knowledge exchange, and empowerment that has been developed and used in developing countries (Sones, 2003) is relevant to these requirements. This approach has been modified in Denmark to support farmers in achieving specific health and welfare goals (especially avoiding use of antibiotics; Vaarst et al., 2007). This 'Stable School' approach has now been used in several European countries. The development of FFS to Danish stable schools is a form of knowledge transfer from less economically developed areas of the world to those with more developed economies. In FFSs, farmers take responsibility for health and welfare planning by identifying issues, setting goals and acting to improve the health situation based on farm-specific data e.g. milk production. Stable schools are led by an external person taking on the role of facilitation, providing and pre-processing available farm data but not giving specific advice apart from when requested by participating farmers (Vaarst et al., 2011a). Stable schools incorporate health promotion and disease handling, based on a strategy of risk assessment forming the basis for evaluation, action and review (Vaarst et al., 2010). Using scientifically sound health and welfare

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indicators as a basis for farmer-to-farmer-advice provides the possibility to bridge the gap between scientific knowledge and farm practice.

This paper reviews the results from intervention studies that used the FFS approach for animal health and welfare planning, providing an overview of on-going activities and their implementation into advisory situations in selected European countries.

Material and methods

European research activities involving stable schools have been reviewed and information about on-going advisory activities were collated.

Results

A summary of on-going and completed research and advisory activities using stable schools for dairy herd health and welfare improvement in several European countries is given in Table 1.

Table 1: Research and advisory activities with stable schools in different European countries

CC	finished and on-going research studies (duration)	n farms	on-going advisory activities (duration)	n farms
AT	spin-off from ANIPLAN [a] (2009-2010) reduction of concentrate input [c] (2009-2013)	6 10	Kuhpraktiker [b] (2010-2012; 65 fac. trained) 1 active stable school	 5
CH	ANIPLAN [d] (2008-2010)	13	-	
DE	Stable Schools [e] (2010-2013)	20	-	
DK	Danish Stable Schools [f] (2004-2005) ANIPLAN [d] (2008-2010)	23 9	as 1 of 2 options for 'obligatory animal health advisory service' (since 2010)	NA
NL	Networkgroups [g] (2008-2012)	~100	2 active groups	20
NO			Norwegian health service for dairy cattle [h] (since 2009, 34 fac. trained for cattle)	~ 60
UK	ANIPLAN [d] (2008-2010) The Soil Association's Farmer Field Labs [i] (since 2012)	9 NA	ANIPLAN group facilitated by DairyCo and new group started	> 9

CC= country code; fac. = facilitators; NA= not available; [a] Cimer et al., 2011a; [b] http://www.bio-austria.at/biobauern/termine/ausbildung_zum_kuhpraktiker; [c] Steinwidder et al., 2013; [d] Ivemeyer et al., 2012; [e] Brinkmann et al., 2012; [f] Vaarst et al., 2007; Bennedsgaard et al., 2010; [g] not exact FFS, but farmers advising each other, occasionally with input of experts; [h] http://storfehelse.tine.no/8747.cms; [i] http://www.soilassociation.org/innovativefarming/duchyoriginalsfuturefarmingprogramme/antibioticuse

Evaluation of effectiveness of stable schools aiming at herd health and welfare

During the original Danish Stable School study aiming at minimizing antibiotic use in 23 organic dairy herds, mastitis treatments decreased from 20 to 10 treatments per 100 cow years. Somatic cell count (SCC) and scores for acute and chronic intramammary infections remained unchanged. Milk yield (MY) of participating stable school farms increased at the same rate as comparable herds not involved in the FFS process. In conclusion, farmers participating in stable schools reduced antimicrobial use without apparent negative effects on production and udder and herd health (Bennedsgaard et al., 2010).

Within the ANIPLAN project in seven European countries, stable schools were adopted for animal health and welfare planning in 27 out of 128 farms (21%). Although there was no significant effect of planning approach (stable school vs. one-to-one advice), the total number of veterinary treatments as well as the number of udder and metabolic treatments, respectively, was significantly reduced during the one year study period. With the exception of somatic cell score, which improved significantly, other parameters such as calving interval and indicators for metabolic imbalances remained stable. MY and average lactation number also remained unchanged (Ivemeyer et al., 2012).

As a spin-off from ANIPLAN, a pilot Stable School was initiated in Austria on six farms resulting in improvements in SCC and energy supply of the dairy cows in the first 100 days in milk (DIM). MY increased on average by 500 kg per herd within one year (Cimer et al., 2011a).

In a German pilot study on the implementation of stable schools in 20 organic dairy farms, the average herd size increased significantly, whilst MY and herd age did not change over the three year project. In all nine farms measures to improve udder health were implemented as recommended by farmer colleagues within the stable school, SCS improved significantly whilst treatment incidence for mastitis and antibiotic drying-off stayed unchanged. Concurrently, there was a significant improvement in the percentage of cows with a fat-protein-ratio ≥ 1.5 in the first 100 DIM on these farms (March et al. 2014, OWC).

In the Netherlands, network groups were formed, with four focussing on limiting antibiotic use, one group focussing on strategic choices and one group on intuitive farming. Farmers shared knowledge and benchmarking of data triggered some farmers to achieve very low antibiotic use.

Farmers' and advisors' opinions on stable schools

Within some of the above mentioned studies, farmers and facilitators were asked how they perceived the process of stable schools and to identify the key aspects for future adoption. Most farmers were of the view that the animal health and welfare planning process was valuable for their farms and had led to sound improvements in their herds (Vaarst et al., 2007; Cimer et al., 2011a; Leeb et al., 2011). Farmers had the opinion that this method should be continued in local advisory structures or farmer group. They gave statements such as 'the project helped us to understand our own influence on the cows and how we can be better animal caretakers' (DK) and 'this method is a link between research and practise' (CH) (Leeb et al., 2011). Participants in the German pilot study expressed a positive attitude towards the tool; they appreciated the joint search for effective and feasible measures and evaluated the self-determined approach in the stable school as highly motivating. Accordingly, the compliance regarding implementation was very high. Of all recommendations given by the group members, more than two thirds had been implemented within the project period, either completely or partly (Brinkmann et al., 2012).

From the facilitators' point of view, the importance was identified of farmers taking the lead in the process, deciding who is involved and who takes responsibility for changes, and thereby taking ownership of the process. Whilst this may require help to organize the process, only the farmer participants can actually carry out changes in practice. However, in North-Western European farming bureaucracy has increased, along with economic pressure and expectations from different stakeholders which may constrain farmers' motivation to take part in such processes. Increasingly larger farms and herds may have more people involved in herd management (e.g. DE, UK and DK), which may create conflict and thereby underlining the importance of involving all relevant persons and ensuring knowledge exchange among farm employees and not just those participating in a FFS (Vaarst et al., 2011a). According to attendees of facilitator trainings in Austria (38 trainees), special attention should be paid to short travel times for participants and support by the facilitator to encourage implementation of additional stable schools (Cimer, 2011b).

On-going activities regarding farmer field schools

Within the Norwegian health service for dairy cattle, 24 advisors have been trained facilitation (plus a further twenty two involved in sheep farming), with further training planned. Precise data on farms participating in stable schools are not readily available, but there are an estimated 60 farms involved. Stable schools in Norway are not restricted to organic farms, with most participating farms being non-organic. In Austria 65 facilitators were trained in the five day 'Kuhpraktiker' courses, consisting of animal- based assessment, herd health planning and on-farm stable school-training on farm. One stable school was established originating from course participants. In the UK, the dairy industry's levy body, DairyCo, have shown an interest in rolling out the FFS concept to its various discussion groups and has continued to facilitate the original ANIPLAN group of farmers plus an additional stable school focussed on voluntary milking systems. Although not specifically concerned with animal health and welfare, the Soil Association has developed an adapted form of the FFS into Farmer Field Labs, which supports facilitated farmer research initiatives concerned with agro-ecological methods. In Denmark, since 2010, Stable Schools have become one of two options that could be chosen by organic dairy farmer with more than 100 cows as an 'obligatory animal health advisory service' before being allowed to store veterinary medicines on farm.

Conclusion

Research studies with stable schools as an intervention tool showed improvements regarding the specific project aim on the majority of the participating farms. Farmers and facilitators were convinced of the approach and benefits for dairy herds. Farmers' attitude and attention towards theirs herds and their ownership of the process appear to be crucial success factors for herd health and welfare situations. In some

European countries this method has been implemented in advisory practice and in other regions there are promising opportunities.

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The effect of intercropping winter peas and non-legumes on the weed suppressive ability in deep and short-term shallow ploughed soils

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Key words: ploughing depth, normal-leafed, semi-leafless, *Pisum sativum*, oilseed rape, triticale

Abstract

The interaction between winter pea sole or intercropping and ploughing depth was investigated in field experiments in Northern Germany with regard to weed infestation. A normal-leafed (cv. E.F.B. 33) and a semi-leafless winter pea (cv. James) were grown as sole crops and in intercrops with oilseed rape or triticale. The two ploughing depths were short-term shallow ploughing to a soil depth of 8-10 cm and deep ploughing to 25-27 cm. E.F.B. 33 showed a better weed suppressive ability than James. Moreover, winter pea-triticale intercrops were more effective in suppressing weeds than winter pea-oilseed rape intercrops. No beneficial effect of intercropping the semi-leafless cv. James and oilseed rape was found with regard to a reduction in weed infestation. The ploughing depth had mostly no significant effect on the weed infestation in winter pea sole or intercrops. In one of three years, intercropping E.F.B. 33 and triticale compensated for a higher weed infestation after shallow ploughing.

Introduction

There is an increasing interest in introducing winter peas in organic farming systems due to agronomic problems with spring peas as well as in reducing the tillage intensity e.g. operating the plough at shallower depth. A reduction in ploughing depth, however, often results in an increase in annual and perennial weed infestation (Brandsæter et al. 2011, Kouwenhoven et al. 2002, Håkansson et al. 1998). Peas, in particular those with a semi-leafless leaf type, have a weak weed suppressive ability (Spies et al. 2011). Growing semi-leafless peas in shallow ploughed soils has been shown to result in yield losses (Pranaitis and Marcinkonis 2005). Thus, weed management is essential to avoid harvest difficulties and pea yield loss. Pea-cereal intercrops suppress weeds to a greater extent than pea sole crops (Corre-Hellou et al. 2011). A high weed suppressive ability is one important aspect of growing winter peas in an intercrop with non-legumes e.g. triticale and oilseed rape. This work was performed to examine the interaction between winter pea crop stand and ploughing depth with regard to weed infestation. Another aim was to determine whether the high weed suppressive ability of winter pea-triticale and winter pea-oilseed rape intercrops can compensate for a possibly higher weed infestation in shallow ploughed soils.

Material and methods

Field experiments were conducted at the experimental station of the Thünen-Institute of Organic Farming at Trenthorst, Northern Germany (53°46'N, 10°30'E, 43 m a.s.l, 8.8°C, 706 mm, sandy loam soil) in the seasons 2008/09, 2009/10 and 2010/11. The experiments were carried out as a split-plot design of four replications with the experimental factor ploughing depth as the main plot and crop stand as the subplot. Deep ploughing (DP) consisted of stubble tillage with a precision cultivator (8-10 cm soil depth) followed by mouldboard ploughing (25-27 cm soil depth), whereas shallow ploughing (SP) was carried out using a skim plough for stubble tillage (4-6 cm soil depth) and primary tillage (10-12 cm).

The factor crop stand included five treatments in the 2008/09 field experiment: the normal-leafed winter pea cv. E.F.B. 33 (shortened EFB) was grown as a sole crop (EFB, 80 germinable kernels m^{-2}), in three intercrops with oilseed rape (cv. Visby, EFB-RA1: 60 germinable kernels EFB and 20 germinable kernels Visby m^{-2}, EFB-RA2: 40 germinable kernels EFB and 40 germinable kernels Visby m^{-2}, EFB-RA3: 20 germinable kernels EFB and 60 germinable kernels Visby m^{-2}) and in an intercrop with triticale (cv. Grenado, EFB-TR: 40 germinable kernels EFB and 150 germinable kernels triticale m^{-2}). In addition to EFB, the semi-leafless winter pea cultivar James was examined in the seasons 2009/10 and 2010/11. In these experiments the factor crop stand comprised winter pea sole cropping (EFB, James: 80 germinable kernels m^{-2}), winter pea-oilseed rape intercropping (EFB-RA2, James-RA: 40 germinable kernels winter pea and 40 germinable kernels oilseed rape cv. Visby m^{-2}) and winter pea-triticale intercropping (EFB-TR, James-TR: 40 germinable

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kernels winter pea and 150 germinable kernels triticale cv. Grenado m^{-2}). Component crops were arranged in alternate rows with a 12.5-cm row distance.

The most prevalent weed species in 2008/09 and 2009/10 were *Lamium purpureum* L. and *Stellaria media* (L.) Vill., whereas *Galium aparine* L. dominated the weed community in 2010/11. No mechanical weed control was performed in the experiments. Weed biomass samplings were performed at winter pea main flowering and at crop maturity from an area of 0.5 m^{-2} and 1 m^{-2} per plot, respectively. Annual weeds were cut 1 cm above the soil surface and dried at 60°C to constant weight.

Proc MIXED of SAS 9.2 was used to analyse data employing ANOVA and subsequent comparisons of means (Tukey test). Weed biomass data were log transformed to achieve normality.

Results

EFB sole cropping after shallow ploughing resulted in a significantly higher weed infestation (25.7 g DM m^{-2}) than EFB sole cropping after deep ploughing at harvest in 2008/09 (Fig. 1). No significant differences were present between deep and shallow ploughing in either EFB-oilseed rape or triticale intercrops. The intercropping of EFB and oilseed rape tended to increase the weed infestation at harvest compared to the EFB sole crops after deep ploughing. EFB-triticale intercrops showed a lower weed biomass accumulation at harvest than EFB-oilseed rape intercrops independent of the ploughing depth. Similar results were found for the weed biomass sampling at pea flowering.

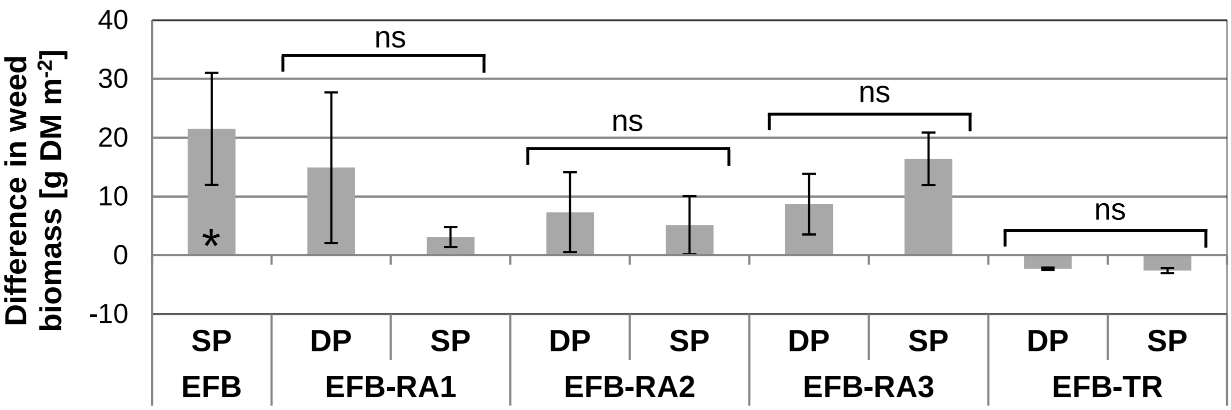

Figure 1. Differences in weed biomass (means ± SEM) in EFB sole and intercrops after deep (DP) and shallow (SP) ploughing compared to the reference value EFB sole cropping after deep ploughing (4.2 g DM m^{-2}) at crop maturity in 2008/09.* = Weed biomass significantly different ($P < 0.05$) from EFB sole crops after deep ploughing, s = significant, ns = non-significant.

The weed infestation in the EFB sole crops after shallow ploughing (13.2 g DM m^{-2}) did not differ significantly from that in the EFB sole crops after deep ploughing, whereas James sole cropping resulted in a significantly higher weed infestation at harvest (DP: 58.9, SP: 93.9 g DM m^{-2}) than EFB sole cropping independent of the ploughing depth in the second experimental year (Fig. 2). The ploughing depth had no significant effect on the weed biomass accumulation at pea main flowering and maturity. Moreover, EFB intercropping did not result in a significantly lower weed infestation than EFB sole cropping. The lowest weed infestation in James crop stands was observed in the intercrop with triticale at pea flowering (DP: 21.4, SP: 53.5 g DM m^{-2}) as well as at crop maturity (DP: 27.5, SP: 36.5 g DM m^{-2}) independent of the ploughing depth. James sole and James-oilseed rape intercrops had a comparable weed infestation level at pea flowering (84.4-107.6 g DM m^{-2}), whereas the weed infestation at crop maturity was highest in James-oilseed rape intercrops in both ploughing depths (DP: 122.4, SP: 130.4 g DM m^{-2}).

The weed infestation in 2010/11 was higher than in the previous years. The weed biomass in EFB sole crops after deep ploughing was 109.1 and 33.9 g DM m^{-2} at pea flowering and crop maturity, respectively. The EFB sole crop after shallow ploughing and all winter pea-triticale intercrops showed the lowest weed biomass accumulation at pea flowering (30.1 - 62.6 g DM m^{-2}) and at crop maturity (8.3 - 35.4 g DM m^{-2}, Fig. 3). James sole crops and James-oilseed rape intercrops produced a significantly higher weed infestation than

EFB sole as well as intercrops and James-triticale intercrops at both sampling dates (Fig. 3). The high weed infestation in James-oilseed rape intercrops is attributable to a high winter kill rate in oilseed rape. With the exception of a significantly higher weed infestation in James-oilseed rape intercrops after shallow ploughing (259.9 g DM m^{-2}) than after deep ploughing (Fig. 3, 187.8 g DM m^{-2}), the weed infestation did not differ significantly between deep and shallow ploughed plots (Fig. 3).

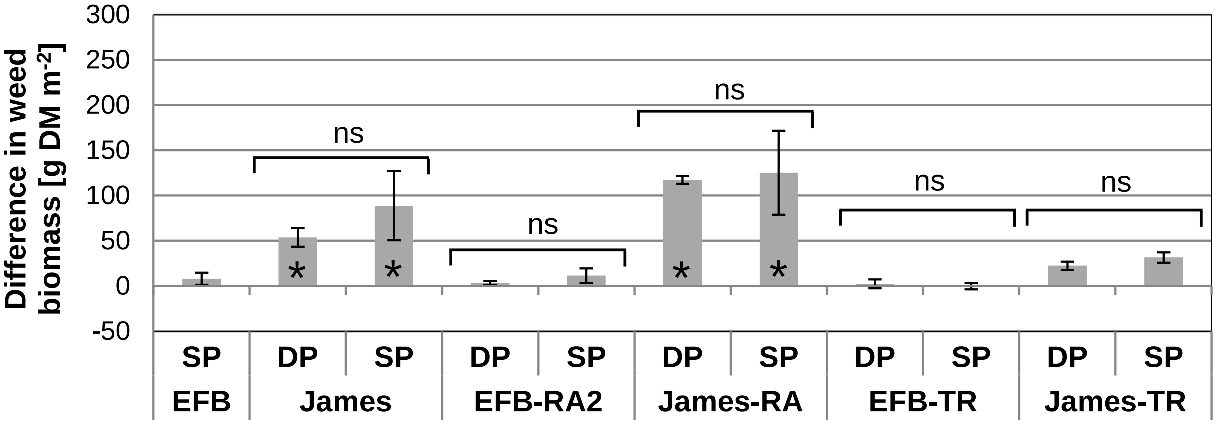

Figure 2. Differences in weed biomass (means ± SEM) in EFB and James sole and intercrops after deep (DP) and shallow (SP) ploughing compared to the reference value EFB sole cropping after deep ploughing (5.0 g DM m^{-2}) at crop maturity in 2009/10. * = Weed biomass significantly different ($P < 0.05$) from EFB sole crops after deep ploughing, s = significant, ns = non-significant.

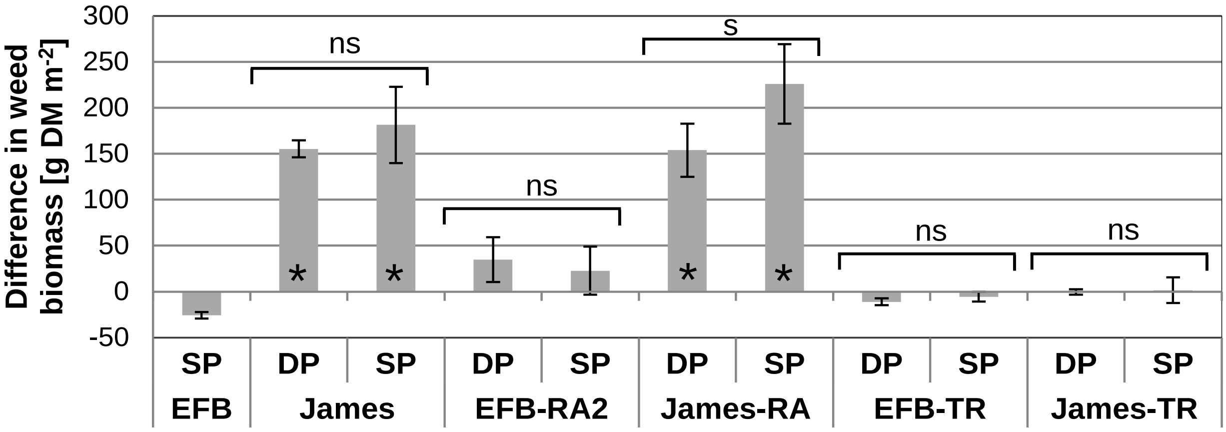

Figure 3. Differences in weed biomass (means ± SEM) in EFB and James sole and intercrops after deep (DP) and shallow (SP) ploughing compared to the reference value EFB sole cropping after deep ploughing (33.9 g DM m^{-2}) at crop maturity in 2010/11. * = Weed biomass significantly different ($P < 0.05$) from EFB sole crops after deep ploughing, s = significant, ns = non-significant.

Discussion

Shallow ploughing does not generally result in a significantly higher weed infestation even in organic crops with a weak weed suppressive ability like semi-leafless winter peas. Intercropping EFB and triticale compensated for the higher weed infestation after shallow ploughing in the field experiment in 2008/09 due to a high weed suppressive ability. Owing to the absence of a significantly higher weed infestation in winter pea sole crops after shallow ploughing, no compensation effect occurred otherwise. Normal-leafed winter peas have a better weed suppressive ability than semi-leafless winter peas. As a consequence of our findings, we recommend that winter peas should be sown in an intercrop with triticale due the effective weed suppression particularly with regard to semi-leafless winter peas. Moreover, intercropping normal-leafed winter peas prevents lodging and thus problems with weed overgrowth at harvest. In terms of weed suppressive ability as well as yield performance, intercropping winter peas and oilseed rape was less effective than intercropping winter peas and triticale.

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Biofumigation – an alternative method to control late blight in organic potato production?

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Key words: *Brassicaceae*, cover crop, glucosinolate, isothiocyanate, *Phytophthora infestans*, *Solanum tuberosum*

Abstract

To control late blight in organic potato production, copper fungicides are currently used. Due to the problematic aspects of copper fungicides, it is necessary to develop alternative methods to control Phytophthora infestans. In this context the use of cover crops and particularly the biofumigation method are discussed, too. Because there is barely literature about the effectivity of biofumgiation in organic potato production, the method was evaluated with laboratory experiments and a field trial in 2012. Brassicaceae plant tissue inhibited the hyphal growth of P. infestans in vitro significantly. However, in the one year field experiment no positive biofumigation effects could be observed concerning late blight infestation and potato tuber yields. Based on the missing biofumigation effects in the field and considering P. infestans to be no mainly soil-borne pathogen, the potential of biofumigation concerning late blight in organic potato production seems currently to be limited.

Introduction

Late blight is probably one of the most important problems concerning organic potato production in Germany. Therefore copper fungicides are currently used by organic farmers to control *Phytophthora infestans (MONT.) DE BARY*, the phytopathogen causing late blight. Due to problematic aspects of copper fungicides, like accumulation in soil and negative effects on non-target organism, it is necessary to develop alternative methods to control late blight in organic potato cultivation. In this context cover crops and particularly biofumigation are discussed as a possible method against *P. infestans* by practice. Thereby *Brassicaceae* with high contents of glucosinolates are incorporated into the soil to support the development of isothiocyanates (ITC), which are toxic to several phytopathogens (Morra and Kirkegaard 2002). Because there is barely literature about the usability and effectivity of biofumigation in organic potato production, the method of biofumigation with different *Brassicaceae* compared with one *Fabaceae* was evaluated with laboratory experiments and a field trial in Southern Germany.

Material and methods

Laboratory experiments

In vitro laboratory tests were used to get first information about the sensitiveness of *P. infestans* to different plant materials (*Brassica juncea*, *Raphanus sativus*, *Brassica rapa*, *Sinapsis alba*, *Vicia sativa*: three experiments) and to allyl isothiocyanate (AITC: one experiment). Petri dishes with V8 agar medium were inoculated with *P. infestans* isolate. After turning upside down, chopped plant material (2.5 g fresh matter) or AITC in methanol (3 µl total) was added to the lids. There was no contact between the Agar and the plant material or AITC. Airtight sealed Petri dishes were incubated in the dark at 17 °C. To the control dishes nothing or only methanol (3 µl) was added. All treatments were replicated three times. The diameter of the radial growth was measured and the relative area under the disease progress curve (relative AUDPC) calculated.

Biofumigation field trial

To test the biofumigation method in the open, a field trial was conducted on an organic farm with intensive potato cultivation in Southern Germany, 25 km northwest of Munich in the year 2012 (average annual temperature 8.5 °C, average precipitation 928 mm). The soil was humic sandy loam and the previous crop was rye. A split-plot design was chosen with the factors cover crop (*B. juncea*, *R. sativus*, *B. rapa*, *V. villosa*) and incorporation time (autumn, spring). All cover crops were seeded in August 2011 and shredded and incorporated in October 2011 (autumn) or April 2012 (spring). Potatoes were planted in April 2012 with 41700 tubers ha^{-1}. Potato growth, *P. infestans* progress (AUDPC) and potato tuber fresh matter (FM) yields were determined.

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Data analysis

All data were analysed using the R Project 3.0.2 (R Core Team 2013) with analyses of variance (ANOVA), split-plot ANOVA and linear models. Tukey's honest significant difference test (Tukey's HSD) was used to identify significant differences. As significance level always $p < 0.05$ was chosen.

Results

Laboratory experiments

Regarding all three laboratory experiments, plant material of the four *Brassicaceae* inhibited the hyphal growth of *P. infestans* on agar significantly. The relative AUDPC according to different plant material is provided by Figure 1 a). Only the *Fabaceae V. sativa* with 0.24 relative AUDPC had no significant effect compared to the control with 0.29. The broadest inhibition showed *S. alba* with 0.07 and *B. juncea* with 0.08 relative AUDPC. The growth inhibition of different amounts of AITC is provided by Figure 1 b). Thereby 0.03 µmol AITC did not inhibit the growth significantly, but 0.3 µmol AITC with 0.25, 3 µmol and 30 µmol both with 0.06 relative AUDPC inhibited *P. infestans* significantly compared to the control with 0.34 relative AUDPC.

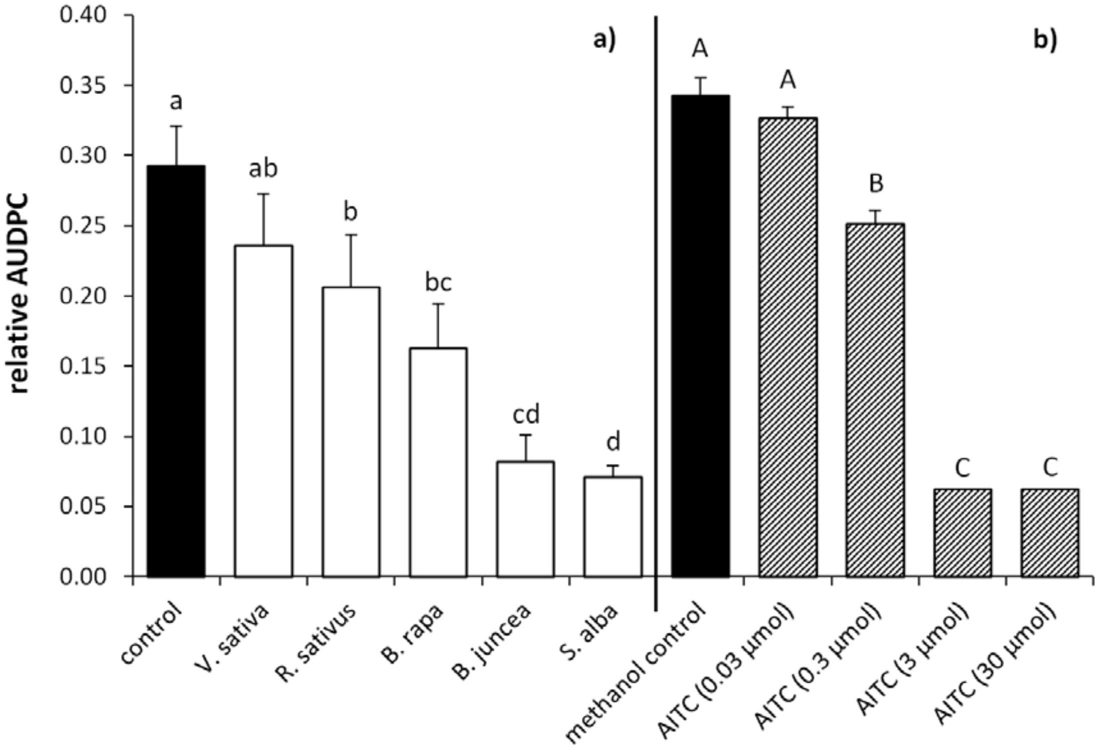

Figure 1. *P. infestans* hyphal growth inhibition. Plant material: 2.5 g fresh matter, three experiments. AITC (Allyl isothiocyanate): one experiment. Mean values, error bars: standard error of the mean, Tukey's HSD ($p < 0.05$), different letters imply significant differences.

Biofumigation field trial

An overview of the tuber yields and the AUDPC of all eight cover crop and incorporation time combinations is provided by Figure 2. There were no significant differences concerning tuber yields and AUDPC. Split-plot ANOVA stated that neither the factor cover crop nor the factor incorporation time or any interaction had a significant effect to *P. infestans* (mean AUDPC 2282) or fresh matter tuber yields (mean 21.8 t FM ha^{-1}). Incorporation time autumn had slightly higher tuber yields than incorporation time spring, but not significant. AUDPC tended to be smaller with incorporation time autumn in the case of the three *Brassicaceae*, however in the case of *V. villosa* AUDPC tended to be higher. Regarding all single plot values, with higher *P. infestans* infestation i.e. bigger AUDPC the tuber yields were decreasing significantly according to linear regression ($b = -0.006$, $p < 0.01$).

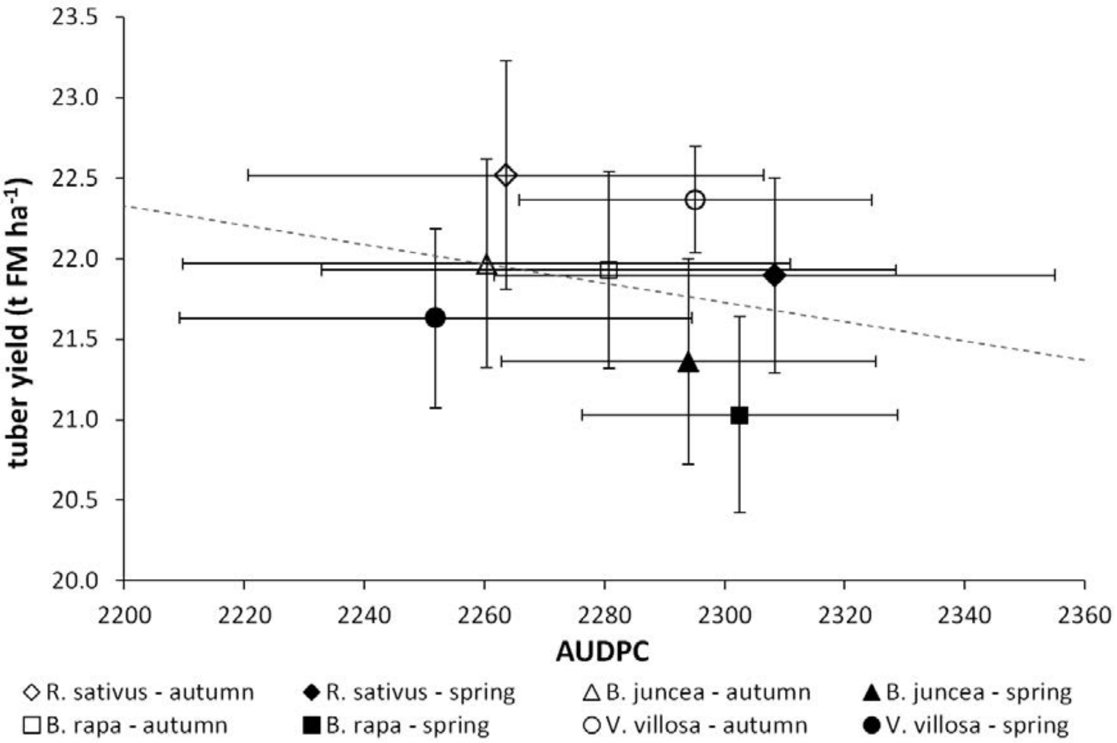

Figure 2. Potato tuber yield and AUDPC. Mean values, error bars: standard error of the mean, no significant differences, ---: linear regression with all single plot values (b= - 0.006, p < 0.01).

Discussion

First it seems like a gap between the in vitro laboratory results and the field trial results. Contrary to the *P. infestans* growth inhibition caused by *Brassicaceae* in the laboratory, there were no significant effects in the field trial. All four *Brassicaceae*, especially *S. alba* and *B. juncea* contained volatile ingredients which inhibited the hyphal growth of *P. infestans* similar to AITC in the in vitro experiments. AITC is a derivative of Sinigrin, the main glucosinolate of *B. juncea* (JKI 2010). But strictly speaking the laboratory experiments can only give hints to the inhibition of the hyphal growth. No conclusion for other development stages like zoospores and oospores are possible. Additionally the plant material is close to *P. infestans*, consequently the volatile ingredients can take effect. In contrary the cover crops in the field are seeded in autumn and incorporated to the soil in autumn or spring before potato planting. Therefore biofumigation can only harm soil-borne phytopathogens. But *P. infestans* mainly overwinters with latent infected seed tubers (Zellner et al. 2011) even though there are hints concerning the formation and existence of oospores in the soil (Andersson et al. 1998). The presented results are based on a one year field experiment with an early and intensive *P. infestans* disease. Maybe therefore rather moderate cover crop and biofumigation effects could not be observed. Furthermore factors like incorporation method and environmental conditions influence the effectiveness of the biofumigation method. Also other studies (JKI 2010) with different field crops showed that biofumigation is not always an effective and practical suitable method to control phytopathogens under middle European conditions.

Conclusions

According to the in vitro laboratory experiments *Brassicaceae* have the potential to inhibit the hyphal growth of *P. infestans*. But in an one year field experiment it was not possible to observe the anti phytopathogen effects of biofumigation under field conditions. The results did not show an effect of cover crop or incorporation time on potato health and yields. Considering *P. infestans* to be no mainly soil-borne phytopathogen, the potential of biofumigation concerning late blight in organic potato production seems currently to be limited. The field trials will be continued to get more reliable results, additional cover crops and further potato phytopathogens like *Rhizoctonia solani* will be considered.

Acknowledgments

The author would like to thank Stefan Kimmelmann, Jan-Dirk Otten, Dieter Hirschel, Florian Schmid and the staff of the experimental farm Roggenstein for the excellent management of the field trials. Thanks to the Bavarian State Research Centre for Agriculture for the possibility to use the laboratory and thanks to the farm for making it possible to conduct the field experiment. The project is supported by funds of the German Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany (FKZ 09OE114).

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Consumers' knowledge and information needs on organic aquaculture

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Key words: organic aquaculture, consumer, communication, label, focus group

Abstract

Organic aquaculture is a reasonably new market segment and so far little is known about consumers' knowledge and perception of organic aquaculture. Therefore the present article explores perceptions and knowledge of German consumers of organic aquaculture and related labels by using focus groups. One central result is that consumers were mainly unfamiliar with aquaculture in general. However, they had some clear expectations regarding sustainable and specifically organic aquaculture. The use of drugs should be minimized; production systems should be close to nature and respect fish welfare. Obviously, test persons deduced their understanding of aquaculture from theirs of terrestrial animal husbandry. The study also shows consumers' low awareness of the existing eco-labels on the German market.

Introduction

Products from organic aquaculture have only recently gained in importance in the market. That is why, so far only little attention has been directed towards consumers' knowledge and perception of organic aquaculture (Schlag & Ystgaard 2013 and references therein). Studies dealing with consumers attitudes towards aquaculture found that consumers are mostly unfamiliar with aquaculture (Aarset et al. 2004; DG Mare 2008). The image of aquaculture seems to be created by comparing it to agricultural systems and by contrasting it with fishing. Furthermore, Aarset et al. (2004) found that even though labels are of crucial importance in indicating fish quality most participants of their study were skeptical about and/or unfamiliar with existing eco-labeling schemes. With EU regulations for organic aquaculture in place, it is time for an update on consumers' attitudes towards organic aquaculture.

Accordingly, the present study aims to explore consumers' knowledge and perception of sustainable and organic aquaculture as well as those of sustainability labels especially organic ones. From our findings we derive consumers' understanding of organic aquaculture and deduce recommendations for further development of standards for organic aquaculture.

Methodological approach

We consciously decided not to opt directly for consumers' views on organic aquaculture in order to find out if consumers differentiate between sustainable and organic aquaculture. In accordance with the 'Brundtland Report' (WCED 1987) sustainability is defined in this study as integrating the three dimensions of environmental, social and economic development. Organic aquaculture is seen as a specific form of sustainable aquaculture practice. The term 'fish' is used in this paper as an umbrella term for all kinds of seafood.

To find out about the range of sustainable aquaculture products and labels present on the German market, we carried out an inventory first. In total we visited 30 retail stores in nine German cities. All aquaculture products available in these stores claiming to be sustainable and related labels were registered.

Afterwards six focus groups each consisting of 7 to 12 participants were conducted in three German cities (Stuttgart, Leipzig and Hamburg). This qualitative approach was chosen due to the explorative character of the study. All participants had to purchase fish at least once per month. Three groups consisted of consumers of organic food, whereas the other three groups were made up of consumers buying conventional food. Consumers were classified as buying organic if they purchased at least once per week organic products. Each session lasted between one to one and a half hours and followed a thematic guideline. All focus group discussions were audio- and videotaped and transcribed for qualitative analysis.

In the focus groups, participants were asked to think about arguments for and against fish farming. Hereafter, they should describe the criteria they thought sustainable aquaculture should fulfill. The test persons were expected to have only limited knowledge of aquaculture production systems. Thus they were informed about the three main production methods in Germany (earth pond, flow through system and closed recirculation

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system) and asked about their attitudes towards the presented systems. Next, participants were shown the five most prominent labels we found in the inventory and the Aquaculture Stewardship Council label (ASC). The ASC label was introduced in 2012 to the German market and was listed because the food industry expects it to become an important sustainability label. The participants were asked if they recognized any of these labels from fish products.

Results

According to the inventory a total of 143 different fish products claiming to be sustainable existed. Most of the products used labels as means of communication. More than half of the articles (61%) originated from organic aquaculture. Altogether, 18 different sustainability labels were found. Eight of which were organic ones. The most prominent label was the EU organic logo which was found on 40% of all articles. The second most frequent label was 'Naturland' (20%) followed by the German 'Bio-Siegel' with 12%.

Participants expected sustainable aquaculture to restrain from drug usage as far as possible and to work without artificial additives and hormones. Sustainable aquaculture should be a natural way of production respecting fish welfare and the environment. Fish feed should be sustainable itself and species-appropriate. Moreover, full transparency along the supply chain and outstanding quality were demanded by the participants. With regard to closed recirculation systems some associations with 'mass animal husbandry' came up. Fish welfare was heavily doubted in these systems. Likely ecologic advantages with respect to nutrient run-offs were outweighed by the lack of naturalness and the assumed deficiencies in fish welfare.

The attributes participants ascribed to organic aquaculture mostly conformed to current organic aquaculture practice. Participants imagined organic production as a natural one that combines eco-friendliness with fish welfare. In this context, a typical comment was: *'[ ] organic, the fish is happy [ ]'* (HH2F2). Other traits of organic aquaculture mentioned by participants were the exclusive breeding of native fish species and the renunciation to drug usage especially antibiotics. Some participants referred to organic aquaculture as a practice that is ecofriendly in a holistic manner. Ponds or tanks should have a natural appearance (e.g., vegetation around the site). Organic aquaculture was interpreted by several of the participants as a more traditional one, which is less industrialized. These expectations led many of them to the conclusion that an organic aquaculture might use earth ponds or flow through systems but not closed recirculation systems since they were perceived as too technical and artificial. Some participants expected organic fish farms to be small to medium sized. Big dimensions were mostly associated with industrial livestock farming and perceived to contradict the idea of organic production.

A large part of the participants did not clearly distinguish between sustainable and organic aquaculture. Some of them mixed the two terms and used them synonymously. Nonetheless, several of the participants had rather clear conceptions and expectations of organic aquaculture. Whereas sustainability was a more or less vague term with unclear definition for most of the consumers, organic on the other hand was a fixed term familiar to the consumers. Some of the organic consumers participating knew that there exists a regulatory framework defining organic. Organic aquaculture was seen by a lot of the participants as the ideal aquaculture practice and some mentioned that sustainable aquaculture should follow organic standards. Overall, differences in perception and knowledge of sustainable and organic aquaculture and related labels were small between the groups of organic and conventional consumers.

The focus groups revealed an obvious lack of knowledge among the participants concerning aquaculture in general. This limited knowledge resulted in a romanticized and misleading image of aquaculture. Apparently consumers' concerns about intensive terrestrial animal husbandry were transferred to aquaculture. In accordance with findings of Aarset et al. (2004) this shows that one motive for buying organic fish is the avoidance of likely negative aspects of conventional products. On the one hand, some participants were aware of their lack of knowledge and called for more transparency and information in general concerning aquaculture. Several participating consumers asked for standardized and comprehensible information on the package. On the other hand, other participants did not wish to know more about fish farming because they feared that more information might be confusing because of an already existing information overload. It even might bring them to stop consuming fish.

Even though organic fish products are sold by all major food retailers in Germany most of the participants were unaware of sustainability labels on aquaculture products. The only sustainability fish label participants mentioned frequently and unaidedly was the Marine Stewardship Council label (MSC), which only refers to marine fishing. This shows that a part of the participants was not able to differentiate between sustainability labels for wild and farmed fish. Fish is still often perceived as a non-domesticated animal which is caught rather than farmed. However, some of the organic consumers recognized some of the labels and stated to know them from other food. Several of the participants mentioned that they never before looked consciously for a sustainability label on fish products. Others said that they trust their retailer or fish monger and therefore did not look for labels. While discussing sustainability labels some participants said that they would trust organic fish products the most. But there was also some distrust of organic products among the participants for example concerning the certification process and the compliance to the specific organic standards. A general skepticism towards the food industry could be observed.

Conclusions

An important result of this research is that consumers' knowledge on fish production was very low. It became also clear that many of the participants were even not interested in additional information.

The impression was that those participants who were interested in sustainability issues preferred organic products when purchasing fish. Obviously their understanding of organic aquaculture practice was inferred from their knowledge of other organic food production. Many consumers relied upon the organic standards for aquaculture complying with their understanding of organic agriculture. The longing for authenticity and naturalness was present through all the group sessions. As in the study of Aarset et al. (2004) the term organic was used by some participants as a heuristic for naturalness. This perception is well in line with communication messages used in the organic fish sector. Further communication of this trait seems promising. Most of the participants refused closed recirculation systems as organic. They only accepted earth ponds and flow through systems as potential methods for an organic aquaculture. It is important to realize that these findings have major impacts on aquaculture systems eligible for organic certification – and for the further development of organic aquaculture standards. Only systems close to the natural cycles of nature and respecting fish welfare concerns will be accepted by consumers as organic produce. Eventually, it is important for the organic aquaculture sector to maintain and improve their high production standards and to align them further to consumers' expectations.

So far labels appear to be of little help to consumers in distinguishing organic fish products from other ones. This finding is in accordance with the study of Aarset et al. (2004) and leaves the standard setting institutions with the task to improve their profiles and to intensify consumer communication. Against the background of frequent information overload and the limited demand for additional information by many discussants the question remains on how to provide information for those interested. Our recommendation is to make use of the internet to explain organic aquaculture and the organic certification system to interested consumers instead of adding further information to packages.

Acknowledgements

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Segmenting the market for organic goat kid meat

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Key words: market segmentation, organic consumer, goat kid meat, communication

Abstract

Organic dairy goat farming is gaining importance in Germany and organic goat milk products become increasingly popular among consumers. At the same time, marketing of the goat kids, which are a by-product of dairy goat farming, is difficult. Consumer awareness and acceptance of kid meat is relatively low as it is not a traditional meat product consumed in Germany. Additionally, a lack in marketing structures besides direct marketing and high production costs contribute to a difficult market situation for dairy goat farms. This segmentation study shows that there are different promising consumer groups for organic kid meat. Certain attributes of the product, like the meat quality or its "Mediterranean flair", appeal to each of these segments and should be emphasised in communication measures. Providing recipes and information on quality and cooking at the point of sale is an important aspect of the communication strategy.

Introduction

While organic goat milk products become increasingly popular among German consumers, marketing of the goat kids is difficult. Consumer awareness of kid meat is relatively low as it is not a traditional meat product in Germany. A lack in marketing structures and high production costs contribute to a difficult market situation for organic dairy goat farms. In the Netherlands, another country with an increasing market for organic goat milk products, the situation is comparable to Germany. In other countries, like Greece, France, Portugal or Italy, there is a tradition of consuming goat kid meat. Yet, even in these countries, marketing structures and strategies for organic kid meat need to be improved.

One approach to explore marketing opportunities is to increase consumers' awareness and acceptance of organic kid meat. Therefore, the objective of this contribution is to identify promising consumer segments for organic goat kid meat and give recommendations for communication measures.

Material and methods

A consumer survey using face-to-face interviews was conducted parallel to tastings of organic goat kid meat in six retail stores in Germany in October 2011. Customers could sample goat kid meat prepared as roast. They were provided with information on quality and cooking and recipes were supplied. After tasting customers were approached by interviewers and asked to answer some questions. Consumers' attitudes towards goat kid meat and food in general as well as buying intentions regarding kid meat were surveyed. Additionally, socio-demographic variables were collected.

251 customers participated in the study. Based on their self-reported buying intentions regarding kid meat the sample was divided into potential buyers and non-buyers. Participants stating that they would likely or very likely buy goat kid meat in the future were considered to be potential buyers. The reduced sample consisting of potential buyers included 165 participants. 39% of these participants were male and 61% female. On average they were 54 years old with 30% being between 55 and 64 years old. Most of the potential buyers lived in two-person households (46%).

In order to identify specific target groups for marketing of organic kid meat a cluster analysis was conducted among the potential buyers. The cluster analysis was based on a factor analysis of 16 statements measuring consumers' attitudes towards food, nutrition and eating. Five factors were identified (Table 1). These five factors were used for clustering potential buyers of kid meat. First, outliers were identified and eliminated using single linkage clustering. Nine cases were eliminated as outliers. The remaining cases were then analysed using Ward's method. A three cluster solution was chosen due to changes in heterogeneity (following Hair et al. 2010).

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Results

Table 2 shows the mean factor values for each cluster and factor. Cluster 1 had the highest value for Factor 1: ‘Sophisticated cooking and enjoyment of food’. Hence, consumers in this cluster preferred premium food and beverages and took their time for cooking. Their ‘affinity for organic food and awareness of animal welfare’ (Factor 2) was only moderate. The mean values for Factors 3 and 4 were close to zero. Therefore, food quality and experimenting with new food products played a minor role. In contrast, the high mean value for Factor 5 indicated a preference for tried and trusted recipes for cooking. Consumers in Cluster 1 could be described as **‘pleasure-oriented meat lovers’** who indulge in gourmet food while being very traditional in their cooking habits.

Table 1: Results of the factor analysis

Factors and statements	**Factor loadings**	**Explained variance** 61.5%
Factor 1: Sophisticated cooking and enjoyment of food		16.1%
Premium food and beverages belong to my lifestyle	0.832	
I have sophisticated taste regarding food and beverages	0.745	
I take my time for cooking	0.670	
I often treat myself to delicacies	0.654	
Factor 2: Affinity for organic food and animal welfare		13.9%
Organic meat tastes better than non-organic meat	0.787	
I prefer organic products when I go grocery shopping	0.715	
By buying organic products I support animal welfare	0.682	
Debates on animal welfare issues reduce my pleasure in eating meat	0.552	
Factor 3: Preference for high quality food		11.6%
Products from animal friendly production are of higher quality	0.754	
I principally prefer high-quality products when grocery shopping even if they are considerably more expensive	0.647	
I pay attention to prices of food rather than to brands	-0.583	
Factor 4: Openness for new eating experiences		11.0%
I like to cook fancy food and dishes	0.802	
I like to try out new products	0.659	
I am really enthusiastic about specialties from foreign countries	0.602	
Factor 5: Conservative cooking preferences		8.8%
I prefer tried and trusted recipes when cooking	0.804	
The simpler the cooking, the more I like it	0.753	

Table 2: Mean factor values for each cluster

	Mean factor values		
Factors	**Cluster 1 (n=42)**	**Cluster 2 (n=52)**	**Cluster 3 (n=32)**
Factor 1: Sophisticated cooking and enjoyment of food	0.700	0.101	-1.079
Factor 2: Affinity for organic food and animal welfare	0.105	-0.094	0.163
Factor 3: Preference for high quality food	-0.068	0.317	-0.189
Factor 4: Openness for new eating experiences	-0.070	0.334	-0.383
Factor 5: Conservative cooking preferences	0.726	-0.692	0.257

Cluster 1 was the oldest of the three clusters with an average of 54 years (Table 3). In comparison to the sample of potential buyers, Cluster 1 had a high share of men (44%). Meat consumption was relatively high with 45% of the consumers eating meat three to six times a week. 55% of Cluster 1 had eaten goat kid meat before they participated in the tasting which equals the share among all potential buyers of kid meat.

Table 3: Description of the three clusters

	Cluster 1	**Cluster 2**	**Cluster 3**
Sex (%)	(n=41)	(n=51)	(n=31)
Men	43.9	41.2	35.5
Women	56.1	58.8	64.5
Age (%)	(n=42)	(n=50)	(n=32)
< 25	0.0	8.0	3.1
25 to 34	9.5	6.0	15.6
35 to 44	21.4	20.0	9.4
45 to 54	19.0	26.0	21.9
55 to 64	26.2	24.0	31.3
65 to 74	16.7	16.0	9.4
> 74	7.1	0.0	9.4
Mean (years)	53.6	49.1	52.6
Household size (%)	(n=42)	(n=51)	(n=30)
1 person	21.4	17.6	26.7
2 persons	47.6	37.3	46.7
3 persons	28.6	15.7	20.0
4 persons	2.4	25.5	3.3
4 to 9 persons	0.0	3.9	3.3
Meat consumption (%)	(n=42)	(n=52)	(n=32)
Daily	0.0	5.8	0.0
Three to six times a week	45.2	38.5	34.4
Once or twice a week	45.2	42.3	50.0
Less than once a week	9.5	13.5	15.6

The mean values for Factors 3 and 4 were highest in Cluster 2. Accordingly, these consumers preferred high quality food products and were willing to pay a premium for higher quality. They were happy to try new food products and food from foreign countries. When cooking they liked to experiment with fancy recipes. Consequently, the mean value for Factor 5 (conservative cooking preferences) was clearly negative. Factors 1 and 2 were of minor importance due to low mean values. Yet, it is notable that the affinity for organic products and awareness of animal welfare issues was lowest in this cluster and even slightly negative. Members of Cluster 2 could be described as **'adventurous gourmets'**.

Cluster 2 was on average the youngest consumer segment (49 years) with the highest share of persons younger than 25 years (Table 3). The share of single households was lower than in the other segments. The majority of the 'adventurous gourmets' ate meat once or twice a week. However, all potential buyers of kid meat who stated to eat meat on a daily basis could be found in Cluster 2. With 64% this segment had the highest share of people who had eaten goat kid meat before the tasting. This corresponds well with the 'adventurous' eating habits expressed by this cluster.

Cluster 3 had the lowest mean value for Factor 1. Hence, people in this segment had less sophisticated eating and drinking habits. Also, food quality (Factor 3) was not of great importance and a high willingness-to-pay could not be expected. At the same time, Factor 2 ('affinity to organic products and animal welfare') was most distinct in comparison to the other clusters, yet at a low level. Openness for new eating experiences (Factor 4) was even lower in Cluster 3 than in Cluster 1, while the conservative cooking preferences (Factor 5) were present but less pronounced than in Cluster 1. Due to their attitudes members of Cluster 3 could be described as **'organic ascetics'**.

The share of women was highest (65%) among the 'organic ascetics'. Household size tended to be smaller than in the other clusters and the share of single households was highest. Meat consumption was comparatively low in this segment. Almost two thirds of the 'organic ascetics' eat meat once or twice a week or less often. Accordingly, the share of people who had eaten goat kid meat before was the lowest among all clusters (38%).

Among the three identified segments the 'organic ascetics' are probably the most difficult to address with communication measures for organic goat kid meat. They have no distinct cooking preference and are very reluctant to try new foods. In addition their willingness-to-pay for high quality products and their meat consumption are quite low. Highlighting animal welfare and organic production could be useful for communication towards this consumer group. Considering the high share of single households, offering smaller cuts rather than half carcasses or complete haunches could also be considered.

Discussion

Overall, the 'pleasure-oriented meat lovers' and the 'adventurous gourmets' seem to be promising target groups for marketing of goat kid meat. Certain attributes of goat kid meat appeal to each of these segments and should be emphasised in communication measures. For pleasure-oriented meat lovers it should be accentuated that kid meat is a traditional delicacy (albeit not in Germany). Accompanying recipes should be easy to cook and not too exotic. Even though consumers in this segment may not easily be convinced to try something new, their relatively high meat consumption makes them an interesting target group.

In contrast, 'adventurous gourmets' are likely easier to win as they like to try new products. Communication should concentrate on the "Mediterranean flair" of goat kid meat and on quality aspects. Provided recipes could be more unconventional and fancy. The slightly lower meat consumption in comparison to the pleasure-oriented meat lovers may be counterbalanced by a higher willingness-to-pay for high quality products.

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Tuber development rates of six potato varieties in organic farming in Osnabrück, Germany

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Key words: tuber development, tuber bulking, potato, organic farming

Abstract

The tuber development of the varieties used is closely related to the maturity groups. Some variety differences within the maturity groups exist. If the development of the yield after a planned harvest (a date between 75.th and 80.th day after planting is recommended) is satisfactory and no further yield formation is expected then it is not necessary to spray any supplements against Late Blight (Phytophthora infestans).

Introduction

Little is known about the variety characteristics of potato in organic farming. All field experiments so far had been carried out by conventional farmers with the possibility of applying chemical-synthetic pesticides and mineral nitrogen fertilizers. Those results are published every year in the German National Listing of Potato varieties (BUNDESSORTENAMT, annual). But a lot of variety characteristics –important for organic farming- are not included in this catalogue and so for many years farmers have been demanding field trials with grain and potatoes in organic farming to fill the gaps. (HUSS, 2006) Despite the importance of potato tubers as a source of food, the growth and development of tubers had not been measured. Therefore, a national organic field trial with 18 varieties and in 7 locations was carried out from 2009-2012. Knowing the dynamic of tuber development it seems easier to manage Late Blight (*Phytophthora infestans*), because this disease is responsible for a restricted yield, especially in organic farming, with permitted supplements. Some research about bulking rates of potatoes (Russet Burbank) with several objective targets like irrigation and/or Nitrogen Management (conventional trials) can be found, but no research based on modern German or European varieties could be found neither in conventional or in organic farming. (BOHL et al. 2006 and BELANGER et al. 2001)

Material and Methods

A four year tuber bulking rate study was conducted at the experimental organic farm of the University of Applied Sciences in Osnabrueck, Germany. The randomized plots consisted of four 5 meter rows spaced 75 cm apart with a seed piece spacing of 33 cm, using sixteen plants per variety with four replications. The plots were harvested after 70 (T1), 80 (T2) and 90 (T3) days of planting. After approximately 125 days (F) the plots were finally harvested. At each harvest the tubers were quantified (weight and number of tubers) and divided into different grading sizes (<30/35 mm, 30/35 – 55/60 mm and >55/60 mm) depending on tuber shapes, weighed again and the number of tubers were counted.

Two varieties of every maturity group with the highest planting relevance in organic farming in Germany were chosen for this paper, their characteristics can be found in Table 1.

Table 1: Characteristics of the used varieties

<table>
<tr><th>Characteristics/Variety</th><th>Annabelle</th><th>Anuschka</th><th>Belana</th><th>Princess</th><th>Ditta</th><th>Allians</th></tr>
<tr><td>Breeder</td><td>Weuthen</td><td colspan="2">Europlant</td><td>Solana</td><td colspan="2">Europlant</td></tr>
<tr><td>Maturity</td><td colspan="2">Very early</td><td colspan="2">Early</td><td colspan="2">Medium Early</td></tr>
<tr><td>Tuber Shape</td><td>Long</td><td>Round</td><td colspan="2">Oval</td><td colspan="2">Long-oval</td></tr>
<tr><td>Yield</td><td>Below average</td><td>More over-sized tubers</td><td colspan="3">Average</td><td>High</td></tr>
</table>

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Results

Figure 1 shows the tuber development from Time harvest 1 (T1) to Final yield (F). Both very early varieties Annabelle and Anuschka have a higher marketable yield until Time harvest 3 (T3) compared to the others. The amount of undersized tubers in theses varieties is less than the later varieties.

The very early varieties Belana and Princess have a higher yield from the beginning but the yield development flattens out towards harvest T3.
The medium early varieties Ditta and Allians start with a moderate yield but over time develop the highest marketable yield by the end.
The all-over yield (undersized + oversized + marketable yield) at Final harvest indicates that Anuschka has a significantly higher yield than Annabelle, Belana and Princess. Ditta and Allians have significantly better yields than Annabelle. The reduction of yield between T3 and Final harvest in Annabelle, Belana and Princess may be attributed to tuber decay for several reasons, such as the earlier decline of the vines and the reduction or decay of tubers due to drought stress or in the case of Annabelle due to tuberrot.

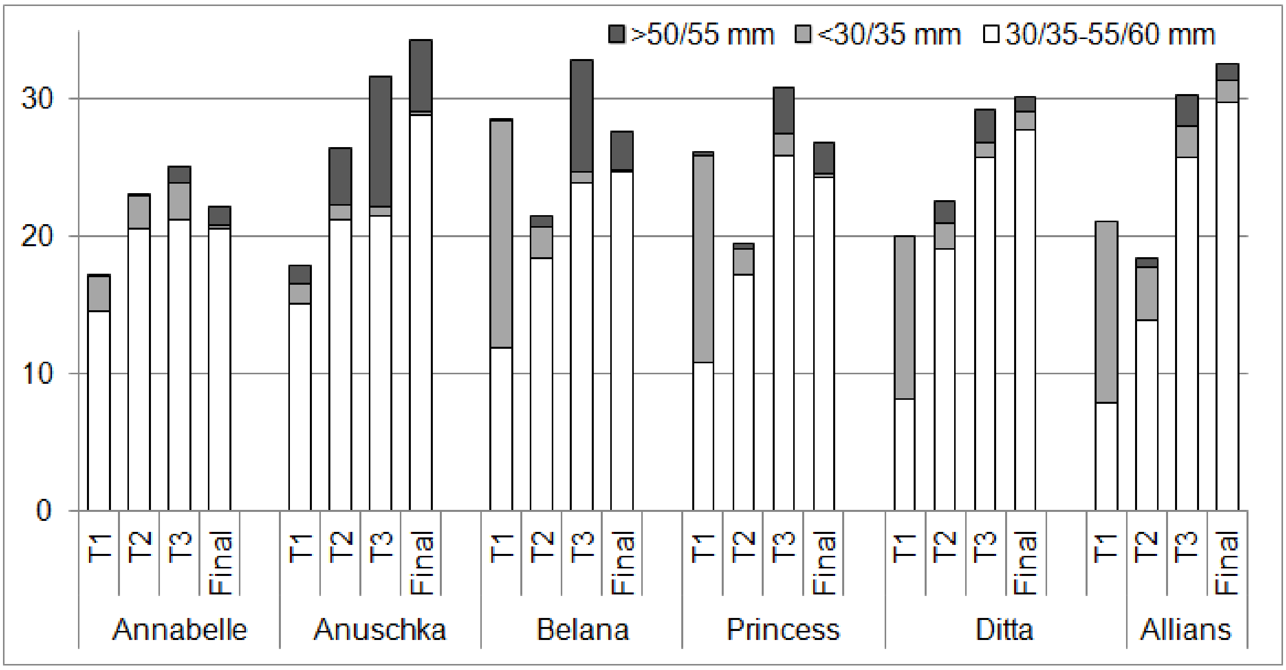

Figure 1: Tuber development in t/ha from harvest T1 to Final harvest, 4-year-medium, Undersized yield (<30/35 mm), Oversized yield (>55/60 mm) and Marketable yield (30/35-55/60 mm) (grading depends on Tuber Shape, Table 1)

Table 2: Marketable Yield (4-year-medium) depending on Harvest Times (different letters indicate significances (p=0,05), BONFERRONI)

Variety	Maturity Group	T1 (Day 70)		T2 (Day 80)		T3 (Day 90)		Final (Day 125)	
		T ha^{-1}		T ha^{-1}		T ha^{-1}		T ha^{-1}	
Annabelle	Very early	14.5	a	20.5	a	21.2	a	20.5	a
Anuschka		15.1	a	21.2	a	21.6	a	28.9	bc
Belana	Early	11.9	ab	18.4	ab	23.9	a	24.3	ab
Princess		10.8	ab	17.2	ab	25.9	a	25.0	ab
Ditta	Medium Early	8.2	b	19.1	ab	25.8	a	27.8	bc
Allians		7.9	b	13.9	b	25.8	a	29.3	c

T1: Allians has at T1 a significantly more undersized yield than the other varieties, except Princess. Anuschka shows a significantly higher yield of oversized tubers. Allians and Ditta have a higher marketable yield than Annabelle and Anuschka. There is a difference between very early and medium early varieties concerning the marketable yield.

T2: Again, Allians has a more undersized tuber yield and Anuschka more oversized tuber yield than the other varieties. Both Annabelle and Anuschka have a higher marketable yield than Allians. At this time the difference between the maturity groups in marketable yield is not clear, only Allians as a medium early variety shows a difference from Annabelle and Anuschka (very early). Within all other varieties no differences exist.

T3: Anuschka has asignificantly less undersized tuber yield than Annabelle, Princess and Allians. Ditta has less undersized tubers than Annabelle. Similarly to the harvest 10 days before, it is only Anuschka that has significantly more oversized tubers than the other varieties. While the yield of the very early varieties could not be extended further, it is now apparent that the early and medium early varieties have an increased yield from T2 to T3 of approximately 5.5 t/ha (Belana) to 11.9 t/ha (Allians). All varieties show no differences in marketable yield.

Final: The medium early varieties Ditta and Allians have more undersized tubers than all the others. Anuschka still has more oversized tubers than all the others. Anuschka, Ditta and Allians have a higher marketable yield than Annabelle. Allians shows a significant higher yield than Belana and Princess. With the exception of Anuschka there is a marketable yield difference between the maturity groups.

Discussion

Infections with Late Blight are usually detected in the first week of July, when the tubers are in full bulking process. In Germany, this is around the planned third harvest approximately 80 days after planting. With the restricted use of supplements against Late Blight in Organic Farming it is important to know how much marketable yield the varieties have developed until this date. This is an important factor for economic success.

Figure 2 compares the marketable yield from harvest T1 to Final Harvest with the Final harvest (=100%) of every variety.

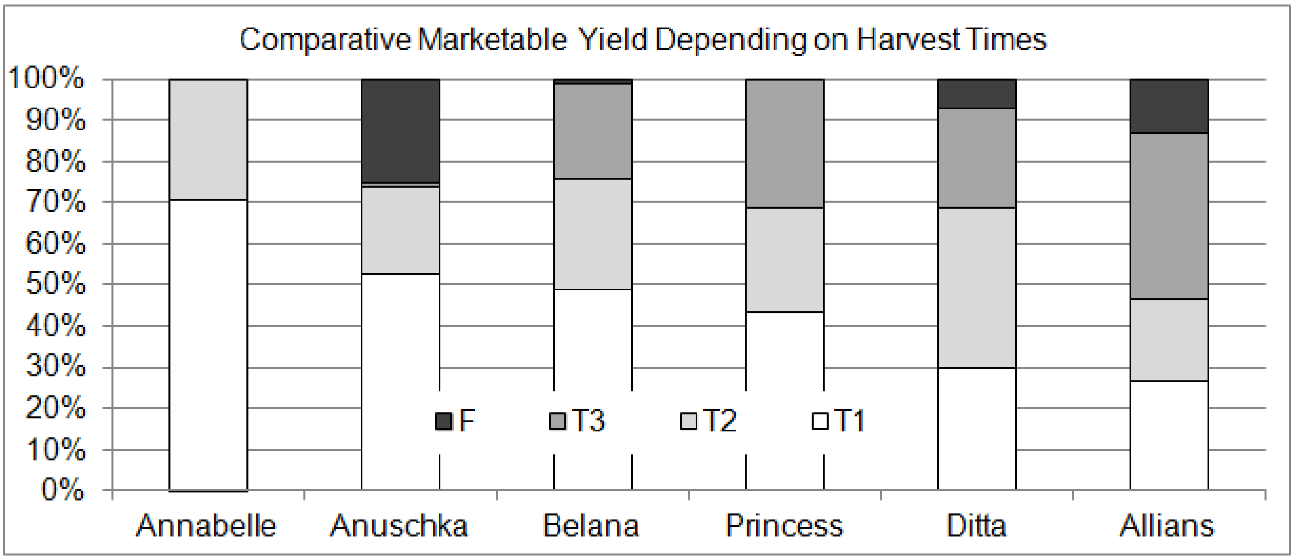

Figure 2: Comparative Marketable Yield Depending on Harvest Times from T1 (70 days), T2 (80 days), T3 (90 days) and Final (125 days)

70 days after planting (T1) only Annabelle has a higher marketable yield (71 %) than the others as predicted due to its very early maturity and already reaches its Final yield at T2. Anuschka in contrast has a later yield

development and reaches 74 % of its Final yield at T2. Anuschka builds almost 25 % of its Final yield in the last period from T3 to final harvest. The vine decline affects Annabelle only.

Belana seems to be a little faster in tuber development than Princess in the same maturity group. Similarly to Anuschka, both varieties reach the same yield as Annabelle at T2. While Princess has more yield development from T3 to Final harvest, the yield development of Belana is constant from T1 to T2 to F.

Ditta and Allians show poor yields at T1 compared to the other varieties as was expected. They belong to the early maturity group. Ditta has a similar yield at T2 to Anuschka, Belana and Princess. Allians reached only 47 % of the Final yield at this time. From T2 to T3 the yield increased around 31 % (Ditta), but 53 % for Allians.Up to the Final harvest the yield development of Ditta is about 7 % and in Allians about 13 %. In conclusion Allians has the slowest yield development of all varieties used in this paper and would need some permitted supplements against Late Blight.

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The Relevance of Subsoil C and N for the Assessment of Cropping System Impact on Soil Organic Matter

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Key words: soil organic matter, subsoil, tillage

Abstract

The aim of this study was to verify the importance of subsoil SOC and STN amounts in the evaluation of the effects of tillage treatments on soil organic matter (SOM). The research was carried out in the Organic Arable Farming Experiment Gladbacherhof (OAFEG). It could be observed that tillage does not show any significant effects on SOC and STN in the topsoil, but influences their dynamics in the subsoil. In particular, SOC and STN decreases with all reduced tillage treatments, while FIT had no significant effect on SOC in the topsoil, and even showed a significant STN and SOC increase in the subsoil. The consideration of subsoil SOM changes therefore makes a difference in the interpretation of treatments compared to an evaluation based on topsoil-data.

Introduction

For a sustainable agriculture it is indispensable to develop management practices which are most appropriate for the specific site where crop production takes place. In this context it is necessary to include all nutrient sources available. Although the subsoil contributes to a remarkable extend to plant nutrition, little is known about the dynamics of nutrients in deeper soil layers (Kautz et al., 2013). This is mostly due to the extent and the costs of analyses needed to provide such information. The aim of this study is to assess the relevance of the subsoil in the assessment of long-term effects of soil management types with focus on the organic long term field experiment at the experimental station Gladbacherhof (Knebl et al., in prep.).

Material and methods

The OAFEG has been carried out at the experimental station Gladbacherhof. The station is located in Villmar in the Taunus hill landscape in Hesse, Germany (altitude 170 masl., mean annual temperature 9.5°C, mean annual precip. 649mm, orthic luvisol, silt with high clay content). The experiment includes three different crop rotations/fertilizations and four tillage treatments in a two-factorial design (Schulz et al., 2014). Crop rotations correspond to mixed farming, stockless cash crop farming and stockless cash crop farming with rotational ley. The different tillage treatments comprise full inversion tillage at 30 cm (FIT), two layer plow at 15/30cm (TLP), reduced inversion tillage at 15 cm (RIT), and non-inversion tillage at 15cm (NIT). The experimental setup is a split plot design with four replications. Soil samples were taken in 0-30cm, 30-60cm and 60-90cm soil depth prior to sowing and after the harvest in four replications per field plot. Additionally the bulk density of each sampling layer was determined and crop yields of each plot were recorded. Amounts of SOC and STN were analyzed by dry combustion. Statistical analyses were performed with STATISTICA (StatSoft) using the GLM procedure.

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Results

Figure 1 illustrates the losses and increases in STN and SOC over an eleven year period in the sampling layers 0-30cm, 30-60cm and 60-90cm. Letters and symbols denote significant differences between the tillage treatments and their effects on STN and SOC levels. Considering the STN and SOC amounts in the sampling layer of 0-30cm soil depth, the tillage treatments RIT, TLP and NIT led to significant decreases in STN and the treatments RIT and TLP resulted in a significant decrease in SOC. In deeper soil layers the FIT treatment is showing a significant increase in STN SOC in the layer 30-60cm, whereas RIT, TLP and NIT result in significant decreases in SOC in the subsoil. The SOC decrease under RIT and NIT is even higher than the decrease observed in 0-30cm soil depth. The treatment TLP stands out with a considerable SOC decrease in the sampling layer of 60-90cm. As one can see, the four examined tillage treatments do not differ in their effect on topsoil STN and SOC. Considering the subsoil. Only the FIT treatment differs significantly in its effect on the STN and SOC amounts in the 30-60cm layer.

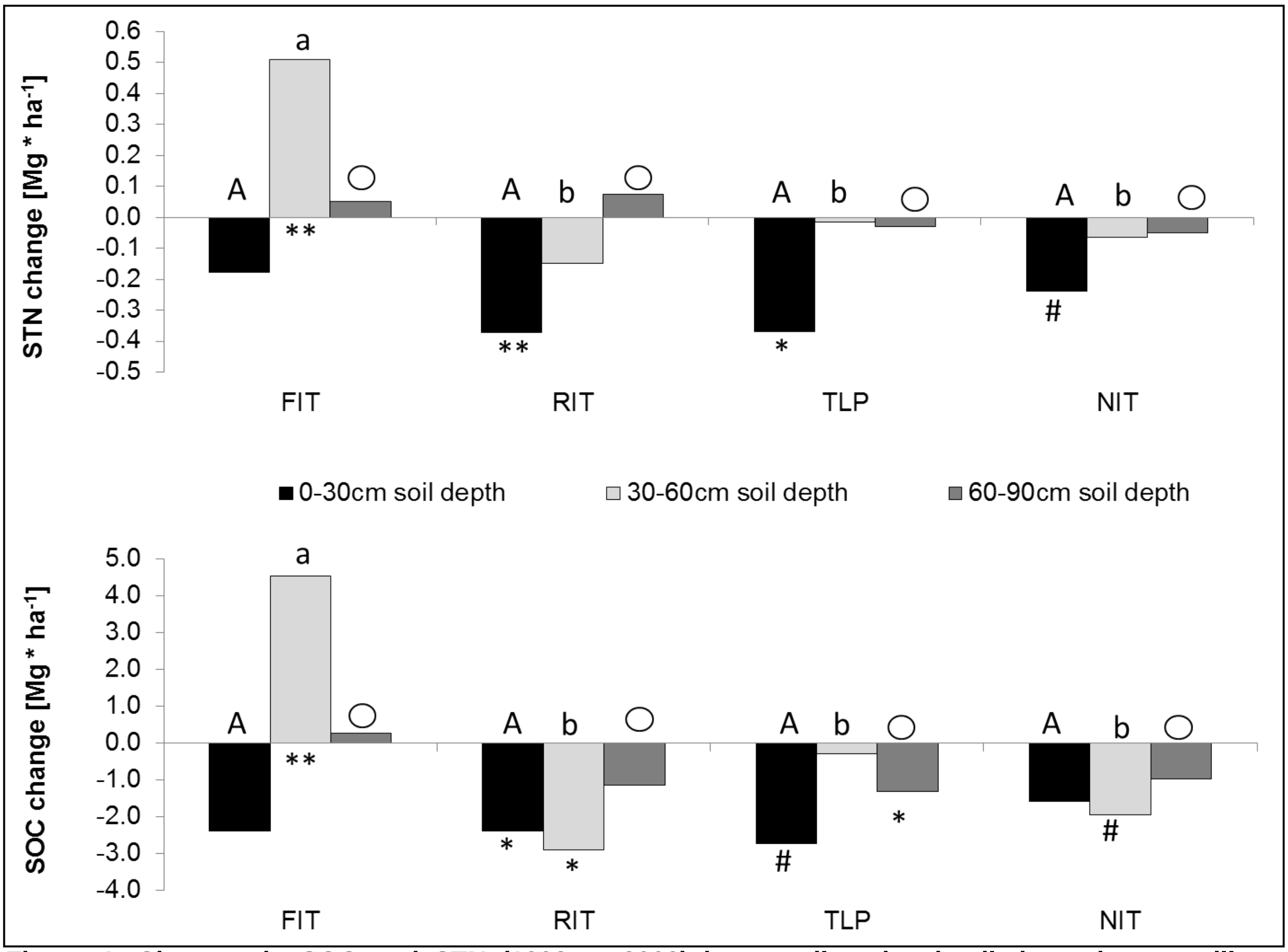

Figure 1. Changes in SOC and STN (1998 to 2009) in topsoil and subsoil dependent on tillage intensity.
** significant change at α = 0.01; * significant change at α = 0.05; # significant change at α = 0..10.
Different letters/symbols denote significant differences between treatments at α = 0.05. Upper case = differences in the level 0-30cm; lower case = differences in the level 30-60cm; symbols = differences in the level 60-90cm; RIT= reduced inversion, FIT= full inversion tillage, NIT= non inversion tillage, TLP= two layer plow

Discussion

The consideration of subsoil soil organic matter changes does make a difference in the interpretation of treatments compared to an evaluation based on topsoil-data. The significant increase in STN as well as SOC in the 30-60cm layer of the tillage treatment FIT may be a result of incorporated plant residues and dissolved organic matter. This reason thus fails to explain the contrary effects observed in the RIT and TLP treatments. Up to now, no similar results of other studies could be found. This indicates the demand for further investigations. It is to verify whether the results of this study are unique findings for the long-term field experiment Gladbacherhof. If similar results occur, the evaluation of full inversion tillage compared to a reduced and/or non- inversion tillage needs to be revisited.

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Growth of barley (*Hordeum vulgare* L.) roots in biopores with differing carbon and nitrogen contents

TIMO KAUTZ[1], MIRIAM ATHMANN[1], ULRICH KÖPKE[1]

Key words: pore wall, earthworms, *Hordeum vulgare* L., carbon, nitrogen, subsoil

Abstract

Large sized, vertical biopores can provide preferential pathways for root growth, hence facilitating the exploration of great soil depths by crop roots. This is of particular importance for organic production systems, where crops are more dependent on nutrient acquisition from the solid soil phase than under conditions of mainstream agriculture. The relevance of biopores for nutrient acquisition from the subsoil can possibly depend on their individual properties. The aim of this study was to test how different chemical pore wall properties affect the growth of barley (Hordeum vulgare L.) roots in large sized biopores. Bulk soil, pore wall material and roots from individual biopores were collected from three depth layers in 45-75 cm soil depth. C and N contents in the pore walls were up to 3 times higher than in the bulk soil. A large variation of C and N contents between the walls of individual biopores indicated that the quality of the pore wall is a function of pore colonization by earthworms over time. N-rich pores hosted more roots than N-poor pores. It is concluded that elevated C and N concentrations in pore walls can facilitate the exploration of the subsoil by crop roots.

Introduction

Crop roots often have only limited access to nutrient and water stored in the deep subsoil because of adverse conditions for root growth such as high mechanical resistance and low O_2 concentrations (Kautz et al. 2013a). Large sized, vertical biopores, created by deep burrowing earthworms and taproot systems, can provide preferential pathways for root growth, hence facilitating the exploration of great soil depths by crop roots (McMahon and Christy 2000). Furthermore, these biopores are assumed to be hot spots of nutrient acquisition by crop roots, because pore walls were reported to provide high concentrations of N, P, K and other nutrients (Pankhurst et al. 2002, Parkin and Berry 1999) and a high microbial activity (Jégou et al. 2001, Tiunov et al. 2001). However, recent studies have shown that the nutrient content of pore walls can considerably vary between biopores of different origin (Athmann et al., in this volume). Hence, the relevance of biopores for nutrient acquisition from the subsoil can possibly depend on their individual properties. The aim of this study was to test how different chemical pore wall properties affect the growth of barley (*Hordeum vulgare* L.) roots in large sized biopores.

Material and methods

The investigation was carried out in a field experiment on a Haplic Luvisol (WRB) derived from loess (loamy silt) in Klein-Altendorf near Bonn, Germany (50°37'9''N 6°59'29''E, 9.6 °C mean annual temperature, 625 mm annual rainfall). The samples were taken in early July 2011 under winter barley. Soil was removed down to a depth of 45 cm on an area of 50x50 cm adjacent to a 1.5 m deep trench dug by a shovel excavator. In a sampling area of 25x40 cm, the surface was cleaned from smeared soil and overlaying particles using a vacuum cleaner. Within the sampling area all visible biopores >2 mm in diameter were carefully opened, starting from a cutting edge of 10 cm height. Material from the pore walls was collected using small spoons and scrapers for determination on C and N contents with elementary analysis (Euro EA 3000, HEKAtech, Germany). Additionally, samples from the bulk soil were taken in four replicates for analysis of C and N contents. Roots from pores and bulk soil were collected seperately, washed, scanned (Epson Expression V700, 400 dpi) and quantified by image analysis (WinRhizo Pro, Version 2009c, Regent Instruments Canada Inc). In total, 3 soil layers of 10 cm each in 45-75 cm depth were investigated.

Results

In all depth levels under study the C content of the bulk soil was approximately 0.45 %. The C contents in the walls of individual biopores varied between 0.45 % and 1.24 %. Correspondingly, the N content in the bulk soil was approximately 0.05 % throughout the three depth levels (Fig. 1). N contents in the walls of individual

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biopores normally varied between 0.05 % and 0.12 %, however in one sample 0.14 % N were recorded (Fig. 1).

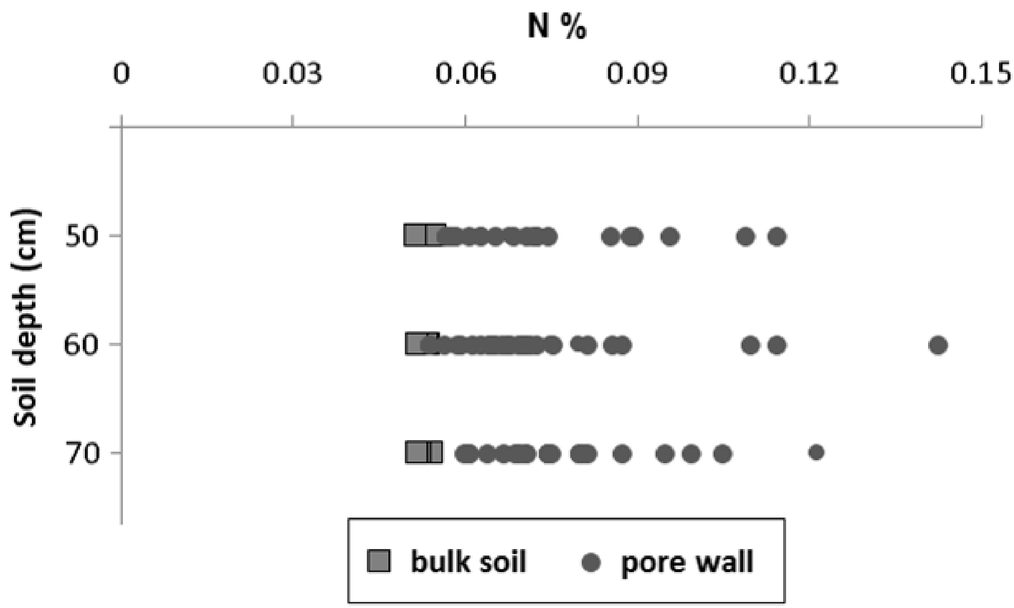

Figure 1. N contents in bulk soil and walls of individual biopores in three different soil layers (45-55 cm, 55-65 cm and 65-75 cm depth)

No significant correlation between N content in the pore wall and root length in biopores was found (Fig. 2). Individual biopores were grouped into one ‘N-poor’ class (N % < 0.07) and one ‘N-rich’ class (N ≥ 0.07). The average root length in N-poor biopores was 3.3 cm root cm $pore^{-1}$ whereas it was 5.7 cm cm^{-1} in N-rich biopores (Fig. 2). This difference was significant at $p < 0.01$ (Mann-Whitney-U-test).

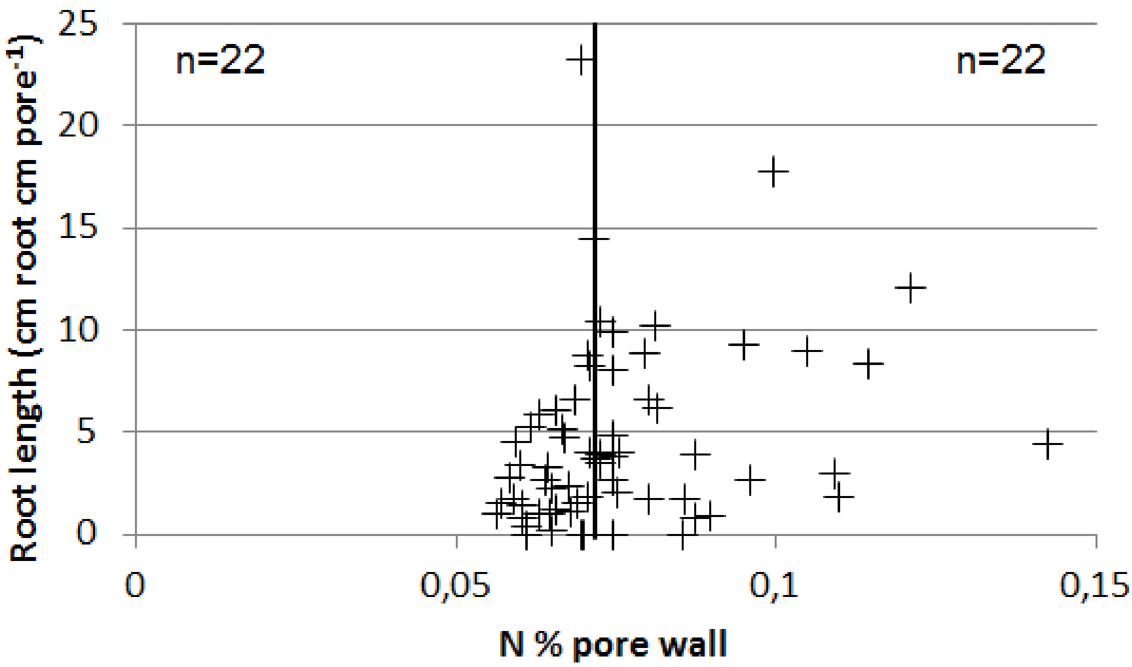

Figure 2. N contents in pore walls and root length in individual biopores

Discussion

In the soil under study, the soil depth from 45-75 cm is comparatively homogeneous and entirely belongs to the Bt horizon. Accordingly, no differences in the C and N contents between the soil layers were recorded.

A large variation of C and N contents between the walls of individual biopores was found, but it was not possible to differentiate between pores formed by earthworms or roots. We assume that a simple classification into two different classes of origin would not reflect the properties of biopores under field conditions: It is well established, that preferential flow paths such as biopores can be stable at least for decades (Hagedorn und Bundt, 2002). As long as a pore is colonized by an earthworm, the walls are frequently coated with N-rich faeces, thus, the N contents of the pore wall are assumed to rise or maintain on a comparatively high level. However, when the pore is abandoned, the N contents of the pore wall are assumed to drop as a consequence of leaching and probably N uptake by roots growing through the pore. Furthermore, abandoned earthworm channels can be recolonized by earthworm juveniles or adult earthworms (Kautz et al. 2013b). Hence, the development of pore wall properties must be understood as the consequence of interaction by earthworm and root activity. Whereas large sized biopores are often primarily formed by roots (Kautz et al. 2013b), the quality of the pore wall is a function of pore colonization by earthworms over time.

The lack of correlation between C and N contents in the pore wall and root length in biopores indicates that nutrient contents of the pore wall do not principally determine root length in biopores. Previous studies have shown that reduced mechanical resistance is the main factor driving roots into biopores (Logsdon und Linden 1992). However, pores with N-poor walls often contained very few roots only, whereas high root lengths were generally found in N-rich pores. Thus, our results provide evidence that the properties of the pore wall have an influence on root growth in biopores.

Conclusions

Elevated C and N concentrations in pore walls can facilitate the exploration of the subsoil biopores by crop roots. Provided that the conditions for nutrient uptake from the subsoil are beneficial (e.g. drought or scarcity of nutrients in the topsoil) biopores with pore walls enriched in nutrients can promote nutrient acquisition from the subsoil.

Acknowledgments

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Thinking aloud about sustainable aquaculture products: Consumer perceptions and barriers to communication

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Key words: Sustainable aquaculture products, communication, think aloud protocols

Abstract

Sustainable methods of aquaculture have evolved as a response to negative impacts of overfishing of the oceans and problems associated with conventional aquaculture. The additional ethical and environmental quality of products from sustainable aquaculture is mainly communicated to consumers via labels and claims. However, little is known about how consumers evaluate and interpret the different food labels and claims of sustainably produced aquaculture products. Think aloud protocols and in-depth interviews were applied to gain insights on how consumers evaluate sustainable aquaculture products. Sustainable aquaculture production was generally supported and valued by consumers. Overall, organic aquaculture products were evaluated as being more sustainable; however, consumers mentioned additional criteria which sustainable aquaculture products should fulfill, namely clear labeling of the geographic origin and traditional production. Apart from attributes like origin and production methods other topics like skepticism and knowledge about procedures of aquaculture were impacting consumers' opinion of sustainable aquaculture products.

Introduction

The world fish market has grown substantially over the last years. The increased production of fish was accompanied by several environmental problems, foremost overfishing of the oceans. But also aquaculture is associated with a number of risks, e.g. the introduction of allopathic remedies and nutrients into the biotic system, the escape of bred fish into the wild, and poor animal welfare. These negative impacts of conventional aquaculture are critically evaluated by consumers (Lasner and Hamm 2011).

Sustainable methods of aquaculture have evolved as a response to negative impacts of overfishing of the oceans and problems associated with conventional aquaculture. The additional ethical and environmental quality of products from sustainable aquaculture is mainly communicated to consumers via labels, and claims. However, little is known about how consumers evaluate and interpret the different labels and claims of sustainably produced aquaculture products. This paper presents results of think aloud protocols about consumers' fish-buying decision making and in-depth interviews on consumer preferences for different sustainability labels and claims.

Material and methods

Think aloud protocols are a good method to explore product evaluation processes and decision making of consumers. In a structured laboratory environment, processing information is traced through verbalizations concurrent to performing a given task (Reicks *et al.* 2003). In the present study, a typical buying-situation was simulated. The participants were shown six packages of fish (smoked trout), three of which were organically produced, and three came from conventional aquaculture. The participants had the task to decide which product they preferred most and were asked to concurrently think aloud during the decision process. As this procedure is unnatural to consumers, the data collection was divided into four phases. First, an introduction and orientation to the methodology took place (Phase I). Then, the decision-making and product evaluation proceeded, while the consumer was thinking aloud (Phase II). Afterwards, questions about the production methods and perceived sustainability of the offered aquaculture products served to further probe the decisions made and evaluated the production methods and sustainability of the offered aquaculture products (Phase III). Lastly, in-depth interviews were applied to evaluate frequently used claims[3] and labels for sustainable aquaculture products (Phase IV). In this phase, the following labels were shown to the

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[2]University of Kassel - Department of Food and Agricultural Marketing

[3] The most frequently used claims and labels on the German fish-market were derived from an inventory-study in 30 different retail shops across Germany.

consumers: EU-Organic-Label, German-Organic-Label, Naturland-Label, ASC-Label, WWF-Label, and one company-owned-Label and the following claims were shown: ‘environmental friendly produced’, ‘sustainable aquaculture’, ‘respecting animal welfare’, ‘near-natural aquaculture’, ‘ensuring local employment opportunities’, ‘saves resources’, ‘no use of antibiotics’.

Data collection took place in three different regions of Germany (North, South, East). In every site six consumers were interviewed, resulting in a study population of N=18. Participants had to ensure that they regularly consume fish or seafood before participating. Besides, they had to work outside agriculture or the food industry. Nine consumers should buy organic products (not necessarily fish) regularly, whereas the other nine consumers should not buy organic products frequently. Data was collected by a trained investigator and recorded through an audiotape and a video camera. The obtained data was fully transcribed and analyzed using qualitative content analysis. Data analysis was facilitated using the software MaxQDA©.

Results

Most interviewed consumers were interested in manifold attributes of the aquaculture products, before a decision was made (see table 1). The attribute commented on most often was *Origin*. Consumers wanted to know where the products came from (geographically) and in which company the fish was produced. Most consumers preferred a local or at least German geographic *Origin* of the aquaculture product, since they had trust in the German Veterinary and Food Administration scheme. In addition, short distance of transport was seen as a desirable attribute. However, most of the participants were not able to quickly find the origin of the aquaculture products on the packages. They emphasized that transparent and easily accessible information on product origin was crucial to them. Some consumers also focused on the producing company with regards to product *Origin*. Consumers preferred the origin from smallholder enterprises or from old-established enterprises. Regarding the *Production methods* consumers stated that they were not receiving a lot of information on the product packages. It became clear that some consumers lacked knowledge on aquaculture production in general. They were not able to state which production processes they would prefer. Others, by contrast, were interested in information about feeds, animal welfare, the usage of chemicals, and GMO-free production. *Organic* production of aquaculture products seemed to be very important for some consumers, especially with respect to the sustainability of aquaculture production. Even though most consumers could not specify the criteria for organic production, they associated it with sustainable production. The optical *Appearance of the product packaging* was also very important to consumers. Most consumers preferred a blue packaging, which reminded them of the ‘sea’, ‘lakes’, ‘ponds’, and ‘freshness’. Pictures showing a natural environment in which the fish was produced were favored. However, the consumers also stated that pictures should be realistic and not misleading. *Product Processing* was mentioned frequently, though this mainly involved the type of smoking applied. It became obvious that there was a lack of information about the different smoking methods. *Branding and Certification* were other important product attributes, which helped consumers to gain orientation and to evaluate the product quality quickly. However, several consumers made clear that they only trusted those brands and certificates which are independently certified.

Table 1: Most important attributes and number of coded units

Most important attributes	Number of coded units
Origin	98
Production methods	92
thereof *Organic*	46
Product processing	71
Branding/Certificates	43
Taste	30
Other Product details (e.g. nutrient value)	60

During the data collection it became clear that other topics were also relevant to the decision process. Many of the consumers expressed mistrust towards product labeling, and referred to food scandals and related publications in the media. Most consumers argued that communication and labeling are often not transparent and misleading. Consumers stated further that communication claims are often 'imprecise' or 'meaningless'. Consumers did not know what the claims meant, which disclosed a *Knowledge gap* between consumers and producers regarding the product qualities.

With respect to product sustainability, the majority of consumers evaluated the organic products as sustainable aquaculture products. Sustainable aquaculture products were associated with a production close to 'natural breeding', with 'low environmental damages', it should 'not be a product of mass production', and be of 'local origin'. When asked to evaluate the sustainability of the products, the organic labels were the most recognized and trusted sources of information.

Most sustainability claims, which were discussed in the in-depth interviews, were seen as being imprecise, even though consumers generally had a positive attitude towards ethical and sustainability claims. The claim 'environmental friendly produced', for example, raised the question of criteria and metrics used to measure an environmental friendly production. The same critique arouse for the claims 'sustainable aquaculture', 'ensuring local employment opportunities', and 'saves resources'. Even though consumers generally evaluated the terms positively, they were asking for background criteria. The claim 'respecting animal welfare' unveiled doubts towards the feasibility of an animal friendly aquaculture production. Some consumers could not imagine an animal friendly aquaculture production for economic, technical or logistical reasons. The message 'near-natural aquaculture' was rejected due to a lack of knowledge about the definition of 'near-natural'. In addition, consumers favored a natural upbringing of the fish, but not a near-natural upbringing. The expression 'no antibiotics' was favored by some. Others, however, were shocked and did not like to associate the topic 'antibiotics' with foods. The message could even lead to avoiding the consumption of fish in general. Overall, consumers demanded more detailed information and transparency along the whole production chain.

The German-Organic-Label was the most recognized label, followed by the WWF-Label, the Naturland-Label, the EU-Label and the company-owned label. The ASC-Label was unknown by all of the participants.

Conclusion

In order to communicate the value of sustainable aquaculture products the knowledge gap between consumers and producers about the production processes needs to be bridged. Consumers prefer local aquaculture production and a clear labeling of the product origin. Communication should therefore include information about the origin of the aquaculture product and, at best, the whole production chain. All information on product packages should be easily accessible to consumers. Claims about sustainability should be precise and certification schemes must be trustworthy.

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Biogas in Organic Agriculture: Utopia, Dead-End or Role Model? – A Synopsis

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Key words: Anaerobic digestion, Organic agriculture, Evaluation framework, biogas

Abstract

Present-day organic biogas production provokes controversy of its role between the poles of societal demands, principles of organic agriculture and economic constraints. By integrating multiple arguments on organic biogas in a meta-level, several future trends are identified. However, only one option seems reasonable, where anaerobic digestion on a confined scale, mainly based on residual substrate input, serves both energy and food security demands while enhancing the productivity of organic farming systems.

Introduction

Aiming to implement the concept of energy self-sufficiency organic farming operations were amongst the first to develop adapted biogas systems (anaerobic digestion, AD) (Anspach *et al.* 2010). Regarding *e.g.* Central Europe, a general biogas boom resulted from the institutional stimulation towards an increased supply with renewable energy, involving massive financial promotion. Likewise an expansion of organic biogas generation with dramatically changing structures towards larger-scaled biogas plants was induced. This process triggered a controversial discussion on both the present and future role of biogas production in organic agriculture (OA). Arguments touch on the fundamental principles and self-conception of OA, *e.g.* the production of food *vs.* bioenergy commodities (Braun-Keller 2012), adressing the problem of regional land use competition as well as indirect land use changes (ILUC) on a global scale (FAO 2010). Another example is the idea of a preferably closed farming cycle, while increasingly externally purchased conventional co-subtrates are applied in organic biogas production (Siegmeier *et al.* 2011). Among other points the effects on humus reproduction and soil life (*e.g.* Möller 2009) are discussed. This paper systematically elicits for different settings, if AD actually contradicts the core ideas of OA, or, on the contrary, might be a valuable component of progressive organic farming systems. Trade-offs of OA objectives and thresholds between sense and nonsense of organic biogas systems are discussed.

Material and methods

On a meta-level, organic biogas production is systematically integrated in the area of conflicts between OA principles, societal demands and economic constraints, in order to establish an evaluation framework to assess the future role of anaerobic digestion in OA. As basis for the framework setup an overview of the diverse aspects of biogas production in OA including arguments and statements from multiple stakeholders (relevant literature, experts, growers associations, scientists) is provided.

Results and Discussion

In the beginnings of anaerobic digestion in OA small-scaled biogas plants fed with animal excreta and herbal residues particularly served the purpose of energy self-sufficiency, and therefore envisioned the organic principle of a preferably closed farming cycle. With increased subsidization of biogas production and subsequent growing plant sizes numerous controversial arguments emerged relating to fundamental organic principles as well as agronomic and ethical concerns. These parameters of controversy, as discussed below, can be associated to three major levels of challenges as part of an evaluation framework for organic biogas production, i.e. i.) society´s demands on sustainable energy and food production, ii.) compatibility with the principles of OA and iii.) production economic potentials and constraints on the farm level (Fig. 1).

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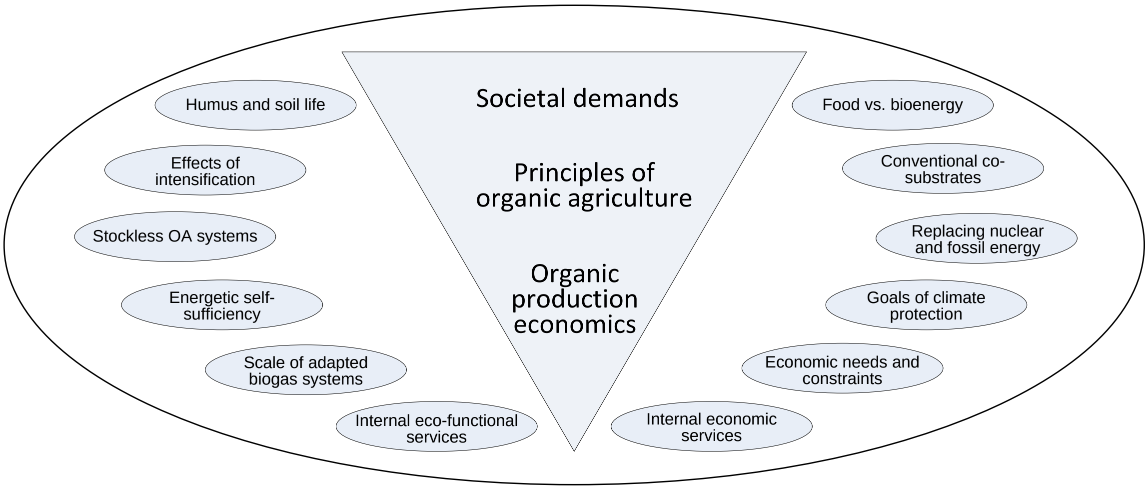

Fig. 1: Levels of challenges (within triangle) and associated parameters of controversy of organic biogas production

One crucial parameter, touching upon all three identified levels, is the **increased use of conventional co-substrates in organic biogas production**. Indeed, by now more than half of the analyzed organic biogas plants in Germany use conventionally produced co-substrates, and 80 % of the installed electrical performance (kW_{el}) is produced with the help of conventional co-substrates (Siegmeier *et al.* 2011). Reasons for this trend can be seen in i.) bad planning of biogas plants too large for the exclusive use of internal substrates or even ii.) deliberate planning to enhance methane and economic yields by using low-cost substrates. Concerning the levels of OA principles and societal response, the intensified use of conventional substrates contradicts the organic idea of a preferably closed farm cycle, negatively influences customer perception concerning organic biogas production and threatens credibility of organic agriculture in general. In summary, the exclusive focus on economic advantages with the tendency of conventionalization of organic biogas production does not seem a viable future option.

One of the most discussed arguments concerning biogas in OA is the **precendence of food vs. energy production**. Here, society´s needs to saturate its rising hunger for energy through increased proportions of renewable biomass resources contradicts the rising need for food and the principles of OA with its focus on food production. Even though organic farming enterprises so far are faced only locally with the competition for agricultural land with (conventional) biogas plants, if political circumstances furthermore heavily promote biogas production, a strong competition between land for organically produced food and bioenergy substrates will prevail. This will lead to a replacement of organically managed cropland, since maximum payable rents for most organic farming systems are estimated below conventional substrate production systems (Meyer & Priefer 2012). In order to promote both organic farming and biogas generation and avoid trade-offs, one of the most crucial preconditions is the increased exhaustion of residual materials for biogas generation, which does not contradict but even sensibly complements food production.

Other concerns particularly relating to the level of OA principles refer *e.g.* to the **degradation of carbon compounds** during fermentation and subsequent methane (CH_4) generation, since it is feared to have **negative effects on soil humus cycles** and supply. In terms of production economics this may require efforts to keep a stable humus balance. In addition, the composition of biogas digestates with a higher ammonium ratio of the nitrogen (N) fraction compared to unfermented slurry is suspected to have negative effects on soil life, in particular earth worm populations. Literature review on these topics is heterogeneous and does not allow for a definite positive or negative evaluation. Results show a tendency, however, that soil humus supply under a biogas slurry fertilizing regime can be sufficient to sustain or even enhance soil humus supply in the long run (*e.g.* Möller 2009). Furthermore, although biogas digestate fertilization can alter the distribution of earthworm species, it is unlikely to negatively affect the total earthworm population (Dominguez 2012). Another argument implies the fear that the higher content of ammonia in the biogas digestates has negative effects on plant health due to its characteristics which are more similar to mineral fertilizers used in conventional agriculture, contradicting OA principles. Looked at from another perspective, however, the **integration of biogas** generation with an intelligent use of biogas digestates **can** (in both stock-keeping and especially stockless organic farming systems) **contribute to the goal of an *eco-functional intensification* of organic agriculture** (Niggli *et al.* 2008). In times of increasingly scarce resources, an integrated biogas approach can achieve both a secured (organic) food supply and a secured provision of ecosystem services by a more efficient nutrient management and therefore sustained or even enhanced productivity (Stinner *et al.* 2008, Möller *et al.* 2008). Performance enhancing systematic effects particularly comprise improved nutrient efficiency through a better spatiotemporal allocation accompanied by an enhanced nitrogen (N) availability of biogas digestates. This can lead to increased yields and product quality (grain protein content) as well as changes in crop rotation towards more N-affine crops, resulting in a better market performance of the whole crop rotation. Instead of mulching herbal residues (*e.g.* in stockless systems) their bioenergetic use increases value-added as well as N_2 fixation of legumes by up to 20 % and supports climate protection goals through reduced N_2O emissions (Stinner *et al.* 2008). Potential phytosanitary effects through weed seed reduction during fermentation or enhanced plant health through more diversified crop rotations are harder to quantify but possible outcomes. Biogas produced on organic substrates so far does not realize a premium organic market prize. Rather than being contradictory to OA principles and society´s needs for food, the integration of biogas in organic farms can therefore help to restore economic sustainability of the whole farming system through an enhanced productivity of food production.

Conclusions

Assessing the above established evaluation framework, conclusions on the future role of organic biogas production are drawn as follows. Even though appropriately integrated organic biogas production can be a reasonable option for organic farming systems, the scarcity of land resources worldwide makes it **utopian** to assume that organic biogas production could provide a substantial contribution to the worlds energy needs based on renewable energy resources. Lower yields at higher costs and land area needs prohibit a vast expansion of organically produced energy crops. In order to attain the goal of independence from fossil or nuclear energy resources an energy mix of solar, wind, biomass and hydro power is needed. Considering the scarcity of agricultural land for food production the „conventionalization“ of organic biogas production cannot be a reasonable future option (**dead-end**). This would include massive cultivation of energy substrates comprising large transport distances and degradation of soil and biodiversity, leading to aggravated competition for land resources, not only locally but worldwide (ILUC). In addition, this form of bioenergy production would deeply undermine the credibility of organic farming systems both for producers and consumers. Especially considering Central European conditions, the only reasonable practice for organic biogas production (**role model**) seems to be a holistic integrated approach considering a balanced focus on both food production and contribution to increasing energy demands, comprising adapted biogas concepts (meaning small to medium scale, including inter-farm co-operations) with primarily using residues and a moderate and ecologically sound cultivation of energy crops. This approach appears to be able to stabilize both food and energy supply as well as organic farms in general by distributing the entrepreneurial risk through diversification and long-term assurance of productivity without abstaining from secured or even enhanced soil fertility.

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Growth, business logic and trust in organic food chains: an analytical framework and some illustrative examples from Germany

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Key words: organic, food, growth, business, strategy, Germany

Abstract

The organic food market in Germany has been growing significantly. While expanding, businesses and food initiatives face challenges. The paper focuses on the challenge of maintaining the added values of organic farming and consumer trust. Both are key assets in organic food chains, and both are difficult to secure when volumes grow and distribution channels change. When producers, processors, sales businesses and consumers are less closely connected, direct communication and transparency tends to be limited. We present an analytical framework that can be used to better understand these connections. Focus is on changes in business logic and chain organisation. Three case studies of organic value chains in Germany are used to illustrate the application of the framework. The analyses indicate that business logic and management and marketing instruments tend to be adapted in processes of growth, and that these adaptations can have a major impact on the organisation of the businesses, the linkages between chain partners as well as communication and marketing.

Introduction

The German market for organic products is growing significantly. Since 2000, the volume of organic sales has tripled, reaching 7 billion Euros in 2012. Maintaining consumers' trust is essential for businesses and food initiatives – in general and in particular during periods of rapid growth. This paper addresses the related challenges in terms of business logic, strategies and instruments. It presents an analytical framework that helps to answer the following questions:

- What business logic, strategies and instruments are used by businesses and initiatives for managing 'added organic value' and trust?
- How are business logic and strategies changing in times of rapid growth in turnover?
- What strategies and instruments are used for securing the added values of organic farming? In other words, how is growth successfully managed?

The particular focus of this paper is on the connections between producers, processors, sales businesses and consumers, and the way they are managed. In this respect, the analysis goes far beyond simply an analysis of marketing strategies. An analytical framework is presented that can be used to better understand business logic, chain organisation and coordination. It is illustrated through three case studies in Germany.

Background

The growth process of the German organic food market was so significant that 3.5% of total food expenditures and 3.9% of total agricultural sales were organic in 2012 (Koepke et al. 2013). However, the organic land area grew at a slower pace with only +50% from 2004 to 2011 (Koepke et al. 2013). The increasing demand for organic food and the growing gap between consumption and domestic production contributed to the development of much more globalised organic market structures (Koepke et al. 2013). Large-scale chains and operations mean that larger volumes can be provided. The development of larger and more globally integrated structures also means that the 'distance' between producers, processors, sales businesses and consumers has increased significantly. Large chains tend to provide standard qualities with a related loss in 'added organic value'. Other critical factors are anonymisation and lack of transparency (Baum 2013).

Recent events throughout Europe, such as elevated dioxin levels in organic eggs in 2012, EHEC germs on organic sprouts in 2011 and below base rate wages of an organic retail business in 2010 have arguably contributed to a growing scepticism toward the mainstream organic food system. Simultaneously, the progressive conventionalisation of the organic sector, especially in the processing and marketing structures,

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has become controversially discussed in the media. These major organic food scandals and the general decrease in trust found in related surveys are an expression of the fact that the communication along the chain is no longer optimal and demonstrates that chains have become less transparent. The Oekobarometer 2013, a survey conducted by the Federal Programme for Organic and Sustainable Forms of Agriculture (BOELN), analyses market trends and consumer views:

- This year elderly consumers bought less organic foods than last year: in 2012, 26% of the 50 to 59 year old consumers purchased organic food regularly, but this group decreased significantly to only 19% in 2013. In addition, the share of elderly consumers who stated that they will never buy organic increased (+9 percentage points.).
- Nineteen percent of all interviewees refuse to purchase organic products which are four percentage points higher than in the preceding year. (BOELN 2013)
- The regional origin of food products is of increasing importance for the elderly consumers (BOELN 2013). There are indications that the reason for this shift is an increasing lack of trust in organic food within at least this consumers group.
- The Oekobarometer ranks the motives for organic purchases as follows: firstly, regional origin of food products with 87% of all interviewees; secondly, animal welfare with 85%, and thirdly, a low level pesticide contamination with 83%. More than half of organic consumers (59%) buy organic due to the lower number of food scandals but this figure has been shrinking from last year (-5 percentage points) (BOELN 2013).

Organic products are sometimes characterized as “trust goods” because the consumer does not have the skills or the information to fully evaluate the quality of the goods (Wieland et al. 2012). The assumption is that the additional value of organic products (positive impact on biodiversity, reduced impact on water qualities etc.) is implemented through the business logic and the business strategies. The challenge is to maintain, and communicate, these values along the entire chain from the producer to the consumer. Organic food businesses with their original claim of shared values seem to be predestined for business and management logic that go beyond pure profiteering. Such an approach is described by Porter and Kramer (2011) as "creating shared value" which involves creating economic value in a way that also creates value for society. Shared value opportunities can be realised by a) reconfiguring products and markets, b) redefining productivity in the value chain and c) enabling local cluster development. Value chain business logic place emphasis on both, the values associated with the particular food quality and the values associated with the quality of business relationships within the chain (Stevenson et al. 2011).

Methodology

Two levels need to be distinguished in order to improve our understanding of the related processes and mechanisms: first, the business logic and second, the business strategy and the instruments used for the implementation of the particular strategy. A basic condition is that businesses and initiatives have to be economically viable in the long term, i.e. they need to (re)cover their full costs and ensure a minimum level of liquidity (economic sustainability). Additional strategic orientations and aspects vary between cases. They could for example be:

- differentiation in the 'market place' via particular product or process attributes,
- altruistic motivations influencing the business logic vis-à-vis profit maximisation goals,
- minimisation of 'distance', in particular between producer and consumer,
- local or regional embedding of business or initiative.

Differentiation in the 'market place' is probably the most common strategy but the other three can also be found. The implementation of the business strategy and its evolution during the growth process is also important. A range of instruments is used for the implementation of business strategies. Contracts and strategic alliances, for example, might often play a key role.

The application of the analytical framework uses business and chain level data. Different data sources will often need to be combined. The main data sources are (in order of importance): interviews with key actors, annual business reports and business communications, and a workshop with decision-makers from the chain's initiatives and/or businesses. The data gathered allows for the identification, description and assessment of business logic and management concepts as well as strategies and instruments.

Illustration of the application of the framework

The business logic tends to be grounded in and representative of the entrepreneur's value system and or an initiative's over-arching and unifying idea like product or process differentiation. It drives the development of the organic chain.

Table 1 shows how the business logic is supported by a business strategy which in turn is expressed in the kinds of instruments used, such as local labelling, animal welfare, artisanal production, the conservation of old varieties, adherence to social or ecological standards etc. Altruistic motivations, for example, can be expressed in paying above average wages or prices; or by providing particular support to small business partners.

High expectations rest on local or regional organic food as a way to reconnect producers and consumers (Padel et al. 2010). German consumers tend to relate organic with regional (BMELV 2013). This is a challenge for organic food chains that grow out of the local (niche) market. The minimisation of distances or local embeddedness is – if applicable for the particular business – often chosen as the business strategy.

Table 1: Examples of business strategies and related instruments

Business logic	Business strategy	Instruments used in implementation
Differentiation in the 'market place'	Process quality	Local labelling based on tagging of vegetable boxes, ear-tag numbers on meat; participation at the Marine Stewardship Council etc.
Altruistic motivations	Fairness between chain partners	Higher product prices for farmers; Higher wages for employees and other contracts within businesses/initiatives and between chain partners
Minimisation of 'distance'	Low impact on climate change	CO_2 footprint; 'food miles'; local/regional labelling; regional window (*'Regionalfenster'*) etc.
Local embedding	Product origin "from the neighbourhood"	Local labelling, information on primary producers on produce, only typical products of the region, sponsoring of regional/local sports clubs or cultural events

Table 2 contains three cases of organic value chains in Germany that illustrate the application of the framework. In all three cases, it is a declared aim to maintain the added organic values. Well-working cooperation and communication within businesses and between chain partners is a key factor. The instruments supporting the cooperation between the members of the chain (e.g. contracting, integration of nodes, communication/marketing tools) and the internal organisation of the businesses or initiatives such as participation of employees in decision-making or the management structure are highly relevant for securing organic values and trust.

Table 2: Illustration of business strategies and their implementation for three cases

Case study	Business logic	Business strategy	Characteristics of the chain
I: Healthy/ wellness food: Herbal tea production and marketing	Very strong focus on consumers' wellbeing ('feel fit and healthy')	"Growing together": close cooperation between product development (health experts), plant production, processing and marketing	Short chain, niche market, "reliable" partnerships within the chain, strict control routines, transparency through the chain and of cooperations, good/open communication
II: Retailer: Organic supermarket	Local embedding, fairness between consumer and producer	"Regionality"; producers and consumers cooperate	Association of producers, contracted deliveries, risk reduction for farmers, stable group of costumers, transparency of producer prices
III: Processor: mill and bakery	Fairness between farms and processor; high quality products and processes	"Openness"; open for internal improvement, new ideas	Fairness between primary producer and processor (contracting), daily processing, professional supply for organic bakeries, proven hygiene standards, fresh delivery

The three cases represent successful organic food chains that have gone through a significant development process in the past. Two of the cases have grown from local niche production to businesses handling significant volumes. The development was successful due to clearly defined business strategies aiming to realise and ensure the distinct values adapted to the chain and the type of product. The analysis shows that successfully grown organic food chains have managed to adapt management strategies and instruments to the new requirements while at the same time continuing to emphasise the process and product quality, differentiation in the market-place, and engagement with consumers' interests and views.

The application of the analytical framework helps to better understand business logic, business strategy, and the related instruments which can differ significantly between chains. It also supports learning from those businesses and chains that have managed the growth process successfully. Based on this understanding and information, small food businesses and initiative can improve their own business strategy and use of instruments. Stakeholders in the field of organic food production, processing, and marketing (such as organic food associations, and organisations) can also profit from the analysis of business logic and strategies resulting from a better understanding of the particular challenges and the instruments for managing growth processes in the organic food sector.

Conclusion

The way business logic, strategies and instruments change in periods of (rapid) growth is a highly relevant success factor at business, chain and sector levels. Business logic and strategies are expressed in the connections between producers, processors, sales businesses and consumers, and in the way they are managed. Therefore the related analyses need to go far beyond simply an analysis of marketing and communication strategies. The analyses illustrate how business logic and strategies are implemented through a particular set of management and/or marketing instruments and how they drive the internal organisation of the chains, as well as individual businesses. Business logic and management concepts differ from chain to chain; they impact on decision-making and shape the evolution of organic food value chains. The analyses highlight that business logic, strategies and instruments are critically important for an improved understanding of the development of the organic sector.

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From organic principles to wider application and a resilient agriculture: a reflections paper

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Key words: agriculture, resources, sustainability, organic, principles, resilience

Abstract

Planetary boundaries are exceeded in many ways and major transformations are needed in economic systems and lifestyles - in particular in the industrialized world. Can organic farming principles be applied more widely and help to make agricultural systems more resilient? How relevant are they to the challenges the agricultural sector faces today? If relevant and effective, why are they not more widely applied? In this paper contemporary challenges of agriculture are related to organic farming principles and practices. In the concluding section reference is made to those factors that seem to limit the application of the particular principles and practices. Reference is made to policy and market failure, information deficits and the widespread misconceptions around 'modernization', innovation and efficiency.

Introduction: conventional agriculture in crisis

The declining resources of critical input factors and exceeding of the buffer capacity of natural systems will in particular affect contemporary industrialized, high-input-high-output agriculture. Key references are OECD's (2012) Environmental Outlook 2050, the assessments published by the European Environmental Agency (EEA 2010), IPCC (2007) and the Millennium Ecosystems Assessment (2005). The SCAR (2012) and IAASTD (2009) reports emphasize that there are also massive economic and social problems affecting the agricultural sector. All in all, it is clear that business as usual and improvements in resource use efficiency alone won't be sufficient.

Can organic farming principles be applied more widely and help to make agricultural systems more resilient? How relevant are they to the challenges the agricultural sector faces today? If relevant and effective, why are they not more widely applied? In the related discussions there has always been a tension between longer-term perspectives and continuity on the one hand, and the need to adapt on the other. The balancing of the two leads us directly to the resilience concept which means adaptive capacity, adaptation and continuity at the same time. And of course there always is also a tension between fundamental principles and individual management skills, knowledge, experience and context-dependence that determines place-based practice. Again it is the balancing of the two that matters.

In this paper I will first have a very brief look at the origins and principles of organic farming. This will be followed by a clarification of the terms sustainability and resilience and a brief discussion of contemporary challenges against the background of organic farming principles and practices. In the concluding section reference is made to those factors that seem to limit a wide application of the particular principles and practices. Reference is made to policy and market failure, information deficits and the widespread misconceptions around modernization and efficiency that cause many contemporary problems. The same failures and deficits also affect the further development of organic farming which is why they need to be discussed much more explicitly.

Organic farming: pioneers and principles

Present organic agriculture practice has been evolving over far more than a century. Soil biologists developed first theories on how advancements in science could be used in agriculture as early as the late 1800s. Rudolf Steiner's Lectures on Agriculture were published in 1925, and Sir Albert Howard was the first to apply scientific principles to traditional and more natural methods in the 1940s. At about the same time J. I. Rodale started an organic farm for trials and experimentation in the US while Lady Eve Balfour was experimenting with organic practices in the UK. The overarching goal of organic farming is today defined by IFOAM as *"a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions."*

It is embodied in the following four principles (based on IFOAM; shortened):

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(1) **The principle of health**: Agriculture should *"sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible"*. This principle points out that healthy soils produce healthy crops that foster the health of animals and people. Immunity, resilience and regeneration are key characteristics of health. Farming practice is to sustain and enhance the health of ecosystems and organisms. In view of this it should avoid the use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects.

(2) **The principle of ecology**: Agriculture should *"be based on living ecological systems and cycles, work with them, emulate them and help sustain them"*. This principle roots agriculture within living ecological systems: nourishment and well-being are achieved through the ecology of the specific production environment. Management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to conserve resources. Ecological balance should be attained through the design of farming systems and maintenance of genetic and agricultural diversity. Production, processing, trade and consumption are to benefit landscapes, climate, habitats, biodiversity, air and water.

(3) **The principle of fairness**: Agriculture should *"build on relationships that ensure fairness with regard to the common environment and life opportunities."* Fairness is characterized by "*equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings"*. Agriculture should provide farmers, workers, processors, distributors, traders and consumers with a good quality of life, and contribute to food sovereignty and reduction of poverty. Animals should be provided with the conditions that accord with their well-being. Natural resources should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Systems of production, distribution and trade are to be open and equitable and account for real environmental and social costs.

(4) **The principle of care**: Agriculture should *"be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment."* The enhancement of efficiency and of productivity should not be at the risk of jeopardizing health and well-being. Given the incomplete understanding of ecosystems, care must be taken. Precaution and responsibility are key concerns in management and technology choices. Scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions. Decisions in particular regarding technologies and risks should reflect the values and needs of all who might be affected, through transparent and participatory processes.

All four principles can be seen as equally important. They complement and reinforce each other and they are described by IFOAM (2013) as "*the roots from which organic agriculture grows and develops"*. They *"concern the way people interact with living landscapes, relate to one another and shape the legacy of future generations."*

From principles to wider application and agricultural resilience

The resilience concept emphasizes the capacity of a socio-ecological system to respond to disturbance, resist damage and recover quickly. The importance of resilience as a conceptual framework is rapidly increasing with the more complex challenges and increasing uncertainty, in particular the rapidly changing climatic conditions. Resilience goes beyond sustainability defined by the Brundtland Commission (1987) in terms of the needs of present and future generations. Sustainability is a description of goals that comprise environmental, social equity and economic dimensions, the three pillars of sustainability. Both concepts are complementary but for the discussion in this paper, system resilience is the more meaningful concept.

Table 1 relates the problems faced in contemporary agriculture to the relevant organic farming principles and practices. In the last column it is tried to identify those factors that limit a wider application of the particular principles. The information given in the table is seen as exploratory and a discussion starter, it is not meant to be complete.

Table 1: Problems, relevant practice(s) and factor(s) limiting a wider application

Problems faced in contemporary agriculture	Related practice(s)	Factor(s) limiting a wider application
Pollution (pesticides, nutrients), GHG emissions	• soil building, nutrient cycling, nitrogen fixation • locally adapted, resistant plant & animal species • limitation of pesticide, fertilizer & antibiotics use • carbon sequestration through soil building	Market failure Policy failure Insufficient information
Intense use of non-renewable resources and fossil fuels, unbalanced sharing of global level resources	• efficient use of on-site resources • improved soil structure & fertility • efficient use of on-site resources • lower use of non-renewable resources	Market failure Policy failure Insufficient information
Biodiversity loss, monotone production landscapes	• wider crop rotations & genetic diversity • soil biology and maintenance of landscape elements and natural habitats	Policy failure Insufficient information
Animal welfare and health deficits	• husbandry practices that meet the specific behavioural needs of animals & particular livestock species • use of free-range, open-air systems	Policy failure Insufficient information
Standardized production & low producer prices, path dependency, limited adaptive capacity, indebtedness, dependency on farm input suppliers, pressure & stress among farmers	• more diversified farming systems • less capital-intensive, specialized systems • better consumer-producer relations & fairness in food chains • taking advantage of on-site resources, such as livestock manure for farm fertilizer	Market failure Policy failure Insufficient information Concentration in processing and retail

Conclusions

The table indicates that the core ideas of organic agriculture are extremely relevant to the problems the agricultural sector faces today, and that this relevance goes far beyond environmental issues. It is a mistake not to take the essence of organic farming principles much more into account in addressing the problems faced by contemporary agriculture. A particular strength of organic farming is that it builds on natural systems and ecosystem services, which allows harnessing synergies. Organic agriculture actually tries to *"work with nature"* instead of trying to achieve full systems control – which makes a lot of sense in times of increasing resource scarcities (Kasperczyk and Knickel 2006).The more recent discussions around ecological or eco-functional intensification might be an indication of a change (and even a paradigm shift).

So far, however, there is very little discussion of the social and ethical goals ex-pressed in the fairness principle. The socio-economic situation of farmers and in the food sector as a whole is far from satisfactory in spite of massive subsidies. To adopt a longer-term, societal and fairness perspective would change policy orientations significantly. Market failure, policy failure and the extreme concentration in processing and retail are key factors aggravated by information deficits and widespread misconceptions around 'modernization'. Many farms considered 'modern' are highly path-dependent – and vulnerable – because of the amounts of money invested in particular lines of production, production systems and technologies, and the resulting narrowing of management options. Adaptive capacity, the efficiency of the use of natural resources and favourable higher level system combinations and links (like between crop and livestock production) appear very much undervalued (Knickel et al. 2013).

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Complete references can be made available upon request.

Influence of Reduced Tillage and Green Manures on Weed Emergence and Yield in Organic Farming (TILMAN-ORG SESSION)

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Key words: *Avena sativa*, chisel, direct drilling, disc harrow, no-till, *Vicia sativa*

Abstract

If farmers want to use reduced tillage in organic agriculture, they often face great challenges in weed control. One goal of the European research project TILMAN ORG (www.tilman-org.net) was to develop a more efficient weed management and increased biodiversity through improved use of green manures in different systems of reduced tillage.

In a repeated one year trial on the research farm of University of Kassel the effects of different green manure species and different tillage systems on weed cover, density and biomass as well as yield of a subsequent main crop were examined. Sinapis alba, Trifolium resupinatum and Vicia sativa were tested as green manure species. Bare fallow served as control. After the green manures the main crop oat was sown in four different tillage systems: (1) plough, (2) chisel (2011/12) or disc harrow (2012/13), (3) mulching + drilling and (4) direct drilling.

In 2011/12, weed cover was generally low in the plough system compared to the other tillage systems. In the mulching + drilling- and direct drilling- systems V. sativa was able to suppress weeds considerably more efficiently than the other green manure treatments. The oat plots after the green manure species S. alba and T. resupinatum as well as the bare fallow had to be given up because weed pressure was too high. Instead, the oat yield in the mulching + drilling- and direct drilling treatments after green manure species V. sativa resulted in oat yields similar to the plough treatments. In the chisel system, oat yield in the V. sativa treatment was significantly higher than in the other green manure treatments. 2012/13 all mulching + drilling- and direct drilling- plots had to be given up because of too high weed pressure. In the disc harrow– system weed pressure differed not significantly from the plough system, but only green manure species V. sativa resulted in comparable oat yields.

Introduction

The control of unwanted wild plants is a challenge in organically managed agricultural systems under reduced tillage. If no plough shall be used, instruments for preventative weed management are mainly crop rotation and use of green manures, which may suppress weeds because of competitive power (Bàrberi 2002, Peigné *et al*. 2007, Shresta *et al*. 2001). One aim of this research project in the context of the European ERA-Net Core Organic II (www.tilman-org.net) was to develop an improved weed management in systems with reduced tillage through efficient use of green manures.

Material and methods

A repeated one year trial (2011/12 and 2012/13) was established on the experimental farm of University of Kassel, Domaene Frankenhausen (51.5 N; 9.4 E; 689 mm; 8.5ºC). The soil is a Haplic Luvisol (Ut4). The trial was designed as a two factorial (green manure and tillage) split plot with eight replicates in 2011/12 and four replicates in 2012/13. Eight replicates were needed because no adequate randomization could have been achieved otherwise due to the trial design. Before sowing the green manure the land was prepared with a chisel. The following leguminous and non-leguminous green manure species were sown in both years: *Sinapis alba*, *Trifolium resupinatum* and *Vicia sativa*. Bare fallow served as control. Before sowing the main crop oat four tillage systems were implemented: conventional tillage (plough) was compared to reduced tillage (chisel in 2012, disc harrow in 2013), mulching + drilling and direct drilling ("no-till"). The pre-crop in both years was winter wheat. The sowing dates of the green manures were 26.08.2011 and 22.08.2012. Sowing densities were 20 kg per hectare for *S. alba* as well as for *T. resupinatum*, and 105 kg per hectare for *V. sativa*. Sowing dates for the main crop oat (*Avena sativa* L., *cv*. Scorpion) were 10.04.2012 and

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22.04.2013. Sowing densities were 400 germinable grains in 2012 and 450 germinable grains in 2013. Weed assessments were done as follows (Table 1).

Table 1. Assessments of weeds

Investigation date	Parameters assessed	Number, type and placement of sampling areas
29.03.2012 / 08.04.2013 (= late stage of green manures)	Weed cover by species	One frame of 100 x 100 cm per plot
23.05.2012 / 21.05.2013 (= early stage of main crop oat)	Weed density by species	Four frames of ~31.6 x ~31.6 cm (= 1/10 m²) per plot
11.07.2012 / 16.07.2013 (= late stage of main crop oat)	Weed cover by species + Total weed biomass	One frame of 100 x 100 cm per plot (both on the same area)

Green manures were harvested on 17.11.2011 and 14.11.2012. A square of 1.5 m x 1.5 m (= 2.25 m²) per plot was harvested by hand. Harvest of main crop oat took place on 09.08.2012 and 12.08.2013. In 2012 two frames of 50 cm x 100 cm per plot were harvested by hand, in 2013 four frames of 50 cm x 100 cm. Total biomass yield, grain yield, panicles per m², thousand kernel weight and hectoliter weight were determined. Statistical parameters to describe the distribution of total weed density, total weed cover, total weed biomass, and yield, such as the mean and standard error were calculated. To check for the significance in differences in each parameter, an analysis of variance (ANOVA) was performed, followed by the Tukey-B test. All statistical analyses were done with SPSS-21.

Results

2012 there were no significant differences for weed cover in the green manures. In the main crop oat the results for weed cover showed significant differences for the factor tillage. The plough - system showed significantly lowest weed cover, whereas the direct drilling - system had the highest values. 2013 there were significant differences for weed cover in the green manures. Weed cover in the *V. sativa* plots was significantly the lowest, followed by the *S. alba* and *T. resupinatum* plots. The bare fallow plots had the highest weed cover. In the main crop oat weed cover was significantly lowest in the plough – system and highest in the direct drilling – system like in the previous year.

Regarding weed density the direct drilling- and the mulching + drilling - system had significantly less numerous but taller weeds than the chisel- and the plough – system in 2012. The plough system was showing the highest density. However, weeds were so tall in the direct drilling- and mulching + drilling - system that all plots beside “direct drilling x *V. sativa*” and “mulching + drilling x *V. sativa*” had to be given up. *V. sativa* was the only green manure species capable to suppress weeds to some extent under no-tillage. 2013 the mulching + drilling and direct drilling – system again had significantly less numerous but much taller weeds than the plough – system. In none of these plots the harvest of main crop oat could be carried out because they were overgrown by the weeds. This may be due to inferior green manure emergence, especially of *V. sativa*, compared to the previous year.

In 2012 the significantly highest weed biomass was found in the direct drilling - system (only *V. sativa* – treatment assessable). Ploughing had the lowest total weed biomass in all green manure treatments, while chiseling showed lower weed biomass under the *S. alba* and *V. sativa* green manure treatments. 2013 total weed biomass in the plough – system was low in all green manure treatments, while in the disc harrow – system it was lower in the *V. sativa*- and *S. alba* - treatments than in the *T. resupinatum*- and bare fallow – treatments.

V. sativa was the green manure treatment which gave the highest oat yield in both years. However, yields were acceptable in all plots (among 4 to 6 t/ha) except those that had to be neglected. 2012 Chisel x *V.*

sativa resulted in the significantly highest yields, plough x *S. alba* and chisel x *S. alba* in the lowest. 2013 there was a significant interaction for green manure x tillage. The treatment *V. sativa* x disc harrow was the only disc harrow treatment that gave no yield reduction when compared with the different plough treatments.

Discussion

The results show that in organic farming it is possible to achieve similar oat yields with reduced tillage like with conventional ploughing, if combined with a suitable green manure species, in this case *V. sativa*.

In this respect the positive findings of Wittwer *et al.* (2013) are confirmed, who had in a system with reduced tillage in the *V. sativa* – treatments yields similar to the plough – treatments.

In contrast to the reduced tillage systems the results of the treatments with "no-till" differed from 2012 to 2013. In the mulching and drilling and direct drilling systems, green manure species *V. sativa* showed a sufficient weed suppressing effect and resulted in proper yields 2012, but not 2013. This may be due to the inferior biomass production of the green manures in 2012/13 compared to 2011/12, especially of *V. sativa*.

Compared to the other green manure species in these two trials, *V. sativa* seems to be especially suitable to be combined with reduced tillage in organic farming.

The use of appropriate green manure species may lead to successful systems with reduced tillage in organic farming. The benefits especially for soil fertility, which reduced tillage may entail (Berner *et al.* 2008, Emmerling & Hampl 2002) let tillage without plough as often as possible appear worthwhile.

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Biopore characterization with *in situ* endoscopy: Influence of earthworms on carbon and nitrogen contents

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Key words: drilosphere, pore wall structure, earthworms, carbon, nitrogen, subsoil

Abstract

Biopores have been shown to be enriched with plant available nutrients as compared to the surrounding bulk soil and therefore are considered hot spots for the nutrient acquisition especially in the otherwise nutrient-poor subsoil. However, depending on their individual biography, i.e. colonization by plant roots or earthworms, different nutrient status can be assumed. In this study, individual biopores were characterized with respect to signs of earthworm passage using in situ endoscopy, a non-destructive technique for display of pore wall characteristics. Subsequent sampling and analysis of biopore linings and blockages revealed that only biopores with visible earthworm coatings had significantly higher C and N contents as compared to the surrounding bulk soil. The results of this study highlight the special role of earthworms for enriching biopores with nutrients and underline the value of biopores for the nutrient acquisition from the subsoil.

Introduction

In Organic Agriculture, nutrient management includes strategies for nutrient mobilization from the solid phase of soils. Biopores, generated and used by plant roots and earthworms, provide access to the subsoil. Moreover, they can be considered hot spots for the nutrient acquisition, with favorable biophysical conditions (e.g. less mechanical resistance, higher oxygen content, Stewart et al. 1999) and higher nutrient contents as compared to the surrounding bulk soil (e.g. Graff 1967, Parkin & Berry 1999, Pankhurst et al. 2002). However, depending on their age and history of usage by plant roots and earthworms, individual biopores can differ widely in their physical conditions (Pagenkemper et al. 2014) and in their nutrient status (Kautz et al. in this volume). The objective of the presented study was to examine the effect earthworms have on the nutrient status of biopores, by characterizing individual biopores with respect to a) influence of earthworms and b) carbon and nitrogen contents.

Material and methods

Biopores were sampled in August 2012 in a field experiment on a Haplic Luvisol (WRB) derived from loess (loamy silt) in Klein-Altendorf near Bonn, Germany (50°37'9''N 6°59'29''E, 9.6 °C mean annual temperature, 625 mm annual rainfall). On the plot sampled, spring wheat (*Triticum aestivum* L.) was grown with precrop tall fescue (*Festuca arundinacea* Schreb.) grown for two years consecutively.

Adjacent to a trench of 150 cm depth, on an area of 50 x 50 cm soil was removed down to a depth of 45 cm, creating a plane horizontal surface. On this area, biopores with a diameter > 5 mm were scraped free using a palette-knife and a vacuum cleaner. Afterwards, a sampling area of 30 x 25 cm was marked. All biopores within this area were investigated with a flexible videoscope (Karl Storz GmbH, Tuttlingen, Germany, outer diameter of 3.8 mm, illuminated with a 150 W cold light projector). The endoscope was introduced only up to 1 cm depth to avoid damaging the pore wall.

To characterize the drilosphere with respect to carbon and nitrogen contents, individual biopore linings and soil material inside the pore volume (biopore blockages) were sampled in 45-55 cm soil depth. All biopores within the sampling area were carefully opened from the side of the trench, using small spoons and scrapers. Throughout the sampling area, six bulk soil samples were additionally collected. For all samples, total C and N contents were determined with elementary analysis (Euro EA 3000, HEKAtech, Germany).

Data were submitted to ANOVA followed by Tukey-test at $\alpha = 0.05$.

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Results

Endoscopy images enabled detection of earthworm cast both in biopore linings (Figure 1) and blockages (Figure 2).

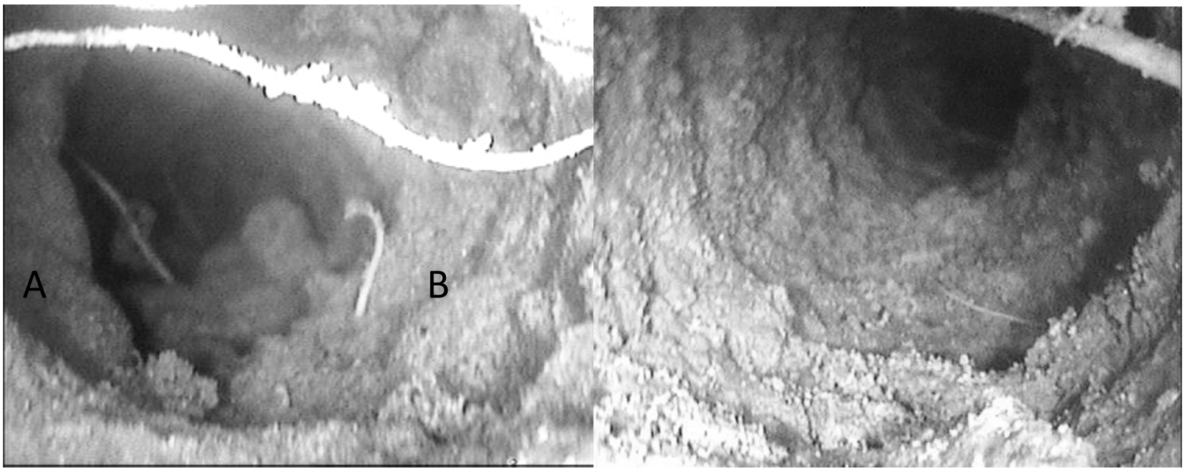

Figure 1. Biopore lined with earthworm cast (A) and biopore lined with material not clearly originating from earthworm cast (B).

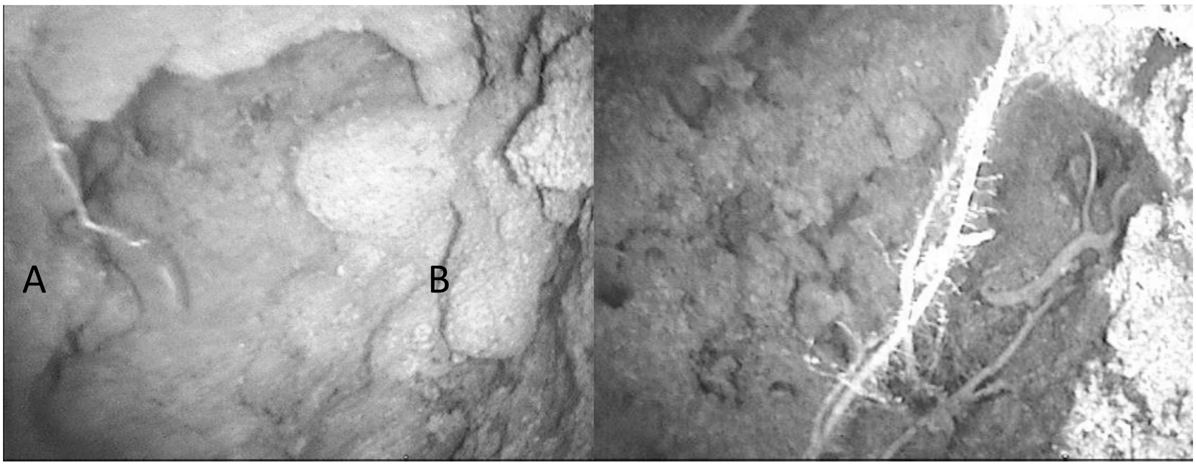

Figure 2. Biopore blocked with earthworm cast (A) and biopore blocked with material not clearly originating from earthworm cast (B).

Within the sampling area, 17 biopores were photographed with the endoscope and sampled. Out of these, 10 were characterized as clearly coated with earthworm cast (biopore+EW), and 7 were characterized as not clearly coated with earthworm cast (biopore-EW). Both for C- and N-content, only the pores with clearly visible earthworm coatings showed significantly higher values as compared to the bulk soil (Figure 3). Biopores-EW ranged for all three parameters in between biopores+EW and the bulk soil.

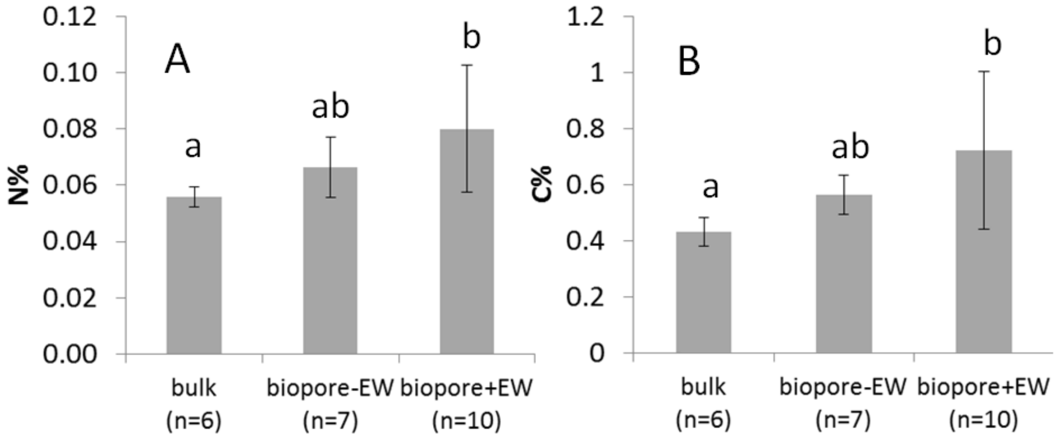

Figure 3. N-contents (A) and C-contents (B) in bulk soil and biopores according to endoscopy images. Biopore+EW: clearly coated with earthworm cast, biopore-EW: not clearly coated with earthworm cast. Different letters indicate significant differences (Tukey-test, α = 0.05). Error bars represent standard deviation.

Discussion

At the site under study, two years of continuous cultivation of tall fescue as compared to one year resulted in a significant increase in the population of anecic earthworms (Kautz et al. 2011). However, in the presented study recent earthworm coatings were visible only in about 60% of all biopores investigated. The site under study is conventionally managed. It is possible that under organic management, with longer periods of soil rest e.g. under grass clover and more organic residues on the soil surface, the population of earthworms would increase even more on the long run, with consequently more pores exhibiting signs of earthworm influence and possibly also higher nutrient contents of pore walls and blockages.

The variation of C- and N-contents in biopores+EW was comparatively high and there was no significant difference of C- and N-contents between biopores+EW and biopores-EW. Obviously, the earthworm casts in biopores+EW were heterogeneously distributed over the pore wall or pores with older earthworm casts, already depleted in C and N, were classified as biopore+EW.

Earthworms can modify biopore properties considerably. After earthworm passage, Pagenkemper et al. (2014) detected changes in the physical properties of biopores, e.g. increasing path lengths, widths and connectivity, with possible implications for root growth in biopores and consequently nutrient uptake. Kautz et al. (2014) found that at the site under study, earthworms prefer colonizing existing biopores – thereby increasing nutrient contents of pore walls and blockages, as shown in our study.

Nutrient contents of biopore walls are relevant for nutrient acquisition from the subsoil: Athmann et al. (2013) showed that roots in biopores establish contact to the pore wall in most cases, i.e. that they can profit from nutrient enrichment of biopore linings and blockages. Furthermore, roots show a preference for nutrient rich pores (Kautz et al. in this volume).

Conclusions

The results of this study suggest that promotion of anecic earthworms contributes to enrich biopores with nutrients. Apart from the total number of biopores, the properties of individual biopores are presumably also relevant for the nutrient acquisition. Therefore, management strategies in organic farming should focus on increasing both biopore quantity (e.g. by cultivation of taprooted precrops) and quality, via promotion of anecic earthworms. More research is needed on usage of biopores by plant roots and earthworms, including nutrient mobilization and acquisition processes inside and around biopores and interaction of plant roots and earthworms.

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Measurement methods on pastures and their use in environmental life-cycle assessment

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Key words: grazing intake, dairy, global warming potential

Abstract

Measurements of the variable feed offer at pasture plots with a rising plate meter provide a data basis to improve grazing and pasture management. Calculating grazing intake by the use of regrowth values of biomass of temporally ungrazed pastures might be a practical and fast alternative to measurements with exclosure cages. On the explored pasture plots high differences in the dry matter intake of the cows were found. Optimizing pasture yields, e. g. by sward improvements and grazing management, offers chances to reduce environmental burdens of milk production. Every kg DM grass silage that is substituted by grazing intake reduces the global warming potential of milk production. Site specific potential was 1.5 % per kg ECM from calculations with a complete farm model. Further reductions by improving feeding management and food quality are anticipated.

Introduction

A total of 70 % of the world's agricultural area is covered by grassland (FAO 2008). It is an important and energy extensive feed source for livestock and good pasture management is required to maintain its productivity. Due to the selective grazing behavior of dairy cows and site and management related sward variability it is difficult to estimate pasture yield or pasture intake. A proper estimation of feed intake of animals on grassland enables the farmer to appropriately manage his pastures. This paper presents a fast and easy-to-use method to estimate pasture intake without exclosure cages. These data are used to describe material flows from grassland. Subsequently environmental impacts of an improved grazing management based on the whole farm process are calculated with the flow model FARM that is designed to conduct life-cycle assessments (LCA) of farm products.

Material and methods

Data were collected on the experimental station of the Thünen-Institute of Organic Farming, Trenthorst in Northern Germany (53°46' N, 10°30' E; 10-43 m asl). For the dairy branch of the station an area of 37 hectare is used as permanent grassland for grazing, silage making and hay cutting. The farm converted from conventional to organic farming in 2001. Mean annual precipitation is 706 mm and mean annual temperature is 8.8°C (1978-2007). In 2012 precipitation was as low as 534 mm, which is 34% lower than average. The soils of the permanent grassland are characterized as Cambisols and Luvisols. On the grassland, a mixture of grass, legumes (mostly Trifolium repens) and herbaceous plants is growing in different proportions. In 2012 the dairy cows (Black Holstein and Red Holstein double usage) grazed approximately 7 hours a day from 24th of April until 7th of October. The permanent grassland is divided into 13 plots (mean size 2.66 ha) and managed by rotational grazing with a duration of 2-10 days per plot. To estimate the pasture intake on a dry matter basis following formula (1) is used: (biomass before grazing – biomass after grazing) + (daily growth rate x days of grazing). The biomass before and after grazing is measured at four representative GPS-located points per pasture plot (Fig. 1, left). The biomass was determined directly by cutting 0.5 m x 1 m to 1 cm above ground level, which took around 20 minutes per plot. The dry matter yield was determined by drying the biomass (24 h, 60°C).

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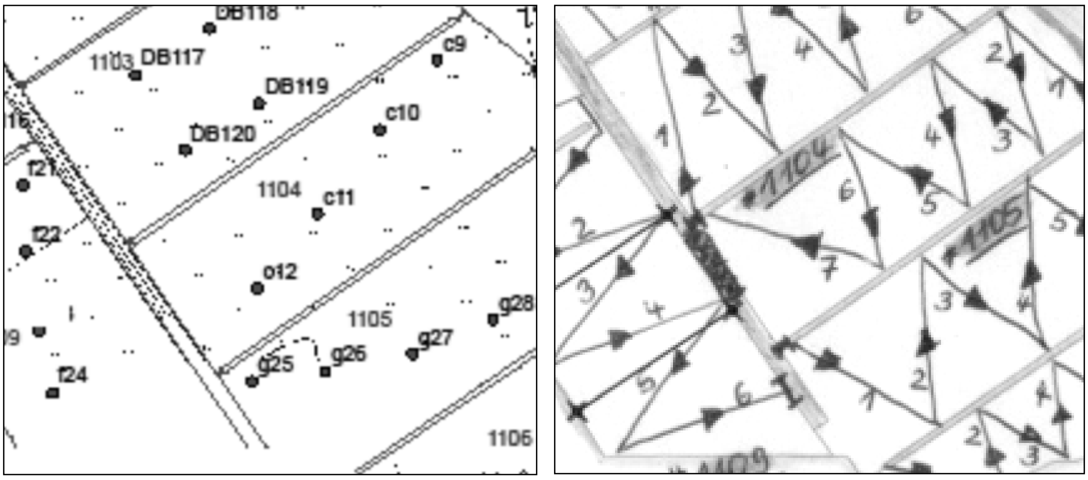

Figure 1. GPS-located sample points (left) were used to measure the difference before and after grazing and weekly zigzag measurement (right) were used to estimate the daily growth rates.

The daily growth rate was calculated on basis of weekly measurements at all ungrazed plots with a rising plate meter (FARMWORKS). It measures the compressed height of the pasture: the plate of the meter lowers from top to bottom until enough plant material carries the plate's weight. The rising plate meter was calibrated to the farm conditions of the permanent grassland in Trenthorst. The calibration shows a linear relationship between dry matter yield (DM) and compressed sward height (H) with the function: DM = 100.41 x H +1 (r^2 = 0.75, n = 396). This function was used to calculate the dry matter yield by the sward height measurements. The sward height was measured every 10 steps (Fig. 1, right) while the plots were crossed in zigzag and needed around 12 minutes. For every crossing line the mean height was recorded. Both methods (four points cutting and zigzag measurement with rising plate meter) showed similar results when yield estimation per plot was compared (data not displayed).The LCA-FARM-Model was developed to calculate the environmental performance of milk production (Schüler and Paulsen, 2012). The input data were obtained from the real farming conditions on the experimental station. The parameters used are tillage steps, crop yields, manure amount, herd size, milk yields, feed intake and feeding regime which includes the grazing management. Greenhouse gas emissions were calculated according to the rules specified in IPPC (2006) and Rösemann et al. (2011). The global warming potential (GWP) connected with grass silage production at Trenthorst depends on the total yield (Table 1). In 2011 grass silage yield was very low (17.5 t ha-1) and the GWP was 327.6 g CO2 eq. kg-1 DM. Yields around 26.5 t ha-1 (mean of the years 2005, 2008, 2009) are more representative for the location and had a GWP of 293.9 g CO2 eq. kg-1 DM. For following calculations a value of 300 g CO2 eq. kg-1 DM grass silage is assumed.

Table 1. Global warming potential (100 a) of grass silage for yields of 17.5 t ha-1 and 26.5 t ha-1 in g CO2 eq. kg-1 DM (experimental farm Trenthorst, 2011 and mean of the years 2005, 2008 and 2009).

Emission source	**Grass silage 17.5 t ha^{-1} [g CO2 eq. kg^{-1} DM]**	**Grass silage 26.5 t ha^{-1} [g CO2 eq. kg^{-1} DM]**
Supply-chain*	11.8	8.8
Transports of silage film, lime and fuel to farm	0.3	0.2
Fuel combustion from fieldwork	89.4	66.4
Direct emissions from soil	226	218.5
Combustion of silage film	$5.96*10^{-6}$	$5.9*10^{-6}$
Sum	327.6	293.9

*The environmental burden of all upstream products have been calculated with datasets from the ecoinvent v2.2 database

Results and discussion

For calculating grazing intake the biomass difference before and after grazing was added to the daily growth rate. The daily growth varied widely during the grazing season. The maximum was in spring with more than 70 kg dry matter (DM) per ha (Fig. 2). The mean daily growth rate was around 25 kg DM per ha. It also shows some negative values which can be attributed to dry periods when the grass went limp.

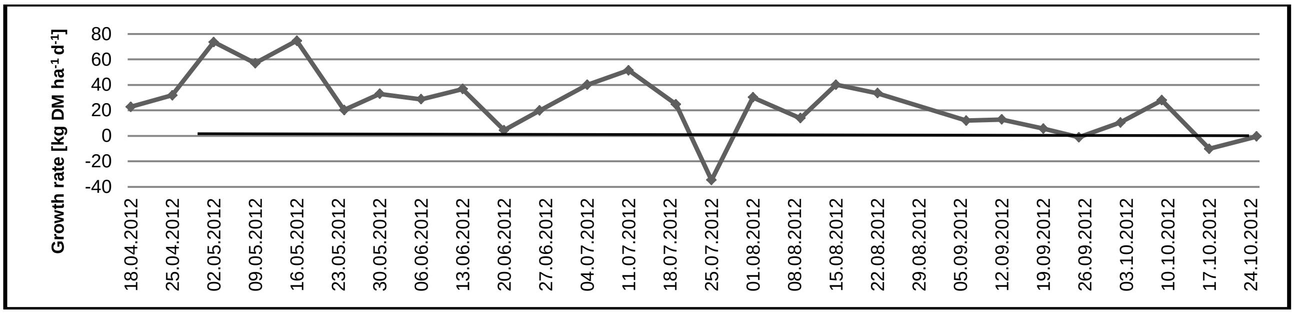

Figure 2. Daily growth rate of dry matter on ungrazed plots in 2012.

Both the dry matter yields from direct cuttings and the estimated yield from growth rates (formula 1) show variations between the plots (Fig. 3). The sum is basis to calculate the DM intake per cow and plot. This is the parameter for the LCA.

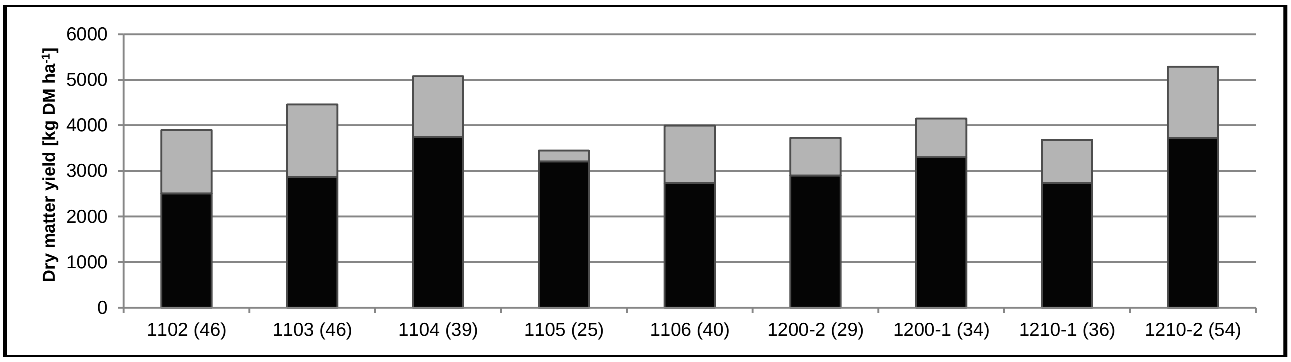

Figure 3. Dry matter yields of the grazed pasture plots calculated by the difference before and after grazing (black) and daily growth rate (grey) in 2012. In brackets: Number of grazing days.

In detail the dry matter intake per cow and day was calculated by the dry matter yield per plot, number of animals and days of grazing (Fig. 4). High differences between the plots occurred and might be an indicator for improvement. Differences might be caused by sward composition, season and soil site differences. But also improper grazing management decisions can lead to a low dry matter intake per cow. If improved management decisions could increase the dry matter intake of the dairy cows during grazing by 1 kg dry matter per day, equivalently less grass silage would be needed to be fed to get the same amount of milk yield. Substituting grass silage by improving grazing management reduces GWP per kg energy-corrected milk (ECM). In other words: This is the potential of an improved grazing management to reduce the GWP of milk. Calculating the LCA for the experimental station results in (a) GWP of 300 g CO2 eq. per kg grass silage DM (Tab.1) and (b) 1 kg CO2 eq. per kg ECM. At daily milk yields of 20 kg ECM per cow and day the GWP can be reduced by 15 g per kg ECM (= 1.5 %) by substituting 1 kg DM grass silage by 1 kg DM intake from pasture. At the pasture plot with the lowest DM intake (plot 1102, Fig. 4) the GWP could even be reduced by 8.2 % if daily DM intake during the grazing period could be more than doubled from 4.6 to 10 kg.

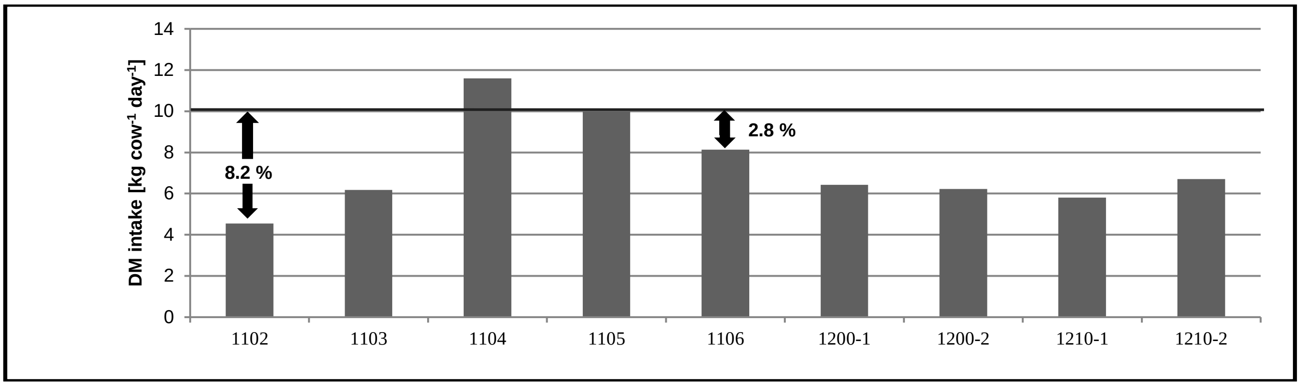

Figure 4. Daily dry matter (DM) intake per cow at the pasture plots in 2012. The % shows the reduction potential of global warming per kg ECM [%] by increasing the DM intake by grazing to 10 kg cow-1 d-1.

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Effects of temporarily reduced tillage in organic crop rotations on yield, earthworm biomass and development of weed pressure. -First results of a case study from Schleswig-Holstein/Germany-

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Key words: reduced tillage, organic crop rotation, soil biodiversity, weed pressure

Abstract

Farming systems applying reduced tillage measures are expected to be beneficial for sustaining important soil functions (ecosystem services) and (soil) biodiversity. Furthermore, a reduction in tillage intensity is connected to reduced need for energy and labour input.

On the other hand waiving the plough is, especially in organic farming systems, suspected to lead to increased weed pressure and therefore decreases in yields.

In this paper, first results of a study on temporarily reduced tillage in organic crop-rotations are presented. Here the plough was set aside before drilling triticale at the end of four crop rotations, and expectable yields, earthworm biomass and weed pressure were investigated. First one-year-results of the experiment on temporarily reduced tillage to triticale at the end of organic crop-rotations did not show enormous decreases in yields, but also the expected positive effects (increase in earthworm biomass) could not be statistically secured.

Introduction

Tillage systems without using a plough are predominantly applied in conventional farming. For example, this concept is widely used in the USA since the enormous problems caused by wind erosion in the 1930s. But also in organic farming, reduced tillage systems are an object of interest for many years now, and scientific work in this area started at least in the early 1990s (Carr et al. 2013). To give but one example there is the on-going pan-European TILMAN-ORG project (http://orgprints.org/20830/; www.tilman-org.net).

In general, preserving and improving of soil functions (ecosystem services) and protection and promotion of (soil) biodiversity are expected benefits of reduced tillage. Furthermore, waiving the plough in soil tillage leads to reduction of labour and energy input (Peigné et al. 2007, Carr et al. 2013). These positive effects are anticipated in conventional as well as in organic farming systems.

Besides, also negative impacts are expected: mainly an increase of weed pressure, which may cause a decrease in yields. This is especially a problem in organic farming, because here no herbicides are used for weed control. Hence effective weed control seems to be a major topic when applying reduced tillage to organic farming systems. Because of many other factors influencing crop-yields the applicability of reduced tillage systems has to be tested site-specific.

Against this background the effects of temporarily reduced tillage at the end of a crop rotation on yield of triticale, weed pressure and earthworm biomass are presented.

Material and methods

Investigations were carried out at the experimental farm of the Thuenen-Institute of Organic Farming in Trenthorst, Schleswig-Holstein, Germany (53°77' N, 10°53' E). The dominating soil types are Stagnic-Luvisols (FAO) with a texture ranging from sandy loam to loamy sand and a soil ranking of 50-55 (German system). Mean total annual precipitation is about 700 mm and mean annual temperature is 8.8 °C.

In Trenthorst four different organic crop-rotations are established with triticale as final crop of each. In September 2012 the triticale-fields were halved and on one half reduced tillage was conducted. For the purposes of this study, the term reduced tillage (rt) means tillage restricted to 15 cm depth waiving the plough. This is compared with a conventional tillage (ct) regime with ploughing up to a depth of 30 cm. The half-fields are addressed by the abbreviation LTM-plots (long term monitoring plot) and a number code in the following. The LTM-plots are arranged in couples (6&7, 17&171, 24&25, 57&571), where one is under conventional and the other one under rt.

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Expectable yields were determined in August 2013 at four fixed sampling points per LTM-plot on 0.25 m^2 by number of ears per m^2, kernels per ear and thousand grain weights. To check the calculated yields for significant differences t-test was used and to reveal potential underlying mechanisms an ANOVA was applied to the data. Additional yield data (grain & straw of threshed square meter samples) will be available in the running project.

Earthworm biomass was investigated, because earthworms are a widely accepted indicator for soil conditions (van Capelle et al. 2012). Earthworms were sampled using Allyl isothiocyanate (Zaborski 2003) coupled with hand-sorting at three locations (at 1-1.5 m, 4.75-5.25 m and 8.5-9 m) along two 10m-transects per half-field. Here pits of 50x50x10 cm were excavated and the soil searched for earthworms. Into these pits the Allyl isothiocyanate solution was poured in two portions of 5 L to expel earthworms from deeper soil layers. In laboratory earthworm biomass per transect was measured. To reveal differences and underlying mechanisms t-test, Kruskal-Wallis-test and ANOVA were used.

To investigate the weed dominance and community structure, in June 2013 on each half-field vegetation assessments following the method of Braun-Blanquet were conducted.

Within the project all statistics were calculated using R 2.15.2.

Results and conclusions

When comparing the couples of LTM-plots, the only significant difference in expectable yield*m^{-2} can be found between LTM 24 and 25 (t-test; p=0.002) (Fig. 1).

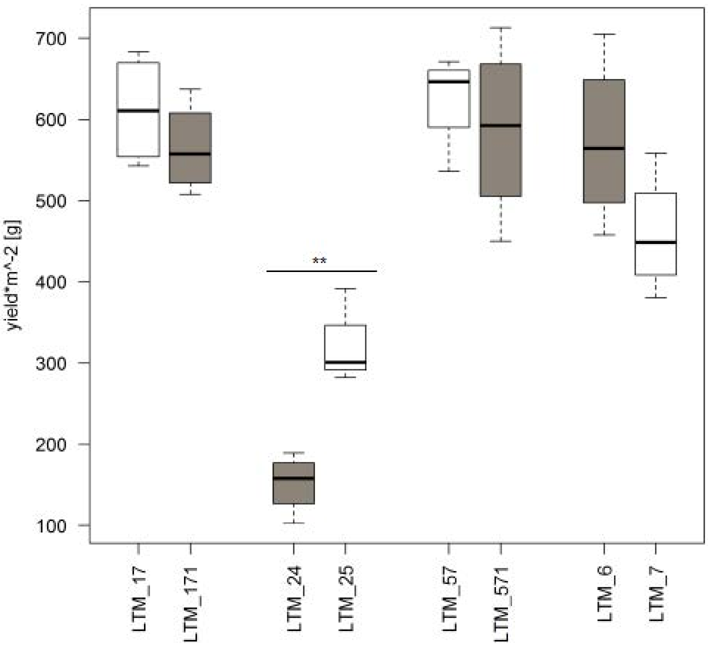


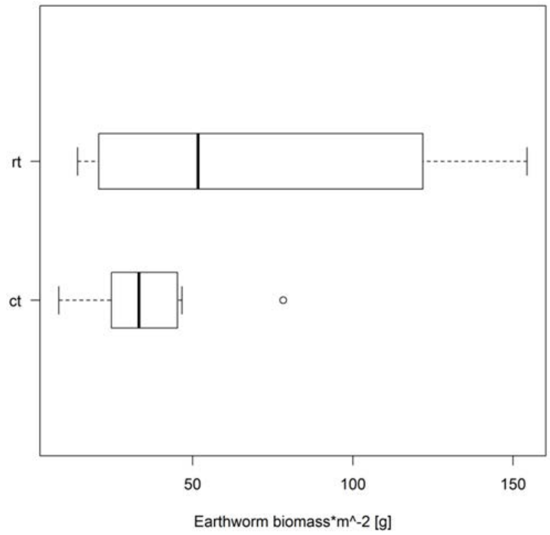
Fig. 1: Expected triticale yields per LTM-plot (dry matter), n=32.
Grey boxes showing results of half-fields under reduced tillage measures.
Significant differences within couples as calculated using t-test are marked using * (p<0.05 *, p<0.01 **, p<0.001 *).**

When comparing expectable yields between conventional and reduced tillage regime no significant difference can be found. Two-way-ANOVA with location (LTM-plot) and type (ct vs. rt) as factors revealed significant influence of location. This significant influence can be totally assigned to yields calculated for LTM-plot 24 and 25. LTM-plot 24 and 25 differ from all remaining LTM-plots in terms of management, because they belong to the cash crop farming system of the experimental farm. Contrary to the other systems on the station no farmyard manure is applied here and only one year of clover in the crop rotation is established since 2003 (Schaub et al. 2007). The fields of the experimental farm belonging to the cash crop farming system are known to generate lower yields, mainly because of lacks in nutrient supply, and to have partly great problems with weed infestation. These problems are well known from other organic farming researches (Carr et al. 2013). In summary on fields with farmyard manure application and higher density of clover and clover grass in the Trenthorst crop rotations no significant reduction in yield was found under a one year reduced tillage regime.

Earthworms were used as one predictor for the status of soil biological activity. The first sampling in spring after tillage in autumn shows no significant difference in earthworm biomass based on statistical tests, when comparing the two tillage measures. But a slightly enhanced mean value could be observed under reduced (69.63 g*m^{-2}) compared to conventional (36.59 g*m^{-2}) tillage (Figure 2).

Van Capelle et al. (2012) mention “the interacting effects of reduced injuries (of earthworms), microclimate-changes, decreased exposure to predators at the soil surface, and an increased availability of organic matter providing a convenient food source” as drivers for the increase in earthworm biomass under conditions of reduced tillage. In return higher abundance of earthworms increases the positive effects assigned to these animals, like enhancement of soil aggregation and creation of channels for drainage, aeration and root growth (van Capelle et al. 2012).

In the combination of weed species no differences could be shown between the soil treatments. Indeed mean values for weed dominance differ between conventional (20 %) and reduced (31.5 %) tillage (Fig. 3), but this difference is not significant.



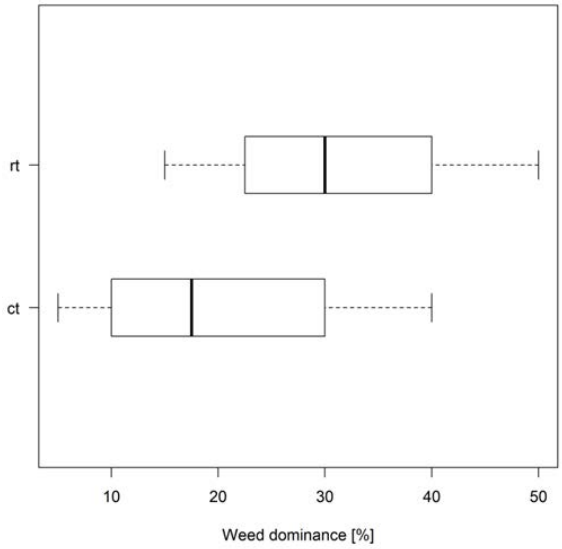


Fig. 2 (left): Earthworm biomass*m^{-2} for the two treatments reduced (rt) and conventional (ct) tillage. No significant differences could be shown. Results from April 2013, n=16.

Fig. 3 (right): Weed dominance for the two treatments reduced (rt) and conventional (ct) tillage. No significant differences could be shown, n=8.

Because of bad weather conditions in spring 2013, no measures of weed control could be executed at the survey fields. So probably if the regularly planned measures could have been used the difference between the tillage regimes would have been even smaller.

To sum up first one-year-results, of the experiment on temporarily reduced tillage to triticale at the end of organic crop-rotations, it can be stated, that:

- The suspected decrease in yield by reduced tillage appeared only in the rotation with lowest yield level.
- The expected positive effects of reduced tillage on earthworm biomass could not be statically secured.
- The suspected increase in weed density couldn't be statistically secured by the Braun-Blanquet method at harvest, even without any measure of weed control.

Soil and weather conditions will have strong effects on the yield performance in different years and no general advice to introduce reduced tillage methods can be expected. But in the upcoming part of the project additional data on the biomass yield will be available and evaluated. Also the possible role of temporarily reduced tillage to enhance biological soil activity and biodiversity will be explored in more detail. Number of individuals and species composition of collembolans (springtails) and also of earthworms will be investigated. In summer 2013 the comparison of tillage regimes was continued in the second year on the research fields, this before drilling clover respectively grass-clover leys. So more results on the parameters discussed above will be generated to investigate consequences of prolongation of temporarily reduced tillage in organic crop rotations on biological activity in soils.

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Open Pollinated Broccoli Genotypes: Agronomic Parameters and Sensory Attributes

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Key words: Open Pollinated Varieties, participatory breeding, broccoli, yield parameters, sensory tests

Abstract

*Breeding of open pollinated (OP) varieties for organic farming gains further importance as varieties developed from CMS-hybridisation and cell fusion are no longer accepted by some organic farming associations. For broccoli (*Brassica oleracea *var.* italica*), the availability of OP varieties is very limited. In a participatory breeding project the German NGO Kultursaat e.V. and the University of Hohenheim tested new OP genotypes for agronomic parameters and sensory traits in 2012 and 2013. Agronomic traits of hybrids and OP genotypes varied widely. Some OP genotypes showed similar head weights and head diameters as the standard hybrids, while others were much lower in weight and head diameter. In the sensory assessments, untrained consumers were able to differentiate between the different genotypes. The OP genotype CHE-MIC showed the highest acceptance amongst consumers in both years. CHE-MIC has the potential to be commercially successful if further selection for homogeneity takes place.*

Introduction

Currently, broccoli (*Brassica oleracea* var. *italica*) has gained attention because of the struggles on patenting genotypes with high concentrations of glucosinolates showing positive effects in cancer treatment (Keck 2004). In addition, the ban on CMS-hybrids by some organic farming associations in Germany drew further attention to broccoli. Currently, only very few open pollinated (OP) varieties with unsatisfactory agronomic performance exist. To meet the demands of organic producers, breeding programmes for new OP varieties are required.

Such new OP broccoli varieties might differ in outer appearance and sensory traits from the formerly used hybrids. Whether or not consumers accept such differences is often not known. Up to now the relation between taste and agronomic properties has not been assessed for open pollinated broccoli genotypes. Therefore, the objectives of the present study were to assess sensory attributes as well as the agronomic parameters of OPs in comparison to hybrids in order to select suitable genotypes for further breeding.

Material and methods

In a participatory breeding project by the German NGO Kultursaat e.V. and the University of Hohenheim, 14 OP genotypes (selected by the on-farm breeders of Kultursaat e.V.), five hybrid varieties and three OP broccoli varieties that were available on the seed market were tested. Out of the complete set of genotypes four OP genotypes, one hybrid and one OP variety were used in 2012 for sensory evaluation; in 2013, two OP genotypes and one hybrid were used. The choice of the OP genotypes was based on breeding lines and time of optimum harvest.

The genotype screening was done at the organic experimental station Kleinhohenheim, University of Hohenheim, Stuttgart, Southern Germany (435 m above sea level, average annual precipitation of 700 mm, average annual temperature 8.8°C) for two cultivation periods (spring 2012 and 2013) in field trials with a randomized block design. Cultivation was done according to local best practice for organically grown broccoli. Agronomic parameters like weight of heads and head colour were assessed for three plants per genotype / variety every week starting at the onset of harvesting. Colours of broccoli heads were assessed using a scale from 1 to 9 (1 = green, 3= greyish green, 6=blue green and 9= violet).

Sensory tests were performed with an untrained consumer panel at two dates in spring 2012 and at two dates in spring 2013. The tasting was performed using cooked and raw broccoli heads. The samples were cooked under standardized conditions for three minutes. The room where the tasting took place was shaded to limit the bias resulting from different colours of the samples. The panel was divided into two groups and each test person received the samples in different, randomized order. In 2012, the panel tasted three OP

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genotypes, one hybrid and one commercially available OP variety. In 2013, two OP genotypes and one hybrid were used and one randomly selected repeater sample was added to check the validity of the answers. During both tests the panel members had to fill in a questionnaire with open and multiple-choice answers on the sensory attributes of the samples.
The data on agronomic traits as well as the data on the sensory attributes were statistically analysed using ANOVA/mixed model (SAS 9.3).

Results

At each harvesting date, all marketable heads (diameter > 7 cm) were used for the determination of agronomic traits. Mean head weights of the varieties / genotypes used for sensory testing ranged from 380 g for the OP genotype CHE-BAL and 340 g for the hybrid Monterey to 241 g for the commercial OP variety Ramoso Calabrese in 2012. Median head diameters ranged from 18 cm for the OP variety CHE-BAL to 13 cm for the OP genotype CN-COA (Fig. 1). CHE-BAL and the hybrid Monterey showed a similar median head diameter. CHE-MIC, the genotype which performed best in the sensory tests (Tab. 1), showed a much lower head diameter of 13.5 cm (Fig.1). The hybrid Monterey and the OP genotype CHE-BAL had a very similar colour of blue green homogenously expressed by the crop stand. On the contrary, the OP genotype CHE-MIC showed a large heterogeneity in colour, some plants were violet while others had a greenish colour (Fig. 1).

Tastings of cooked broccoli with an untrained consumer panel showed significant differences according to the attribute “popularity” (Tab.1). In both years the OP genotype CHE-MIC ranked highest in the attribute “popularity”. Low “popularity” was attributed to Ramoso Calabrese in 2012 and genotype CHE-GEBA in 2013. The taste attributes “nutty”, “cabbage like”, “spicy” and “bitter” showed significant differences among the broccoli genotypes and hybrids as well. High popularity values were determined by the attributes “nutty” and “sweet” and low values in the attributes “bitter”, “spicy” and “off-flavour”. The ranking for raw broccoli differed from the ranking for cooked material (data not shown). For the attribute “popularity” significant differences could only be found in 2012 for CN-COA and Monterey respectively.

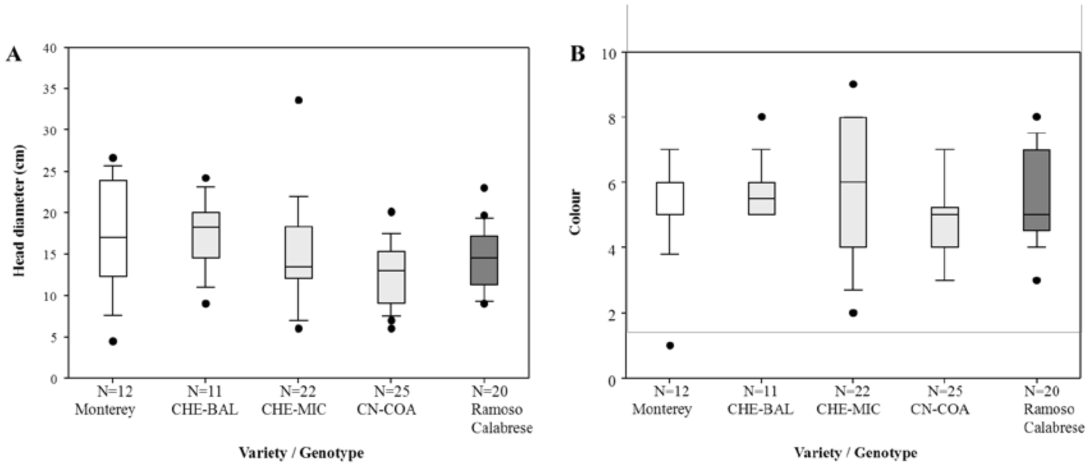

Fig. 1: Agronomic parameters head diameter (A) and colour (B) of broccoli hybrids (Monterey), a commercially available open pollinated variety (Ramoso Calabrese) and open pollinated genotypes (CHE-BAL, CHE-MIC, CN-COA); Colour is ranked from green (1) to violet (10); N = number of observations; Boxplots: Black line = median, Box = 25% and 75% percentiles, whiskers = 10% and 90% percentiles, dots = outliers

In both trials, untrained consumers were able to assign different attributes to broccoli varieties and differentiate clearly between the varieties, but the personal factor and the date of tasting showed a strong influence on the results (data not shown). On an overall level, the OP genotype CHE-MIC performed best (highest ranking for “popularity”) in both years in the tastings for cooked material, while the OP genotype CHE-GEBA showed the lowest ranking in 2013 for cooked tastings. In 2012, the lowest acceptance when cooked was assigned to the OP variety Ramoso Calabrese.

Discussion

Consumer preferences were assessed only for the taste, but not for the appearance of the different genotypes and varieties. As consumers are used to the taste and outer appearance of hybrids, it remains unclear whether they will accept the genotype CHE-MIC with its high heterogeneity in colour and its rather low head diameter. If organic traders are willing to deal with a product that is heterogeneous in colour and in size, is an open question unless marketing strategies for premium prices based on the added value of open pollinated varieties become successful. In addition, organic producers will probably refrain from using such genotypes, which may generate lower numbers of marketable heads and therefore lower revenue. For these reasons further breeding activities based on the genotype CHE-MIC are necessary.

Table 1: Ranking of different taste attributes during two sensory testings of cooked Broccoli hybrids (Monterey, Batavia), commercially available open pollinated variety (Ramoso Calabrese) and open pollinated genotypes (CN-COA, CHE-MIC, CHE-GEBA, CHE-GRE)

Attributes	Sensory Testing			
	2012		2013	
Ranking	highest	lowest	highest	lowest
Overall popularity	CHE-MIC[a]	Ramoso [b]	CHE-MIC[a]	CHE-GEBA[b]
Positively associated taste attributes				
Sweet	CN-COA[a]	Ramoso[a]	CHE-MIC[a]	CHE-GEBA[a]
Nutty	CHE-MIC[a]	Monterey[b]	CHE-MIC[a]	Batavia[a]
Cabbage-like	CN-COA[a]	Monterey[a]	Batavia[a]	CHE-GEBA[b]
Spicy	CHE-GRE[a]	Ramoso[a]	Batavia[a]	CHE-MIC[b]
Negatively associated taste attributes				
Bitter	CN-COA[a]	CHE-MIC + Monterey[a]	Batavia[a]	CHE-MIC[b]
Off-flavour	CHE-GRE[a]	CHE-MIC[a]	CHE-GEBA[a]	CHE-MIC[a]

Different letters indicate significant differences at the level p<0.01, *=two genotypes/varieties show the same ranking

For cooked broccoli consumers of an untrained sensory panel preferred OP genotypes rather than hybrid varieties. The genotype CHE-MIC is promising and could be used for further breeding efforts given taste is the central criterion for selection because its sensory traits outperformed the other OP genotypes and the hybrids. The large heterogeneity of the crop stand may be further limited by continued breeding activities. Nevertheless, it remains open if an OP variety will reach a level of uniformity comparable to hybrids. In addition, colour or head shape may differ from what consumers are used to. Therefore further trials and/ or information exchange with consumers, producers and traders are necessary to improve the acceptance of these OP varieties.

Within the project, a workshop with stakeholders along the organic food chain was done to include their views in a participatory breeding approach to develop OP broccoli varieties which are widely accepted. Besides taste, agronomic performance, harvest times and outer appearance of the heads were discussed as crucial selection criteria by the stakeholders from trade and agriculture.

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Creating education and training opportunities to support the development of direct marketing strategies

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Key words: Education and training, lifelong learning, direct marketing, marketing strategies, analyses of latent educational needs

Abstract

The increased interest towards local food provides farms engaged in direct marketing new opportunities. Therefore it will be important to highlight individual USPs with suitable marketing concepts to attract and retain loyal customers. Expertise in how to design and implement these concepts is increasingly important. However, farmers intending to market their products directly often do not have the required experiences or knowledge on how to market effectively and thus cannot take advantage of the mentioned opportunities. The aim of this research was to provide education and training actors with recommendations on which training and education offers could be made. This was achieved by identifying the education and training needs in direct marketing in terms of content and methodology and comparing these with the existing opportunities for training and education in the region of Berlin/Brandenburg. The results suggest that there are a range of knowledge gaps among direct marketing farmers. Few opportunities for training and education in agriculture and food marketing exist for these farmers in Brandenburg. For training and education providers, it is recommended to develop specific training and education concepts for direct marketing farmers, with a specific emphasis on providing a forum for sharing knowledge.

Introduction

In times of increasing globalisation and recurring food scandals, consumers are putting more trust in local food (BMELV 2013). This trend can be incorporated into direct marketing strategies as particularly authentic and thus offers farms engaged in direct marketing, in farm stores, at farmers market stands, etc. as well as by directly supplying retail stores, with new opportunities. However, quality-oriented food retailers have also recently taken up this trend with specifically targeted marketing concepts to differentiate themselves from discount supermarkets. In terms of direct marketing, this means that it will be important to abandon anonymity and highlight individual USPs with suitable marketing concepts to attract and retain loyal customers (Hassan 2010). Expertise in how to design and implement suitable marketing concepts is thus increasingly important for expanding regional sales and marketing capacity. However, because marketing was not originally the responsibility of producers, they are often overwhelmed by this task (Haberland et al. 2008).

The aim of this research was to provide education and training actors with recommendations on which training and education offers could be made. This was achieved by identifying the education and training needs of direct marketing farmers in terms of content and methodology by a survey and comparing these with the existing opportunities for training and education in the region of Berlin/Brandenburg. This model region features a high demand for organic products in the Berlin metropolitan region, a high percentage of organically farmed land in the surrounding area of Brandenburg but very weekly developed supply chains or direct marketing concepts (Nölting et al. 2005). In particular, the survey of direct marketing farmers analysed what knowledge producers are lacking and how they usually acquire new knowledge. A further aim was to identify suitable teaching and learning concepts and other aspects relevant to participation from the farmers' point of view. Knowledge gaps not specifically mentioned but which still potentially existed, were captured using a broader methodological approach to the educational needs analysis. From a methodological viewpoint, the challenge of finding a way to identify latent knowledge needs.

Material and methods

The educational needs were assessed on the basis of an analysis of secondary literature, an analysis of the existing training and education opportunities, supplementary expert interviews and a telephone survey with direct marketers. The evaluation of a pilot training seminar also provided findings on the structure of teaching and learning concepts.

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The secondary studies were initially assessed for concrete indications of knowledge gaps. Based on the result that the studies make almost no explicit assertions about knowledge gaps in marketing, we tried to indirectly assess whether knowledge deficiencies exist. To this end, relevant obstacles to sales and purchases were first described based on a study conducted by Dienel (2002). Core assertions made by Recke/Wirthgen (2004) about problem areas when establishing direct marketing were incorporated into the expanded description of relevant obstacles to sales and purchases along with key elements that contribute to the success of organic marketing initiatives (Hensche/Schleyer 2005). The respective marketing areas were assigned to the obstacles identified based on Dienel's (2002) study. Important fields of knowledge in the individual marketing areas were defined based on Meffert et al. (2008) and Becker (Becker 2002).

Table 1: Example of sales obstacle and the conclusions that can be drawn

Sales obstacle (perspective: producer	Reasons it hinders sales of regional organic agricultural products	Marketing policy area	Knowledge fields
Price obstacle	Price level too low, prices not stable enough	Pricing policy and communication policy	Translation of stated goals and strategies into the individual fields of the marketing mix Knowledge of specific practical tools Knowledge about the selection, prioritisation, structure of the individual tools for systematic application

Source: Own research based on Dienel (2002), Recke/Wirthgen (2004), Hensche/Schleyer (2005), Meffert et al. (2008), Becker (2002)

Additional information was collected standardised telephone interviews of direct marketers. This included sociodemographic factors, business- and activity-related data as well as information about the factors that influence farmers' participation in education and training and what they are interested in learning. 39 of the 166 farms contacted took part. Data was analysed using unvaried analysis methods in the statistics program SPSS and in Excel. Mayring's methods of inductive category development were used to formulate open questions (Mayring 2010).
Regional training and education opportunities related to agriculture were analysed using online databases and the published course offerings of various training and education providers. In addition, eight interviews with experts supplemented the analysis of the existing opportunities for training and education.

Results

The analysis of the secondary literature identified various obstacles to sales and purchases. The corresponding fields of knowledge in marketing were derived on this basis, which then provided an initial idea of potential training and educational needs. The sales obstacles identified, for example, suggest infrastructural characteristics unique to the region and indirectly indicate a need for networking between the various actors in the value chain. The purchase obstacles identified indicate knowledge gaps in how to translate goals and strategies to the individual fields of the marketing mix and the selection, prioritisation and structuring of the individual marketing tools. Conclusions were also drawn about knowledge gaps that affect the acquisition and analysis of relevant information.
Compared to other Federal States in Germany, there are few opportunities in Brandenburg for training and education in agriculture and food marketing for farms engaged in direct marketing. Even though more than half of the farmers surveyed said they had participated in training and education in the last three years, training mainly focused on production-related topics. This trend is also evident in our analysis of available opportunities for training and education. They focus primarily on issues related to production, agricultural policy and business management. Marketing training was offered only sporadically. The organisers usually identified the topics to be addressed without performing a systematic needs analysis ahead of time. The

farmers surveyed mainly showed interest in strategic and interdisciplinary topics such as business development, EU and national law, human resource and time management, as well as marketing. In the field of marketing, the interviewees expressed particular interest in business and operational themes in the marketing mix as well as in general market information.
The training and education opportunities on offer are mainly held in seminar format (as learning formats with a practically-oriented context and a platform for sharing experiences). For farmers the preferred format for training and education in addition to informational events, lectures and courses of study is discussing experiences with colleagues. In addition, books, journals, the internet, farming associations were identified as relevant to knowledge acquisition.

The most important factors influencing participation in training and education were:

- Time (February is the best time)
- Content (combination of theory and practice)
- Trainer/teacher (practical knowledge)
- Experience with the training and education provider
- Fees (little willingness to pay)
- Venue (on-farm)
- Distance to the location of the event (in Brandenburg max. 100 to 150 km)
- Farms' awareness of problems
- Ability to leave the farm due to farm staff

Discussion and conclusions

Knowledge gaps in marketing were identified in the model region. The current training and education opportunities only sporadically address these knowledge gaps. Systematically structured training and education opportunities in the field of marketing for direct marketers which, in particular, adequately incorporated farmers' need to share experiences with colleagues were not identified. For training and education providers, the study concludes that the training and education on offer should be adapted to the influential factors above and the respective concepts should, in particular, offer a solid platform for farmers to adequately share knowledge. The next step will be to work closely with the relevant training and education providers to develop and further test corresponding options for training and education in Brandenburg.
The methodological analysis shows that an indirect needs analysis of sales and purchase obstacles can be useful to complement other methods of educational needs analysis because it can provide an initial idea of where latent knowledge gaps may exist and in which areas. Assessing the knowledge gaps identified by means of a direct survey of direct marketers proved useful.

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Preliminary results of the global comparative study on interactions between PGS and social processes

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Key words: Participatory Guarantee Systems, social processes, organic agriculture, food security

Abstract

Participatory Guarantee Systems (PGS) are viable organic verification systems. This paper evaluates the interactions between PGS and social processes (e.g. seed management) and identifies how they can play a trigger role to improve livelihoods of rural communities worldwide and particularly in the Peruvian Andes. It draws from in-depth interviews with 84 PGS farmers from eight selected PGS initiatives in India, the Philippines, South Africa, Peru, Mexico, Brazil and France, as well as 24 stakeholders involved in the development of PGS. Preliminary results show that PGS is an important platform for the development of social processes and that social processes positively impact PGS initiatives, thereby improving their sustainability. The results also demonstrate so far that the entry into PGS offers farmers and farm families a range of benefits such as: improved social bonds; farmer empowerment; better market access and regular sales; increased farm incomes; enhanced food security.

Introduction

PGS are locally focused quality assurance systems, alternative and complementary to third party certification. They certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge building and exchange (IFOAM 2008).

Currently, over 49,000 small operators are involved in PGS. 50 PGS initiatives are now established on all continents, and more than 60 initiatives are under development (Castro 2014). In order to further develop PGS as a tool for improving livelihoods of rural communities, particularly in the Peruvian Andes, this study evaluates the interactions between PGS and social processes such as seed management and collective marketing etc. It is hypothesized that if PGS initiatives base their activities on long lasting social processes and are well connected to markets, they achieve more sustainable impact on livelihoods improvement. The main research questions are:

1. How do PGS and social processes interact?
2. What are the benefits of PGS on the communities where PGS initiatives are operational?
3. Which main factors favor the sustainability of the PGS?

Research methods

The research questions were explored using a participatory rapid appraisal method based mainly on qualitative studies. In a consultation with key individuals and organizations involved in the development of PGS, as well as with members of the IFOAM PGS Committee, successful PGS initiatives and their relevant social processes were identified. In a second step, in-depth case studies were conducted with members of eight selected PGS initiatives that are using social processes: Keystone Foundation, India; Green Foundation, India; Association of Sustainable Agriculture Practitioners of Palimbang (ASAPP), a member of the Farmer-Scientist Partnership for Development (MASIPAG), Philippines; Asociacion Nacional de Productores Ecologicos (ANPE) / Instituto de Desarrollo y Medio Ambiente (IDMA), Peru; Nuclei of Alto Uruguai and Planalto from Rede Ecovida de Agroecologia (Ecovida), Brazil; Red Mexicana de Tianguis y Mercados Orgánicos (REDAC), Mexico; Bryanston Organic & Natural Market (BONM), South Africa; COMAC Lozère, a member of Nature et Progrès, France. These in-depth studies were conducted as facilitated self-assessment processes in which the selected PGS initiative can learn how to further improve. At least 6 farmers were interviewed per case. The selection criteria for interviewed farmers included at least three years of participation in the PGS; gender; location and landholding/activities.

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Preliminary Results

Main social processes identified and their interactions with PGS

The preliminary results of this study show that PGS is an important platform for the development of social processes. While there is indication that social processes were in place before a PGS developed in some cases, PGS nevertheless has either contributed to strengthening such pre-existing processes and/or stimulated the development of new social processes, which are now recognized as important by the respondents in their relation with PGS and livelihoods improvement. Table 1 shows the main social processes identified among the surveyed PGS. According to this table, the main social processes identified are:

- collective marketing and sharing information, techniques and traditional knowledge, both identified in all cases;
- collective seed management and conservation, particularly relevant for PGS in Asia; small scale saving systems, which are relevant for PGS in Asia and Latin America.
- socialized pricing and collective work or *Bayanihan,* specific to the Philippines.

The study shows these social processes positively impact PGS initiatives in different ways, thereby improving the sustainability of the PGS. The most relevant social processes cited by farmers in this regard are in order of importance 1) sharing information, techniques and traditional knowledge and 2) collective marketing.

The respondents pointed out to a number of ways in which PGS processes and tools have contributed to intensifying this exchange, such as: (i) visits to the production unit that are considered as an opportunity to discuss farming challenges with peers and relevant stakeholders (e.g. consumers) and seek advice; and (ii) regular meetings of the group that stimulate farmers' participation and information exchange through collective discussions over common challenges and solutions. This builds and improves group dynamics, which are essential for PGS.

Table 1: Main social processes identified

	Keystone Foundation	Green Foundation	ASAPP	ANPE / IDMA	Ecovida	REDAC	BONM	COMAC Lozère
Sharing information / techniques	x	x	x	x	x	x	x	x
Collective marketing	x	x	x	x	x	x	x	x
Collective seed management and conservation	x	x	x	x	x			
Small-scale saving	x	x		x	x			
Collective work / *Bayanihan*			x					
Socialized pricing			x					

x: relevant empty cells: not relevant or was not specifically mentioned

Collective marketing initiatives have developed within PGS or were strengthened following the entry into PGS. Therefore, PGS enables farmers access to specific markets, reduces costs related to the organization for the market and helps reach consumers on a larger scale, which contributes to the sustainability of the PGS in return.

Collective seed management and conservation processes, such as trial farms or Community Seed Banks, contribute to the continuity of organic agriculture practices with regard to the availability of locally suitable organic seeds. Also, they strengthen social bonds and positively impact the way the members of the PGS interact.

Small-scale savings systems (e.g. common fund or collective savings systems) are a good tool to guarantee the financial sustainability of the PGS, by covering common expenses, while improving farmers’ livelihoods through better access to credit.

Collective work or *Bayanihan* is a communal system of labor traditionally used in different parts of the Philippines where people come together to work on each other's projects – either as pure reciprocal labor or sometimes for a portion of the harvest. According to respondents, *Bayanihan* not only reduces the need to purchase labor and capital but also increases trust, thus leading to better relationships within the group and a more efficient running of the PGS.
Socialized pricing enables Philippine farmers to command the price of their produce to make them affordable to members of the organization and consumers. This enhances relationships among PGS members and increases the availability of guaranteed organic rice in the community.

Benefits associated with the entry into PGS
The study found that the entry into PGS offers farmers and their families a range of economic, environmental and social benefits, thus improving their livelihoods. The main benefits as perceived by surveyed farmers are:
1. Improved social bonds: PGS promotes personal relationships based on trust and leads to sharing of knowledge and best organic practices, thereby leading to empowered social organizations at the local level.
2. Lower costs of production: For many farmers, the entry into PGS is associated with adoption of organic practices. This results in lower costs of farming, as organic farming involves the use of affordable inputs that are generally produced on the farm rather than externally purchased (such as seeds and synthetic pesticides).
3. Better market access and regular sales: PGS facilitates the establishment of collective marketing initiatives and diversification of marketing channels, promoting increased volume of the offer and product diversity, thus helping farmers access specific direct and regular markets and further increase their profit margins.
4. Enhanced food security: The setting up of kitchen gardens by farmers and their increased cultivation of indigenous seeds, which are suited to local agro-climatic zones, contributes to increased yields, diversity and nutrient content of meals. In addition to increased diversification, the access to different markets leads farmers to improve the productivity of both their cash and subsistence food crops, thereby improving households' nutritional requirements and their ability to feed themselves.
5. Better management of natural resources: By acting as platforms for farmer-to-farmer knowledge sharing and exchange, PGS contributes to traditional knowledge maintenance and dissemination and empower farmers to make use of locally available inputs and breeds, therefore contributing to improved natural resource management in the communities.

Common challenges

The most common challenges, as reported by the respondents are: involving consumers in PGS; gaining recognition and financial and technical support from authorities; long distance or difficult access between the members of the group, as well as from farm to market; low understanding of PGS among farmers involved in the initiative; low participation of some farmers in the PGS.

Final results

The final detailed research report will be available March 2014 and will include guidance on conditions under which a PGS is likely to become successful and recommendations for farmers, policy makers, researchers and the organic movement.
These factors could assist people and organizations designing and establishing PGS around the world, even if their situation might be different and require the development of a PGS that is specific to their region or community.

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Reversion of organic farms to conventional farming in Germany

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Key words: reversion, farm strategy

Abstract

In the past years a considerable number of farms have returned from organic to conventional production in Germany. Survey and interview results show that this change is due to a variety of personal and farm-specific as well as external factors. Here economic aspects as well as problems with the organic regulation and control system play a relatively large role. The diversity of the farm reversion constellations means that there is no central key point by which the reversion can be avoided. Instead, a mix of different measures is necessary that would lead to an improvement of the framework conditions for all organic farms.

Introduction

Organic farming has shown constant growth in Germany. The organically farmed area has increased by more than 12 times since 1990 and the number of farms has increased more than seven times. But these figures only describe the growth dynamic in organic farming to a limited extent. They only indicate the net increase and do not show the number of farmers that have returned to conventional farming. According to a statistical analysis of farm structure data between 2003 and 2010 this number is considerable; on average 415 farms, or rather 3.3 per cent of the organic farms were lost per year through a reversion to conventional farming - although the demand for organically produced foods in Germany has increased (Schaack et al., 2013) and different organic support measures were available (Nieberg, et al., 2011). These figures make clear that a further expansion of organic farming in Germany - as desired politically (Federal Government, 2012) - requires not just adequate incentives for conversion to organic farming, but also measures to avoid the reversion of organic farms to conventional farming. Against this background, the objective of this contribution is to identify the reasons for reversion and to show approaches that could result in a lower number of reverting farms.

Material and methods

Building upon a review of international literature and an expert survey on reversion of organic farms, the analysis used a written survey as well as semi-structured interviews:

- A German-wide written survey of all organic farms that deregistered from the EU organic control system between 2003 and 2009. From the returns of questionnaires, a data basis with 388 former organic farms which reverted to conventional farming was created and analysed.
- Personal interviews with 29 farmers with a specific focus on the reasons for the reversion as well as the proceeding decision-making processes.

The study results were reflected upon in four regional workshops with practitioners and experts in organic farming. Building upon this, possible approaches for the avoidance of reversion were derived.

Results

According the results of the survey, economic aspects played an important role in the decision to return to conventional farming. Of significance were particularly unsatisfactory farm incomes, marketing problems, low price premiums for organic products and low or reduced organic support payments. Further economic reasons for the reversion were high inspection costs as well as the expensive purchase of organically certified feedstuffs.

Among the central reasons for the reversion were also problems with the organic regulation and the control system. These were especially mentioned in the context of time-consuming documentation and reporting duties as well as requirements that were difficult to implement. In this regard the provision for bovine animals to feed 100 per cent organic feedstuff and the expiring exemptions for the tethering of cows were mentioned explicitly. Interestingly, technical production difficulties such as the increase of weed pressure, strongly varying yields,

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low yields of arable crops and problems with the nutrient supply were of somewhat less significance for the reversion.

The statistical analysis of the survey data makes clear that there are significant correlations between farm structure and reasons for reversion. For example, full time farmers mentioned much more often lower yields in arable crops as well as lacking cooperation possibilities with other organic farmers as important reasons than part time farmers. A lack of income improvement was cited more often as relevant for reversion by pig and poultry farmers, sheep and goat farmers, suckling cow and beef fattening farmers than by the farmers of other farm types (arable crops, mixed, dairy farmers).

Conclusions

The diversity of the farm reversion constellations means that there is no central point by which reversion can be avoided. Therefore, a range of different measures are necessary in order to improve the framework conditions for all organic farms, so that reversion will not be taken into consideration. The establishment of a coherent and reliable political framework, which leads to an increased competitiveness of organic farming with conventional farming in the long-term, is in this context a central challenge. In order to ensure the economic viability of organic farming, measures are also necessary which lead to an increase in the yield and production performance of organic farms. In addition, actors of the organic sector and the agricultural administration should make an effort to improve the transparency and practicality of the requirements, to eliminate the weak points in the control system and to develop better farm advisory services.

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Options to reduce greenhouse gas emissions from enteric fermentation and manure handling in dairy farming – An analysis based on farm network data

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Key words: greenhouse gas, feed quality, manure, calculation methods

Abstract

In the project 'Climate Effects and Sustainability of Organic and Conventional Farming Systems' 44 paired organic and conventional dairy farms in Germany were analysed for their greenhouse gas (GHG) emissions from enteric fermentation and from animal excretions in the stables, on the pastures and during storage of manure. In milk production, methane (CH_4) from enteric fermentation of the cows is the dominating GHG source. On the analysed farms the calculation results for CH_4 emissions were strongly dependent on the choice of methodology. Considering crude nutrient contents of the actual feed rations, as opposed to using dry matter intake, generally increased the level of the results and widened their range. This was particularly prominent at lower milk yields when high amounts of fibre rich feed stuff were used. Since feed quality management on farms is crucial for both milk yield and CH_4 emissions from enteric fermentation, it should be of high importance in advisory concepts that aim at reducing GHG–emissions in milk production. Just like CH_4 emissions from enteric fermentation, GHG emissions from dairy manure are also directly connected with the feed intake and feed quality. Technical changes in manure storage and handling (e.g., integration of biogas plants) offer high GHG reduction potential in dairy farming.

Introduction

In the project 'Climate effects and Sustainability of Organic and Conventional Farming Systems', dairy farms in Germany were analysed for their greenhouse gas (GHG) emissions based on the whole process chain (Hülsbergen and Rahmann, 2013). This article focuses on the main GHG from dairy production. The most important source is methane (CH_4) from enteric fermentation of the cows. Second in importance are the GHG from livestock manure: CH_4, nitrous oxide (N_2O) and indirect N_2O-emissions ($N_2O_{indirect}$) by ammonia (NH_3) deposition on soils. They are determined by manure composition, manure management in stables and storage and by excreta of grazing animals dropped on pasture. The results from organic and conventional dairy farms are presented. A view on limits of modelling approaches based on practical farm data is given. Some practical recommendations for farm management to produce climate-friendlier milk are concluded.

Material and methods

In total, 44 farms were explored between 2009 and 2011. Each year, all feedstuffs were sampled and characterized by Weende analysis (crude nutrients). Energy and protein contents were calculated according to GfE (2001). Digestibilities of organic matter were taken from DLG (1997). For each farm, average feed demands of the lactating and dry cows were calculated from the energy demands under consideration of the average winter and summer diets, feed qualities, average milk yields and cow weight. Dairy and manure management were assessed via interviews on the farms. All manures in the different storage facilities of the farms were sampled and the components that are relevant for GHG emissions (N_{total}, NH_4-N = total ammoniacal nitrogen (TAN) and organic matter = volatile solids (VS)) were analyzed. CH_4 emissions from enteric fermentation of the dairy cows were calculated in two ways: (a) based on the results of the feedstuff analysis (formula: CH_4 [g] = (63 + 79 XF + 10 NfE + 26 XP – 212 XL) [kg], Kirchgeßner et al. (1995)) and (b) based on dry matter intake (CH_4 [MJ] = 3.23 + 0.809 TS [kg], Ellis et al. (2007, 2d)).

The excretion of substances that are relevant for GHG-emissions from manure management were calculated by feedstuff composition and feed demand of the dairy cows according to the procedures used for the German National Greenhouse Gas Report (Haenel et al., 2012). They are based on C and N flow models. GHG emissions from excreta dropped on pasture and in the stable and during manure storage were calculated under consideration of the duration animals spent in the respective stable compartments and on pastures. GHG emissions from manure management were calculated by multiplying VS, N and TAN (from analysis of manure or calculation of excretions) with emission factors (IPCC 1996, IPCC 2006). Average annual temperatures and storage conditions of the manure were included in the calculations. So only the rather narrow range of milk production of an average dairy cow was analysed. Pre-chain emissions or credits

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(e.g., emissions from feed production by energy use or soil carbon gains) are not included in the following results.

Results

The highest share of GHG emissions per kg energy corrected milk (ECM) results from CH_4 emissions from enteric fermentation (Fig. 1). With only one exception, results for enteric CH_4 emissions from the Kirchgeßner (1995) formula (using feedstuff quality as input parameters) were higher than those from the Ellis et al. (2007) formula (using dry matter intake as input parameter). Differences between the methods were particularly pronounced on farms with lower milk yields and high amounts of hay or straw in the diet (up to 60%). These were largely organic farms which also fed a low share of concentrate. Another example for a large difference between the methods is a conventional farm that fed 20 % straw in the average diet. If highly digestible feedstuffs are used, lower differences between the calculation methods occurred even at lower milk yields. This can be seen in the results from the farm indicated in Fig. 1: It uses feedstuff with low fibre contents (fresh grass, concentrates, maize-silage, high quality grass silage) and has a relatively low milk yield (6,393 kg ECM cow^{-1} a^{-1}). The higher the milk yields and the higher the contents of concentrate and maize in the diets, the lower the product related differences between the results of the calculation methods.

GHG emissions from manure in stables, storage and during gazing on pasture were dependent on the type of manure (solid or liquid), grazing duration and manure storage conditions on farms. In the two farms with biogas plants, the GHG emissions from stable and storage were significantly reduced (Figure 1). The farm with solid manure only (farm with 5,285 kg ECM cow^{-1} a^{-1} in Figure 1) showed the highest product-related emissions from this source. This results from the high emission factors for N_2O and CH_4 for solid manure (IPCC 1996) and the low milk yield of this farm. In all farms the GHG emissions from manure in the milking parlour were negligible because (a) only NH_3-emissions were considered here (the rest of the emissions of the excreta that were excreted in the milking parlour occurred in the manure storage) and because (b) the animals spent a comparatively small amount of time here. For the product-related GHG emissions for milk there is a strong negative correlation of milk yield for all evaluated emission sources, except for the emissions in the milking parlour (Tab. 1).

Table 1: Pearson correlation matrix for the interrelationship of the sources of product-related greenhouse gas emissions in milk production.

	Enteric fermentation (EF) acc. to Kirchgeßner/Ellis	Stable and storage	Milking parlour	Pasture	Sum
Milk yield a^{-1}	-0.89*** / -0.93***	-0.62***	-0.08	-0.42**	-0.68***
EF Kirchgeßner	– / 0.96***	0.6 ***	0.23	0.38*	0.65***
EF Ellis		0.58***	0.13	0.42***	0.65***
Stable & Storage			0.10	0.22	0.9 ***
Milking parlour				0.07	0.12
Pasture					0.63***

significance of correlation: * 0.05 ≥ p < 0.01, ** 0.01 ≥ p < 0.001, *** p ≤ 0.001

The lower coefficients for the correlation of manure emissions in stable and storage and on pasture with the milk yield can be hypothesised to be influenced by parameters that are determined by management (type of manure, duration of grazing). The positive correlation between the sum of the product-related GHG-emissions and these from manure in stable and storage was high (90%). This reflects interrelationship in calculation between digestibility of feed, milk yield and the amount of manure. On the other hand this shows the possibilities for reduction by technique and management on the farms, e. g., increasing digestibility of feed or optimising manure storage.

Only small differences between organic and conventional farms were found in the mean concentrations of VS, N_{total} and TAN in the manures, in the resulting potential to emit GHG (called 'potential greenhouse effect' in the following), and in the storage conditions. In both systems, storage of solid manure and storage of liquid manure had comparable potential emissions of approximately 32 kg t^{-1} CO_2-eq. based on fresh matter (FM) (Table 2). Based on dry matter (DM) the mean potential greenhouse effect of stored solid manures was higher than that from liquid manures. CH_4 was the most relevant source for emissions in liquid manures, whereas N_2O and CH_4 were equally relevant in solid manures (Table 2). The mean values show high standard deviations. This reflects (a) the wide range of manure composition, (b) the effects of the individual storage conditions on the farms and (c) the setting of emission factors. The latter influences results and complicates interpretation and adequate management reactions.

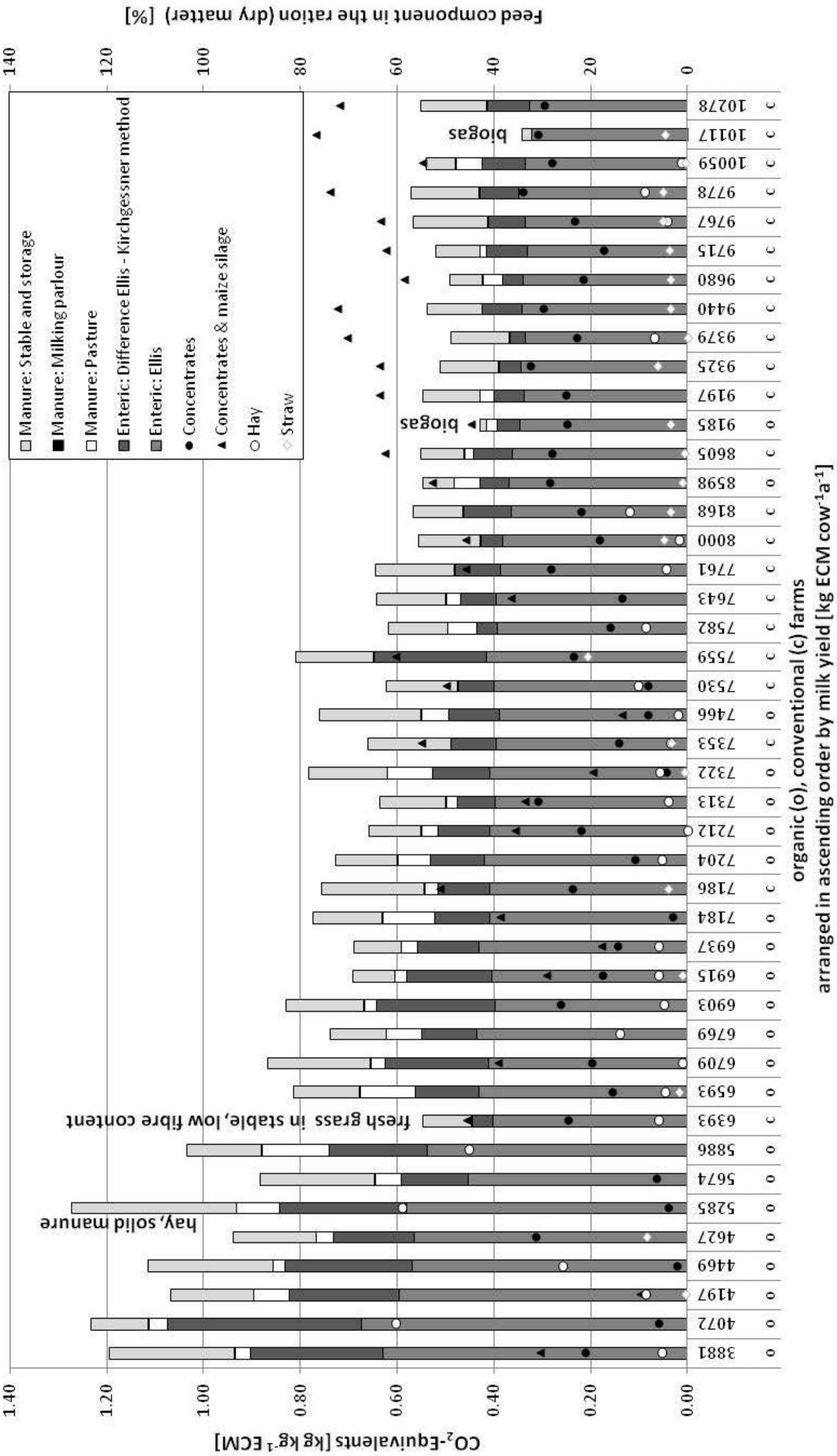

Figure 1: Product related greenhouse gas emissions of milk production from enteric fermentation and from manure in stable, storage and pasture and share of selected feed components in the average yearly feed rations of dairy cows on 44 organic and conventional farms in Germany.

Table 2: Mean concentration of substances relevant for GHG emissions and calculated potential GHG effects from livestock manures under consideration of the storage conditions in 44 dairy farms in Germany based on dry (DM) and fresh matter (FM).

		Solid manure (n=36)*				Liquid manure (n=38)*			
		[kg t^{-1} DM]		[kg t^{-1} FM]		[kg t^{-1} DM]		[kg t^{-1} FM]	
VS		778	±121[A]	208	±43[a]	727	±65[B]	40	±21[b]
N_{total}		20.0	±3.7[B]	5.3	±1.1[a]	63.7	±39[A]	2.7	±1.6[b]
TAN		3.1	±1.58[B]	0.81	±0.4[b]	36.5	±28[A]	1.3	±0.7[a]
CO_2-eq. from	CH_4	62.6	±9.8[B]	16.7	±3.4[a]	526	±47[A]	27.5	±16.5[b]
	N_2O	46.8	±8.6[B]	12.4	±2.5[a]	113	±102[A]	4.5	±3.1[b]
	N_2O (indirect)**	8.85	±4.46	2.27	±1.1[a]	6.83	±6.16	0.25	±0.15[b]
	Total	118	±16[B]	31.4	±5.2	646	±11[A]	32.2	±18.3

* mean values of the different manures on the farms (sampling in 2009-2011); ** resulting from NH_3 deposition; ABab results of comparison of the mean of solid and liquid manures (t-test, p≤0.05), different capital or small letters are indicating significant differences in the dry or fresh matter content, respectively

Discussion

CH_4 emission from enteric fermentation of dairy cows is the most important on-farm source of GHG emissions in dairy farming, independent of the estimation method used. However, the choice of methodology to calculate these CH_4 emissions is highly relevant for the level of both the animal related and the product related GHG emissions of milk. Compared to the estimation formula based on dry matter intake (Ellis et al. 2007) the weighted diversification of crude nutrients in the formula of Kirchgeßner et al. (1995) increased the level of GHG emissions from enteric fermentation in almost all cases. Highest differences between the methods were found in both organic and conventional dairy farms that use high amounts of fibre rich feed stuff and have lower milk yields. Detailed feedstuff analyses and feed quality management on farms are absolutely necessary to govern milk yields. Additionally, the inclusion of these data in calculations of GHG loads from enteric fermentation and manure allows a systematic management of GHG emissions on dairy farms based on feed quality management. Hence, systematically optimising feedstuff quality serves to stabilise milk-yields while simultaneously reducing CH_4-emissions from enteric fermentation in dairy farming. Therefore, feed quality data should also be included in management recommendations aiming at reducing GHG emissions in milk production. As shown by the analyses of practical farm data, changes in storage and management of manure also have a high reduction potential for GHG emissions. They should be clearly addressed for reducing GHG emissions in organic and conventional dairy farms. However, overall approaches to reduce GHG-emissions in milk production must include the complete farm organisation.

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Effect of storage temperature during tuber pre-sprouting on sprout and yield development of organically grown potatoes

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Key words: pre-sprouting, potatoes, temperature, varieties, late blight

Abstract

In the frame of the on-farm-research project 'Organic Pilot Farms in North Rhine-Westphalia' (Germany) the influence of different storage temperatures (8, 12, 16°C) during pre-sprouting under full light (> 200 lux) on tuber development was tested. Sprout length and yield development of cultivars 'Belana' and 'Nicola' as affected by the pre-sprouting regime were recorded in five field trials on two sites over three years. Increasing storage temperature during pre-sprouting resulted in significantly longer sprouts at planting. The higher risk of sprout breaking during mechanical planting of seed tubers with longer sprouts was overcompensated by faster crop development. As a function of higher temperatures during pre-sprouting all measured parameters showed consistently the same tendency of faster shoot growth and higher tuber yield. These results were significant only in 2012 when late blight infestation started extremely early in the season.

Introduction

Reducing copper application is a highly ranked objective in organic crop production. However, no applicable alternative to copper for controlling late blight (*Phytophtora infestans*) is currently available for organic potato growers. Seed tuber pre-sprouting is known to be one of the most efficient preventive methods to reduce yield losses by late blight in organically grown potatoes (Karalus & Rauber 1997, Paffrath 2007). For successful pre-sprouting light (Stumm & Köpke 2011) and storage temperature are the most relevant factors. Krug & Pätzold (1968) and Allen et al. (1978) showed a clear positive correlation between temperature and the elongation of sprouts even under conditions of high illumination that tends to reduce sprout growth. Longer sprouts are prone to breaking at planting and should therefore be avoided by lower storage temperatures during pre-sprouting (Haverkort et al. 1990). However, this approach may also reduce sprouting capacity, which is induced by higher temperatures during pre-sprouting (van Loon 1987). Due to the fact, that the influence of temperature during pre-sprouting on organic potato tuber yield is still unclear, field trials with two cultivars pre-sprouted under full light and different temperatures, were carried out on two sites and three growing seasons.

Material & methods

During 2010 and 2012 the cultivars *Belana* (slow germination) and *Nicola* (fast germination) were pre-sprouted in climatically controlled rooms at the research centre of the Chamber of Agriculture in Cologne-Auweiler. Pre-sprouted tubers were planted in a total of five field trials on the commercial organic farm 'Stautenhof' (ST) in the Lower Rhine region (N 51°16' E 06°28', 45 m above sea level, temperature 9.3 °C, precipitation 700 mm, sandy loam) and on the organic experimental farm of the University of Bonn 'Wiesengut' (WG) in Hennef/Sieg (N 50°48', E 7°17', 65 m above sea level, temperature 10.2 °C, precipitation 800 mm, silty loam, more details see: www.leitbetriebe.oekolandbau.nrw.de). Potato tubers were stored over a six weeks period under full light (> 200 Lux) and different temperatures (8, 12, 16°C). Prior to planting sprout length of all sprouts was recorded from ten tubers. The field experiments were carried out in a two factorial block design with the factors 'cultivar' and 'temperature' with four replications. The percentage of emerged shoots was counted in the whole plot area. Tuber yield was assessed at an early stage during blooming (1.5 m^2 $plot^{-1}$) and at tuber maturity (12 m^2 $plot^{-1}$). Data were evaluated by a two-factorial ANOVA followed by the Tukey-test. In cases of significant interactions between the factors, a one-factorial ANOVA was separately carried out for each cultivar. All statistical calculations were operated with SAS Version 9.3.

Results & discussion

Mean sprout length was significantly higher in tubers pre-sprouted at 12 and 16°C compared with storage at 8°C (Tab. 1). Differences in sprout length between 12 and 16°C were significant in 2010 only. Sprout length

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differentiation was higher for the faster sprouting cv. *Nicola*. Generally, average sprout length was relatively short (< 15 mm) in all treatments due to the high illumination with more than 200 lux. Our findings underline the clear correlation between storage temperature and sprout length (Krug & Pätzold 1968, Allen et al. 1978).

Tab. 1: Length of tuber sprouts (mm) at the time of planting as affected by cultivar and temperature during pre-sprouting. Different letters in one line within one cultivar indicate significant differences (Tukey-test, p < 0.05).

Cultivar	***Belana***							***Nicola***						
°C	**8**		**12**		**16**		***HSD***	**8**		**12**		**16**		***HSD***
2010	7.87	c	8.86	b	10.23	a	*0.82*	6.29	c	11.62	b	13.44	a	*1.44*
2011	5.15	b	7.56	a	7.97	a	*0.64*	4.84	b	10.85	a	10.82	a	*1.01*
2012	6.44	b	9.43	a	10.00	a	*0.98*	6.96	b	10.56	a	10.59	a	*1.13*

Dates of measurements: 19th April 2010; 26thApril 2011; 17th April, 2012; HSD = honestly significant difference

The rate of emergence tended to be higher with rising storage temperature (Tab. 2). *Nicola* showed a stronger reaction on higher pre-sprouting temperature than cv. *Belana*. Greatest and mostly significant differences in crop emergence were determined between 8 and 12°C for both cultivars while a further increase to 16°C was significant only in one case for cv. *Nicola*. These observations confirm the assumed impact of higher temperatures on sprouting capacity, a factor which may compensate higher sprout losses during planting (Haverkort et al. 1990).

In 2011, when late blight pressure was low, there was only a slight tendency to higher yields at early stage as a function of higher storage temperature in both trials (Tab. 3). Contrarily in 2012, when late blight infestation already occurred early in June, tuber yield at early stage was clearly lower than in the year before and the influence of temperature during pre-sprouting was mostly significant. In 2012 cv. *Belana*, pre-sprouted with 12 and 16°C gave tuber yields twice as much compared with pre-sprouting at 8°C.

Tab. 2: Rate of emergence (% of planted tubers) as affected by cultivar and temperature during pre-sprouting. Different letters in one line within one cultivar indicate significant differences (Tukey-test, p < 0.05).

Cultivar	***Belana***							***Nicola***						
°C	**8**		**12**		**16**		***HSD***	**8**		**12**		**16**		***HSD***
2010	54.2	b	80.8	b	85.0	a	*16.8*	50.8	b	85.8	a	90.8	a	*10.2*
2011	8.0		15.5		24.5		*n.s.*	23.0	b	32.0	b	55.5	a	*19.9*
2012	0.0		23.5		38.5		*n.s.*	23.5	b	82.5	a	89.5	a	*8.4*

Dates of measurements: 19th May 2010 ST; 20th May 2011 ST; 17th May 2012 WG; HSD = honestly significant difference

For *Nicola* a significant difference was measured in 2012 on one site (Wiesengut) only. Tuber yield of cv. *Belana* was higher at early stage than *Nicola* in nearly all trials, although shoot development of cv. *Nicola* was earlier and stronger (Tab. 2).

Tab. 3: Tuber yield at an early stage (t^{-1} ha) as affected by cultivar and temperature during pre-sprouting. Different letters in one line within one cultivar indicate significant differences (Tukey-test, $p < 0.05$).

Cultivar	***Belana***				***Nicola***			
°C	**8**	**12**	**16**	***HSD***	**8**	**12**	**16**	***HSD***
2011 ST	22.10	23.72	24.31	*n.s.*	18.59	20.93	21.44	*n.s.*
2011 WG	15.85	16.04	19.35	*n.s.*	10.50	12.21	13.86	*n.s.*
2012 ST	4.11 b	8.12 a	9.44 a	*2.20*	3.29	3.56	3.80	*n.s.*
2012 WG	3.11 b	8.60 a	10.72 a	*4.40*	3.97 b	6.94 a	6.75 a	*1.80*

Dates of measurements:, 12th July 2011 ST; 30th June 2011 WG; 21st June2012 ST; 19th June 2012 WG; HSD = honestly significant difference

In all trials tuber raw yield was higher when seed potatoes were pre-sprouted at higher temperatures (Tab. 4). Similar to the results of harvest at early stage (Tab. 3) in 2012 this impact was significant for *Belana* at both sides and for *Nicola* at the experimental farm Wiesengut only. In all other trials these findings were visible in trend. In 2012, when late blight infestation occurred extremely early especially at 'Stautenhof' nearly no further yield formation was recorded after early tuber lifting on 21st June.

Tab. 4: Raw tuber yield (t^{-1} ha) as affected by cultivar and temperature during pre-sprouting. Different letters in one line within one cultivar indicate significant differences (Tukey-test, $p < 0.05$).

Cultivar	***Belana***				***Nicola***			
°C	**8**	**12**	**16**	***HSD***	**8**	**12**	**16**	***HSD***
2010 ST	16.38	20.68	21.63	*n.s.*	24.74	24.93	28.00	*n.s.*
2011 ST	21.90	25.60	27.27	*n.s.*	28.40	29.09	31.87	*n.s.*
2011 WG	38.32	41.11	42.82	*n.s.*	38.55	41.87	39.83	*n.s.*
2012 ST	3.10 b	8.53 a	10.83 a	*4.06*	6.08	7.44	9.56	*n.s.*
2012 WG	12.89 b	22.95 a	23.82 a	*4.33*	20.75 b	23.56 ab	24.88 a	*3.13*

Dates of measurements: 22nd Sept. 2010 ST; 13th Sept. 2011 ST; 1st Sept. 2011 WG; 4th Sept 2012 ST; 29th Aug. 2012 WG; HSD = honestly significant difference

The observation that lower storage temperature during pre-sprouting phase leads to more sprouts, shoots and tubers (Allen et al. 1978, van Loon 1987) could not be confirmed in our study (data not shown). In some cases this effect could be observed in the comparison of the treatments 12 and 8°C whereas between 16 to 12°C the result was vice versa and in other cases no effect was visible.

Summary

Higher temperatures than 8°C during pre-sprouting increased sprout length significantly. In-between 12 and 16°C only small differences in sprout length were determined. The rate of emergence was significantly higher when seed tubers were pre-sprouted with 12 than with 8°C while continued increase to 16°C was significant in one case only. Tuber yield was higher at early stage as well as at final harvest after pre-sprouting with 12 or 16°C compared with 8°C, and more pronounced in 2012, when late blight occurred very early.

Conclusions

The results suggest that the positive effect of higher temperatures on sprouting capacity is more important for yield formation than the assumed negative impact of higher losses of longer sprouts during planting. Optimisation of pre-sprouting conditions can be considered as an important measure to protect organically grown potatoes against yield losses in case of early infection with late blight (*Phytophtora infestans*).

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Differentiation of rearing systems: Is there a market for organic beef from extensive suckler cow husbandry?

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Key words: extensive suckler based beef, market differentiation

Abstract

Animal welfare is becoming increasingly important to German consumers. Extensive suckler-based rearing is supposed to meet consumer preferences for animal welfare to a much higher degree as conventional indoor rearing. However, beef products differentiated according to rearing systems are not available on the German market yet - except direct sales from farmers. In order to gain insights into consumer preferences in beef purchases regarding different rearing systems, a consumer survey along with a choice experiment was carried out. The data collection took place in three different regions in Germany (South-, West- and North-Germany), n= 341 consumers were interviewed in organic grocery stores. The survey population did not regard price as the most important product attribute. Consumers were willing to buy products from suckler cow husbandry. However, the differences between the rearing systems need to be communicated to close knowledge gaps.

Introduction

Animal welfare is becoming increasingly important to German consumers. One of the main reasons for buying organic products is the perceived animal-friendliness of the production system (SPILLER *et al.* 2004; Oekobarometer 2012). However, due to an undifferentiated marketing, there is no possibility so far for German consumers to purchase a beef product according to the rearing system of the cattle - except for the purchase directly from farms.

Within the beef market there is a great range of products coming from different rearing systems: starting from intensive stocks of male cattle with a minimum of outdoor access to intensive grazing systems, extensive grazing, and up to extensive suckler cow systems with year-long grazing. Within the conventional beef market intensive breeding is dominant, whereas in the organic beef market extensive suckler cow rearing is often applied in Germany. A differentiation of beef products according to the system, in which the animal is raised, seems to be promising, taking consumer preferences into account. Yet, there is only little research published on the potential of a differentiated marketing approach for beef from animal-friendly rearing systems, such as extensive suckler cow husbandry. The objective of the present paper is to present findings from a project that assessed the potential for a differentiation of rearing systems for the organic German beef market.

Material and methods

In order to gain insights into consumer preferences regarding the organic beef market and in particular the potential for a differentiated marketing of products from differing rearing systems, a consumer survey along with a choice experiment was carried out. Choice experiments are increasingly used to evaluate market situations for innovations within the food market as they enable the researcher to specifically assess preferences for certain product attributes. The aim of the choice experiment was to evaluate consumer preferences for beef products from different designated rearing systems. The experiment was designed as a food-choice situation in which three different 200g beefsteaks with different product attributes were offered, varying in the rearing system, organic or conventional production, and the price. Consumers were given an incentive of 8€ and were informed that one of the decisions made in the choice experiment was binding. Within the choice experiment the rearing system had three different levels: barn-based-production, pasture-based-production, and suckler-cow-based-production. Furthermore, the production was declared to be either organic or conventional, and four different price levels were applied: 1.98€; 3.98€, 5.98€, and 7.98€. Also, consumers could decide not to buy a steak. The focus of the consumer survey was to assess underlying attitudes, factors, and sociodemographics.

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The data collection took place in organic grocery stores in three different regions in Germany (South-, West- and North-Germany) during April and May 2013, each offering a variety of different beef products. Overall 341 consumers were interviewed. Prior to the choice experiment different communication materials about suckler cow husbandry were applied: a documentary film (n=84), an image film (n=86), and an information leaflet (n=86). One group received no information and served as a control group (n=85).

Data were gathered by trained investigators through computer-assisted self-interviewing (CASI) and computer-assisted personal interviewing (CAPI). Data were analyzed using the software SPSS 20 and NLogit 4.0.

Results

Results of the study indicate that consumers highly value the organic production process. Results of the choice experiment (ref. Table 1) show that organic production was the most valued attribute (ß-coefficient=2,66; *P*=0.000). In addition, suckler cow husbandry (ß-coefficient=1,61; *P*=0.000) and pasture based husbandry (ß-coefficient= 1,23; *P*=0.000) were significantly impacting the buying decision in the choice experiment. The price, on the other hand, was not of high importance for consumers. The data from the experiment revealed that the price had the least impact on the buying decision (ß-coefficient=0.04; *P*=0.1067). Survey data confirmed that price is not of high importance for most of the consumers. When asked to evaluate how important a low price was, almost 70% of the consumers stated that it is not or not at all important when buying a beef product.

Table 1: Results from the Mixed Logit Model[3]

Product attribute	Coefficient	Standard Error	*P*
Organic production	2,66	0,22	.0000
Suckler cow husbandry	1,61	0,23	.0000
Pasture based husbandry	1,23	0,21	.0000
Price	0,04	0,02	.1067

The rearing system was significantly more important to consumers (*P*=0.004)[4] when they were informed about it prior to the choice situation. Further analysis of the variety of the means for the estimated regression model (Tab.1) showed, that a film, which rationally documented information about a suckler cow rearing system, had the highest impact on the buying decision of suckler-based beef (value for heterogenity of the mean (HfM)=1.91). An image film, which emotionally transported the information about suckler cow based rearing also showed a positive impact on buying decision (HfM=0.99) as well as an information leaflet (HfM=0.89).

In addition to the choice experiment, the consumer survey confirmed that animal welfare is a very important attribute when buying a beef product: 81% of the consumers valued this attribute as highly important. Animal welfare is almost equally important to product quality attributes like freshness (78% of the studied population evaluated this attribute as very important) and good taste (74%). Above, results showed that other product attributes, such as grass based feeding (50% valued this as highly important, 33% valued this as important) or ethical values like supporting local economic structures (55%; 31%), the protection of the environment (66%; 27%), conserving biological diversity (46%; 29%) were evaluated to be highly important or important, respectively, for most of the consumers.

[3] Modellspezifikation: McFadden Pseudo R^2 =0,22; Log Likelihood: -1919,98

[4] Using Kruskal-Wallis Non-Parametric-Testing

Discussion

Differentation according to extensive suckler cow rearing system seems to be a promising approach, since it can accomplish consumer preferences for ethical values like animal welfare and environmental conservation.

Even though organic production quality was the most important product attribute, animal welfare was very important to consumers. In the survey it was valued equally important to product attributes like taste and freshness. Suckler cow husbandry was a highly appreciated product attribute in the choice experiment. Especially if consumers were informed about the rearing system, consumers preferred beefsteak from suckler cow rearing in the choice experiment. Additionally, other ethical values such as the protection of the environment and biological diversity seem to be important aspects for market differentiation, which can be accomplished through extensive suckler cow husbandry.

Organic beef products should not only focus on the organic production process, but should differentiate beef products according to the rearing system, like extensive suckler cow husbandry, to meet consumer preferences.

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An agronomic approach to yield comparisons between conventional and organic cropping systems

DANIEL NEUHOFF[1]

Key words: yield limiting factors, BNF, rotation design

Abstract

This paper discusses relevant agronomic aspects related to the comparison of the productivity of organic and conventional cropping systems. In a first step some key requirements are being delineated, which ensure the validity of comparisons. These include the need to consider complete rotation yields and the use of representative amounts of organic inputs. A main chapter is dedicated to the potential of biological nitrogen fixation (BNF) to substitute mineral nitrogen, which currently covers an estimated third (83 Tg) of the total nitrogen input to agricultural fields with a growing trend. Replacing this input by BNF would result in a strong decrease of global cereal production. In regions with sufficient farm land increased legume growing has a considerable potential to substitute N-fertilizers, provided that P-deficiency and pathogens can be managed. In areas with high population density and limited availability of agricultural land, e.g. Bangladesh, differences in output between conventional and organic systems are expected to be high. To bring forward Organic Agriculture (OA) as a sustainable method of global food production with high process quality, it is suggested to focus rather on a large scale organic vegetable and fruit production than on global supply of carbohydrates and proteins.

Introduction

The question whether OA-systems are able to supply the current and future global demand for food and feed is a controversial and topical issue in public and political discussions. A sober analysis needs to distinguish between political, economic and agronomic aspects of world nutrition before integrating them into complex strategies. Political and economic aspects of world nutrition include armed conflicts, rural poverty, access to land as well as availability and affordability of food. These factors are more or less independent of the production system. In contrast the absolute amount of carbohydrates and proteins needed for human nutrition is mainly an agronomic issue, which depends of the productivity, i.e. the yield level and stability of the production systems, and of consuming patterns.

A recent meta-analysis compared conventional and organic yield data of 362 data sets. Crop yields in organic systems were on average 80% of those obtained in conventional systems (de Ponti et al. 2012). Yield differences (conventional = 100% versus organic) showed a wide range, e.g. 40-145% for rice and 21-140% for vegetables. A further meta-analysis partly confirmed these estimations. On average of 316 comparisons organic yields were 25% lower than conventional yields (Seufert et al. 2012). Interestingly, yield differences (67 data sets) were much higher in developing (less 43%) than in developed countries.

This paper critically discusses some key issues of yield comparisons between conventional and organic systems focussing on the agronomic context.

Methodical problems of yield comparisons

The two main problems related to the validity of yield comparisons between different systems are adequate scaling, i.e. the necessity to consider the output of complete rotations, and the selection of representative production techniques. Paired comparisons of individual crop yields are generally only of limited validity since yield over time, i.e. the whole production system is not adequately considered (Connor 2013). Intensive, often unsustainable rice production systems for example in Bangladesh with up to three seasons per year produce high amounts of caloric energy in a short period of time and cannot be run organically without significant yield reductions. These practices however also require convincing solutions for decreasing soil fertility, in particular with respect to soil carbon balance. Organic systems in contrast require the time to grow fertility building crops and are best suited for areas where cropland availability is high and population density is low. Using scarce farmland for fodder crops in contrast is an unrealistic option for cash crop regions.

The validity of a study is also reduced if the empirical data has been generated using non-representative amounts of manure, an occasional practice in OA, e.g. in the Republic of Korea. The approach of applying

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high amounts of manure (substitution method) is also a common practice on some research stations and counteracts the generalisation of yield comparisons. Likewise it is important to distinguish between actual and attainable yields. Under conditions of low input agriculture with missing access to agricultural inputs, conversion to OA may lead to higher actual yields compared with conventional production. A proper comparison however also needs to include the attainable yield, which could be obtained if key constraints were resolved.

Agronomics constraints in OA

Nitrogen supply

A key difference between conventional and organic systems is the availability of nitrogen input sources. Since the end of the Second World War the global use of mineral nitrogen fertilizers has steadily increased. Together with animal manure they constitute the major input of nitrogen in conventional arable land (Bouwman et al. 2009). Soil fertility in OA in contrast is mainly maintained by growing leguminous crops and applying manure. The only relevant factor for net nitrogen input to the soil however is biological nitrogen fixation (BNF) via legumes, since manure is just a by-product. Absolute nitrogen input in fields via BNF is mainly a function of legume share in the rotation, legume total dry matter production and the percentage of nitrogen derived from the air. Net contribution to the soil nitrogen balance further depends on legume use either as green manure, fodder for livestock or cash crop and may vary considerably. A recently published summary of global estimates of N_2 fixed by BNF indicated global averages of 110 - 227 kg N ha^{-1} a^{-1} for fodder legumes and ~ 115 kg N ha^{-1} a^{-1} for grain legumes. The authors estimated that ~ 77% of the N_2 fixed by legumes resulted from soybean production (Herridge et al. 2008). Under temperate climate the N_2 fixing potential in particular of red clover or alfalfa grown in pure stands may be much higher attaining values of ~ 300 - 400 kg N ha^{-1} a^{-1}. Under most practical conditions however, BNF via fodder legumes is much lower, mainly because fodder legumes are preferably grown in mixtures with grasses. The use of fodder crops for animal nutrition further leads to inevitable NH_3 volatilization losses during storage and broadcasting of manure or slurry. The strong dependence of soil nitrogen mineralization of environmental conditions, in particular temperature and humidity may further limit the productivity of organic cereal growing, if crop nitrogen demand is not adequately matched. Under temperate climatic conditions in North Western Europe calculative net nitrogen amounts available in a standard organic crop rotation may attain 50 - 100 kg N per crop and year. In contrast mineral nitrogen input in intensive conventional cereal production systems ranges between 140 - 240 kg N ha^{-1} and may additionally include manure.

According to recent calculations from Bouwman et al. 2009 the total global nitrogen input in agricultural soils (cropland and grassland) amounted ~ 249 Tg in 2000. Mineral nitrogen covered one third of the input (83 Tg), while the contribution of BNF was only 30 Tg. Fixing 83 Tg with fodder legumes with an estimated annual fixation of 165 kg N ha^{-1} would require at a rough estimate ~ 500 Million hectares, which is one third of the estimated arable land world-wide. In any case the partial substitution of cereals by legumes will have consequences on the global cereal supply and would imply a strong change in human food consumption patterns. In countries with high population density and low availability of arable land, e.g. Bangladesh or Japan, this scenario seems not to be very probable. Likewise the lower output of exclusively legume driven rotations often goes along with lower yield stability, since many legume species are known to be self-incompatible. Soil P-deficiency, e.g. in East Africa and the Sahel (Sanchez 2002) and various diseases such as stem rot of clover and alfalfa (*Sclerotinia trifoliorum*) may further decrease the efficiency of BNF.

Biotic constraints for crop productivity

Biotic factors include a wide range of animal pests, pathogens and weeds, which may lead to significant reductions in crop performance. Actual yield losses of major food crops in 19 world regions in the period 2001-2003 were estimated to amount 28.2% for wheat, 31.2% for maize, 37.4% for rice and 40.3% for potatoes (Oerke 2006). *Nota bene* that actual yields are those obtained with the current status of crop protection, which already includes physical, biological and chemical control. Potential losses without any crop protection were estimated to be much higher amounting 67% on average of the four crops, mainly as a result of weed competition. Actual yield losses of different crops in contrast were mainly affected by other factors (insects, pathogens) indicating the use of herbicides in many systems (Oerke 2006).

Weeds in OA, although a serious problem, can be managed by site specific combinations of indirect methods such as crop competitiveness (Drews et al. 2009) and direct methods such as mechanical control. In general, the success of weeding mainly depends on the level of intensity. In contrast, pest and diseases may cause significant yield losses impossible to control via reduced interception of radiation, through early canopy senescence, reduced rates of photosynthesis or reduced partitioning of assimilates from infected leaves (Hay and Porter 2006). For example, diseases such as late blight of potato (*Phytophthora infestans*) may have devastating effects on tuber yield and are still without serious biological control options. Pests and diseases both also affect yield stability, which is of equal importance to absolute yields.

Discussion

Maintaining or increasing crop productivity by mineral nitrogen application is not sustainable as long as nitrogen is synthesized using non-renewable energy sources. Nevertheless, on a global scale energy use for mineral nitrogen production is negligible and ecological problems of nitrogen use such as water pollution are much more relevant. Organic farming systems in contrast have to stick to demanding principles, which include the necessity for sustainable production and the limited intensity of soil use. To fulfil these requirements OA-systems need to have a balance for soil carbon and nitrogen, which includes an adequate proportion of fertility building crops in the rotation. Without them soil N and C soil reserves would be depleted in the medium term with disastrous effects on crop yields. Feeding ruminants on valuable arable land with fodder legumes is only an option for countries with sufficient land resources. Regions with intensive rice production, e.g. in South East Asia with high population densities are currently heavily dependent on nitrogen fertilizers to maintain the production level.

From an ecological and agronomic point of view the greater use of BNF via inclusion of legumes in conventional crop rotations would be beneficial for soil fertility. The extent to which it is possible to replace mineral nitrogen however will mainly depend on the economically feasible proportion of fodder legumes in the crop rotations and the development of global consuming patterns. Another important issue related to conversion scenarios is the effect on production and consumer prices, which is currently not clear, although increases of both seem to be probable. Increases of food prices however are controversial, since they would mainly affect food security of the poor.

Conclusions

Discussions on the world nutrition situation need to distinguish between system immanent and system independent aspects in particular economy and policy. Currently the contribution of OA to global food supply is low (< 1%) and there are no clear indications that OA in the pure form can play a relevant role for global food supply in a larger scale. However, many approaches currently practised in OA may help to increase the sustainability of conventional production systems, e.g. manuring and enhanced growing of legumes. The level of agricultural intensity needed to meet the increasing demand for carbohydrates and proteins still needs to be determined.

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A Practice applicable model for the Assesment of Management Impact on organic matter in arable soils

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Key words: soil organic matter, modelling, decision support, environmental impact assessment

Abstract

We present the HU-MOD-2 model for the assessment of management impact on organic matter levels in arable soils. The model aims at optimal applicability as a management support tool in framing practice and therefore requires only easily available input data. In validation, the tool proved to be capable of giving a rough estimate on soil organic matter changes in arable soils. Taking into account the low demand for input data, the modelling error seems tolerable for a practice applicable decision support tool.

Introduction

Much knowledge exists on the relevance of soil organic matter (SOM) as a factor in crop production. Still, the assessment of management impact on soil organic matter in arable farming practice is difficult. SOM heterogeneity in space is very large compared to short- and mid-term SOM changes, causing a considerable 'noise' in analytical assessments. With this contribution we want to present a model that calculates SOM loss in soils mainly based on nitrogen withdrawal with crop yields, and thus bypasses the need for detailed soil data to predict turnover rates. The model can therefore be used as a decision support tool (DST) in farming practice. A first version of the model has been presented in Brock et al. (2012). At that time, the model applied a bi-partite approach, were SOM loss was calculated based on net N withdrawal with crop yields, and SOM supply was calculated based on C input. The concept performed well in principal, but had difficulties under N limited conditions, when C input was high at the same time. Therefore, we revised the SOM supply submodel and included a stoichiometric approach considering both C and N fluxes in the soil-plant system. By doing so, the performance of the model could be improved. A full description of the model is in preparation (Brock 2014). We would like to outline the model here, as it may have great potential for decision support and environmental impact assessment in organic farming practice.

Material and methods

The original humus balance model HU-MOD has been described in detail by Brock et al. (2012), and the revised HU-MOD-2 version will be presented in detail soon (Brock 2014). Briefly,, the approach of the HU-MOD-2 model for SOM change calculation is:

SOMloss = f (N in crop biomass, effective N sources, mechanical impact, site conditions)

SOMsupply = f (C inputs, N inputs, site conditions)

In order to achieve optimal applicability in practice, the model only requires data on crops in rotation, yield levels, and fertilizer types and amounts. Further, basic site data are required (mean annual precipitation, estimate of the soil clay content and CN ratio). All other parameters included in the calculations (e.g. harvest residues, root biomass, symbiotic N fixation, C and N losses) are estimated by the model.

The revised approach was tested with the same data sets as the initial model version to allow for comparison, and with further data sets to improve validation power. Here we present the results from the model validation in the Organic Arable Farming Experiment Gladbacherhof (OAFEG, cf. Schulz et al. 2014) as an example, as this data set features the highest quality of both crop and soil data.

The experiment was started in 1998 and comprises three "farm type" treatments that differ in crop rotations and fertilization: A "mixed farm" (MF) with a 0.33 share of perennial legumes in the crop rotation and manure of 1 LU cattle ha^{-1}, a "stockless farm with ley" (SFL) and a 0.165 share of perennial legumes, and a "stockless cashcrop farm" (SFC) without perennial legumes in the crop rotation. In the "stockless" systems, all straw, catch crop and ley (SFL only) biomass is left on the field, wereas all straw is exported in MF. Yield data are available for all crops (including catch crops) in all years. Soil data are taken on an annual basis in two topsoil and two subsoil layers. All data are available on the plot level.

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We included the data set for the first two rotations (1998-2009). The model performance was tested applying linear regression.

Results

The modeling results correlated with observed SOC and STN change in topsoils (0-30cm) of the OAFEG (fig. 1). Both with SOC and STN, the regression coefficients are close to 1, indicating that the model in this experiment was even able to quantify absolute SOM change (NB: SOM balance indicates kg SOM-C – target *b* therefore is aprox. 0.1 with STN!).

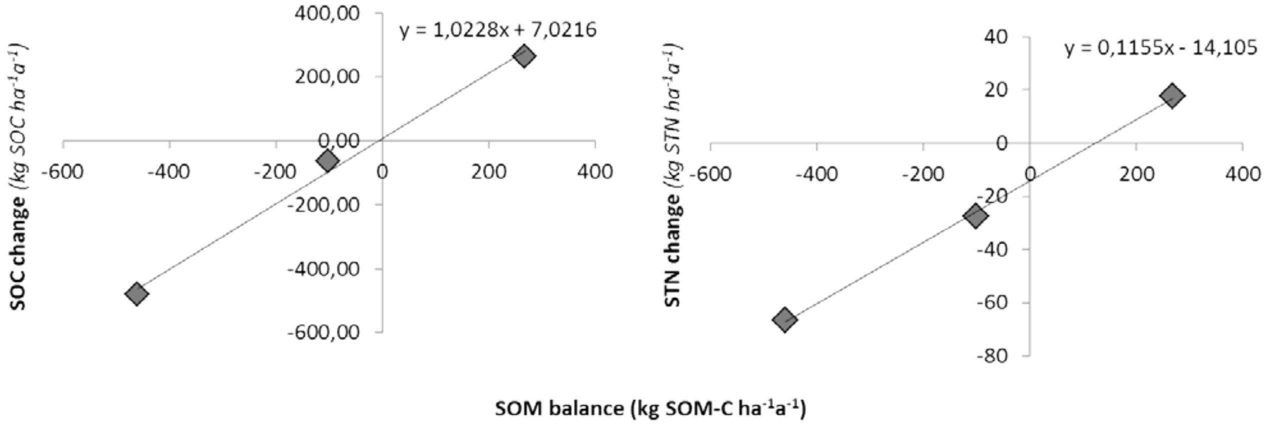

Figure 1. Relation between measured soil organic matter change (indicators: SOC and STN change in the 0-30 cm soil layer) and soil organic matter balances for 'farm type' treatments in the OAFEG long-term field experiment.

Discussion

The performance of the model in the OAFEG supports the model concept. Still, the high performance quality in that experiment must not be repeated under different site conditions, as important ecological drivers of SOM turnover are not –or not sufficiently- considered in the model for reasons of applicability as a practice tool. In fact, performance quality in other experiments usually was lower, even though the model in principal performed well at other sites, too (Brock 2014).

The most relevant sources of uncertainty in the model probably are the estimates of root biomass and symbiotic nitrogen fixation by legumes. Both parameters have a considerable impact on the model result. Still, they cannot easily be assessed under field conditions, and the state of knowledge does not allow for a sufficient parameterization under different site conditions.

Further, the basic model assumption is that the CN ratio of arable soils at a defined site does not change too much in the short or medium term and that the remainder of C and N form various inputs in soils can therefore be calculated referring to that site specific CN ratio. The applicability of this assumption is supported by the validation results. However, the model has only been tested under climate/soil conditions of central Europe up to now. It is possible that the assumption of a low short and medium term variability of CN ratios in arable soils must be revised in other climatic/soil regions, which would make a calibration of the model necessary. With a sufficient data base for this calibration (if demanded), the geographical applicability of the HU-MOD-2 should be easily extendable even to subtropical and tropical regions.

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Livestock in organic farming – how important is it for soil fertility management?

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Key words: farming systems, stockless farming, soil fertility, soil organic matter, rotational ley

Abstract

Stockless management is increasing even in organic farming, but it is not known until now, whether organic matter supply is sufficient in such systems. Results from the long-term Organic Arable Farming Experiment Gladbacherhof (OAFEG) show that after two 6 y rotations, only a "mixed farm" treatment (MF) with fodder legumes in the rotation and cattle manure application corresponding to 1 LU ha^{-1} was able to maintain, and in the long term perhaps increase, SOM levels. The "stockless farm" with fodder legumes as green manure ley (SFL) was barely able to maintain the SOM level, while the "stockless cash crop farm" where organic matter supply relied on green manure catch crops and straw alone (SFC) showed considerable SOM decrease. We conclude that the inclusion of fodder legumes is a crucial prerequisite for sustainable soil organic matter management in stockless organic farming, unless new approaches (e.g. farm cooperation concerning fodder-manure exchange) provide a full substitution.

Introduction

The general orientation in organic farming is a system with livestock (usually cattle), perennial fodder legumes in crop rotations, and farmyard manure application. But, as concentration and specialization of farms increase even in organic farming, roughly 25% of organic farms in Germany do not keep livestock today. In order to evaluate the effects of stockless organic farming in comparison with a "classical" system with cattle keeping and farmyard manure application, the two-factorial Organic Arable Farming Experiment Gladbacherhof (OAFEG) on organic crop rotation/fertilization and tillage effects has been set up in 1998 at Villmar in Hesse, Germany (Schulz et al. 2013). With this paper we want to present results on the effects of the three included crop rotation/fertilization treatments (called "farm types" in the experiment) on soil organic matter levels, nitrogen balances, and crop yields in the first two rotations (1998-2009).

Material and methods

The experiment is located at the Gladbacherhof experimental station of Giessen University at 50° 24' N, 8° 15' E. The soil under the experiment is a haplic luvisol with 285/680/35 g kg^{-1} clay/silt/sand. Mean annual precipitation is 649 mm, mean annual temperature is 9.5°C. Table 1 outlines the three crop rotation/fertilization (farm type) treatments that correspond to a mixed farming system with perennial fodder legumes in the rotation and farmyard manure application (MF), a stockless farming system with rotational ley as a green manure crop (SFL), and a stockless farming system with cash crops in all main crop positions (SFC).

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Table 1: Crop rotations and fertilization in the „farm type" treatments of the OAFEG. Unless indicated differently, stubble crops and underseed are green manure.

Field no. in rotation	Year	MF (Mixed farm)	SFL (Stockless farm with green manure ley)	SFC (Stockless cash crop farm)
1	1998, 2004	*Alfalfa grass* (harvested)	*W. wheat* (1998) / *Oats* (2004) (straw left) +underseed	*W. wheat* (1998) / *Oats* (2004) (straw left) +stubble crop
2	1999, 2005	*Alfalfa grass* (harvested)	*Alfalfa grass* (incorporated)	*Field beans* (straw left) +underseed
3	2000, 2006	*Winter wheat* (straw removed) +stubble crop	*Winter wheat* (straw left) +stubble crop	*Winter wheat* (straw left) +stubble crop
4	2001, 2007	*Potatoes* (450 dt cattle manure ha^{-1})	*Potatoes*	*Potatoes*
5	2002, 2008	*Peas+oats* (2002) / *W. wheat* (2008) +stubble crop	*Peas* (straw left)	*Peas* (straw left)
6	2003, 2009	*Winter rye* (straw removed, 150 dt cattle manure ha^{-1}) +underseed (harvested)	*Winter rye* (straw left) +stubble crop	*Winter rye* (straw left) +stubble crop

Data collection included, inter alia, soil organic carbon (SOC) and soil total nitrogen (STN) contents in topsoils (0-30 cm) on an annual basis, biomass, DM, C, and N contents of all plants (crops and weeds), biomass removal (harvest), and DM, C and N inputs from cattle manure applications. On that basis, we i) analyzed the development of SOC and STN levels under the treatments, ii) calculated soil N balances (i.e. nitrogen balances including quantitative N changes in soil organic matter) and nitrogen use efficiency of the soil-plant system in the treatments, and iii) compared the treatment crop yields.

Results

Table 2 shows the development of SOC levels under the farm type treatments. While an increase is indicated for MF, both SFL and SFC obviously lost SOC over the two rotations. Trends for STN were similar. Even though the trends for MF were not significant, and SOC change was not significant for SFL either, differences in the state of SOC levels in 2009 support the apparent changes (variation of starting values 1998 has been considered). According to our results, the SOC loss in the stockless SFC system corresponds to roughly 0.4 t SOC per ha and year.

Soil nitrogen balances were 41 kg N $ha^{-1}a^{-1}$ for MF, 66 kg N $ha^{-1}a^{-1}$ for SFL, and 79 kg N $ha^{-1}a^{-1}$ for SFC. The potential loss, correspondingly, increased in the same order. At the same time, nitrogen use efficiency in the soil-plant system (data not shown) decreased in the order MF (0.82) > SFL (0.72) > SFC (0.66). This is due to the trends in SOC and STN development indicated above, and to the yield levels in the farming system treatments. The mixed farming system (MF) had a significantly higher yield than the stockless cash crop system (SFC). Total aboveground biomass in SFC was roughly one fourth lower than in MF, the mean non-legume cash crop yield was lower by one fifth, and the sum of all harvested crop biomass was even lower by more than one third. The stockless farming system with rotational ley, however, could keep up with MF, except for the sum of all harvested biomass

Table 2: Aboveground biomass production and yield indicators dependent on the "farm type" in the OAFEG long-term field experiment. Data refer to the second rotation (2004-2009).

	MF (Mixed farm)	SFL (Stockless farm with green manure ley)	SFC (Stockless cash crop farm)
SOC change in 0-30cm (kg C $ha^{-1}a^{-1}$)	233 (n.sig.)	-158 (n.sig.)	-407*
STN change in 0-30 cm (kg N $ha^{-1}a^{-1}$)	7.4 (n.sig.)	-20.2*	-57.0*
SOC state 2009 in 0-30 cm (kg SOC ha^{-1})	54107 a	51273 ab	47881 b
STN state 2009 in 0-30 cm (kg STN ha^{-1})	5962 a	5736 a	5332 b
Aboveground biomass (dt DM ha^{-1})	591	536	440
	a	a	b
Mean non-legume cash crop yields (dt DM ha^{-1} a^{-1})	39,9	38,3	32,9
	a	ab	b
Sum of all harvested biomass (dt CU* ha^{-1})	326	200	208
	a	b	b

Different letters denote significant differences within rows (α = 0,05, Tukey-Test).
Denotations in rows "SOC change" and "STN change" refer to the significance of trends.
DM = Dry Matter. CU = Cereal Units (KTBL 2009).

Discussion

Soil organic matter is of great relevance for crop production in organic farming, and for the production of non-legumes in particular (e.g. Brock et al. 2011). Therefore, losses of soil organic matter are likely to have a negative impact on crop yields in organic arable farming systems. In the OAFEG the slight increase of SOM levels under MF will be an effect of the combined impact of crop rotation and fertilization. Both the cropping of perennial legumes and cattle manure application have been identified as efficient measures in organic matter supply to soils (e.g. Lipavský et al. 2008). Green manure leys cropped with fodder legumes have been identified as key factors of soil fertility management especially in stockless organic farming e.g. by Watson et al. (2002). Our results show, that even this measure could be insufficient for organic matter supply in stockless organic farming systems. Whether it will be possible to maintain SOM levels in organic cash crop rotations, where organic matter supply is based on green manure catch crops and straw alone, cannot sufficiently be assessed until now. Results on green manure catch crops do not indicate a general ability to build up organic matter (Shepherd 1999), and the same is true for straw (van Groenigen et al. 2011).

Conclusions

Sustainable soil organic matter management in organic farming can most easily be achieved by mixed farms with fodder legumes and animal manure. Stockless systems should at least maintain fodder legumes as a green manure ley. Otherwise the sustainability of farming systems may be threatened. Such conditions require the development of new approaches: farm cooperations (fodder-manure exchange), biogas production with recirculation of residues, or intercropping to extend legume shares in rotations.

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Agitation behaviour and heart rate of dairy cows with and without calf-contact during different stimuli in the parlour

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Key words: agitation behaviour, heart rate, calf-contact, stimuli, milking, dairy cows

Abstract

Three stimuli were tested to overcome problems in milk let-down in dairy cows with calf-contact. In this contribution, the effect of these stimuli during milking, on heart rate (HR) and agitation (rumination, posture of the head and behaviour during udder preparation) are presented. Olfactory (calf hair), tactile (teat massage) and acoustic (recorded calf calls) stimulation were tested on 15 dairy cows with permanent calf-contact and 22 control cows. Rumination and posture of the head were not influenced by any factor. Agitation and HR in the parlour were not affected by calf-contact. Acoustic stimulation had a decreasing effect on HR in German Holstein independent from calf-contact. German Red Pied showed more agitation behaviour and a higher HR during udder preparation compared to the German Holsteins. Heifers showed more agitation during udder preparation than pluriparous cows. The results did not indicate higher stress reactions in the parlour of dairy cows with calf-contact.

Introduction

In dairy production it is common that calves are separated from their mothers soon after birth. In contrast, calves are suckled for about 10 month by their mothers if there is no human intervention (Reinhardt and Reinhardt 1982). There is a growing interest in systems with prolonged cow-calf-contact, where the young is suckled by the dam and the cow is also milked. But despite a good development of calves (e.g. Roth et al. 2009) and a better social ability of calves (Wagner et al. 2010) and heifers which stayed the first weeks in life with their mothers (Wagner et al. 2012), problems with milk let-down during machine milking due to disturbed alveolar milk ejection (reviewed by Barth et al. 2008) constrain the realisation in practice. Udder preparation before milking is an adequate stimulus for oxytocin ejection in dairy cows without calf-contact, but is possibly insufficient in cows with calf contact. Moreover, an increased stress response during milking may lead to inhibition of oxytocin ejection (reviewed by Bruckmaier and Wellnitz 2008). In our project possible effects of acoustic, olfactory and tactile stimuliation on milkability of dairy cows with permanent and without calf-contact were investigated. In the following effects of these stimuli on the stress indicators agitation behaviour and heart rate (HR) in the parlour are presented.

Animals, materials and methods

The experiment was carried out between November 2010 and May 2011 at the Thuenen-Institute of Organic Farming (Germany). There were two herds of 45-48 horned dairy cows of the breeds German Holstein and German Red Pied. They were housed separately but under same conditions (for details Wagner et al. 2012). Fifteen cows had contact to their calf for the first 12 weeks post partum (p.p.) (contact group). They stayed for five days after parturition together with their calf in a calving pen, which they only left for milking and feeding. Thereafter the dairy cows were integrated into their herd. Calves could freely move between the calves' area and the lying area of the cows. Cows of the control group (n=22) were separated within 12 hours p.p.. All cows were milked twice daily in a 2x4 tandem milking parlour (GEA, Boenen, Germany): 38 kPa milking vacuum, 40 s vibration stimulation, automatic stripping and cluster removal. The milking routine, used as control treatment, consisted of manual premilking and cleaning of the udder (approx. 20 s), attaching and positioning of milking cluster, as well as manually check of the udder after cluster removal and if necessary milking cluster was attached again. During the measurements animals were milked by one milker who was familiar to the cows. During olfactory stimulation cows were confronted with hair of the anogenital region, hind legs and tail of their own calf. The hair (approx. 0.8 g per milking) was filled in a thin cloth bag, sprayed with distilled water before milking and put in a stainless steel punnet, installed at the head region of the milking box. For tactile stimulation, after premilking and cleaning of the udder, teats were

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massaged in a standardised way. Udder preparation and massage took 60 s together and no automatic vibration stimulation was applied. Acoustic stimulation consisted of calf-call play-backs from ten 2-12 weeks old calves kept on the farm of the University of Kassel, approx. 10 h after their last milk feeding. Between the fifth and seventh week of lactation the three stimuli were applied in the parlour. In each week at four consecutive milkings each one stimuli and routine milking as a control was carried out. Between different treatments, there were one to two days of routine milking without data recording. The order of stimulation and routine milking during the week was as far as possible randomised. Six cows of the control group had stillborn calves or their young died soon after birth, so no olfactory stimulation was possible. Further, missing data occurred due to udder and technical problems during videotaping or heart rate measurement.

Agitation behaviour

Behaviour during milking was videotaped (Axis 221 network-cameras, 640x480 pi zoom lens, Axis Communications, Lund, Sweden) and analysed with ObserverXT® (Noldus Information Technology, Wageningen, The Netherlands) by two observers. Inter- and intra-observer reliability was acceptable before, during and after the observation phase (Cohen's Kappa Coefficient >0.65). Graphically no influence of daytime could be detected. Thus medians for each animal per treatment were calculated and if applicable rounded to 1. Data were analysed with R 2.15.0 (R Foundation for Statistical Computing) with a generalized linear mixed effects model for binomial data (Bates et al. 2012) with the fixed factors treatment, calf-contact, breed, parity (primiparous vs. pluriparous), and animal as random factor. It was checked that there were no interactions. Through contrasts the routine milking was compared with each stimulus.

parameter	definition
behaviour during udder preparation	0=calm or max. three steps 1=more than three steps and/or kicks
ruminating at milking	0=no ruminating 1=ruminating
posture of the head at milking	0=no or seldom changes of position 1=frequent changes of position

Table 1: Definition of behaviours observed in the parlour

Heart rate

During the fourth week of lactation animals were habituated to wear the belts for HR measurement. Only during morning milkings HR was measured with Polar S810i and RS800CX (Polar Electro Oey, Kempele, Finland) in beat-to-beat interval. The HR equipment (without monitor-watch) was attached after the afternoon milkings, when the cows were locked at the feeding rack. The monitor-watch was activated and fastened at the belt after a cow had entered the milking box in the morning. Approximately 5 minutes after this manipulation the milking started. Sequences for analysis were selected and corrected with the software Polar Trainer 5.0. Data where more than 5% should be corrected were excluded from analysis. Due to missing values HR of 15 contact and 20 control cows was analysed. For the phases 'udder preparation', 'milking' and 'preparation+milking' means for every milking were calculated and these were averaged for each treatment per cow. The HR-differences between treatments were analysed separately for the two breeds with Friedman's ANOVA and Wilcoxon signed rank test as post-hoc test comparing the stimuli with routine milking. The differences in breed were analysed with Mann-Whitney U-test in SPSS (IBM® SPSS Statistics 20.0).

Results and Discussion

There was no significant impact of calf-contact on the investigated variables. Posture of the head and rumination were not influenced by any factor. HR during acoustic stimulation was lower than at routine milking ($p<0.01$), but only in German Holstein (n=14); there was no significant difference in HR between milkings with olfactory or tactile stimulation and the control (Fig. 2). Thus calf calls had a more relaxing influence on German Holstein cows with and without calf-contact. Concerning agitation behaviour during udder preparation no effect of the different stimuli was found (Fig. 1). German Red Pied (n=14-15, median=78.5 b/min) had in tendency a higher HR during udder preparation than German Holstein (n=21-22, median=72.3 b/min, $p=0.052$) and showed more agitation during this phase (57.4% vs. 27.5% of observations agitated, $p=0.003$). In both breeds HR decreased during milking (German Red Pied: median=74.7 b/min, German Holstein: median=70.5 b/min) and there was no difference between breeds any longer. Beside differences in reaction towards human contact between breeds, measurements of activity in the stable (unpublished Barth 2013) point to a greater reactivity in German Red Pied in general. Also agonistic behaviour in the waiting area could have influenced the data. Heifers (n=9) were agitated during udder preparation in 65.7% of observations which was significantly more often than in pluriparous animals (n=28, 30.3%, $p=0.003$). HR did not significantly differ between parities, but as HR is influenced by body weight (Hagen et al. 2005), which was not considered in the analysis, possible differences in HR between parities could be concealed.

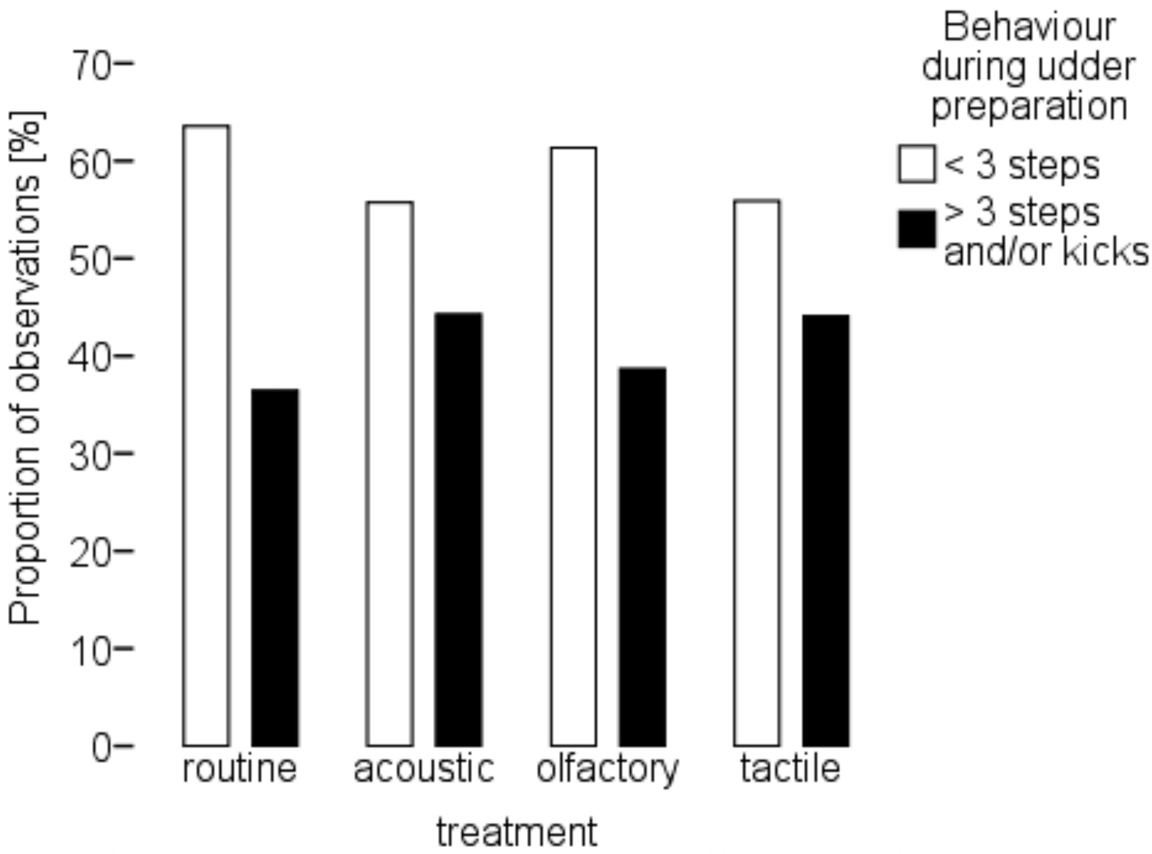

Figure 1: Relative frequency of agitation behaviour at udder preparation according to treatment

Suggestions to tackle with the future challenges of organic animal husbandry

Cows with calf-contact did not show more agitation behaviour in the parlour. The effect of the stimuli on the parameters of the project in total (milk yield, milk flow, HR, heart rate variability, agitation in the parlour) must be considered before final recommendations can be given. Acoustic stimulation had beneficial influence on HR independent from calf-contact.

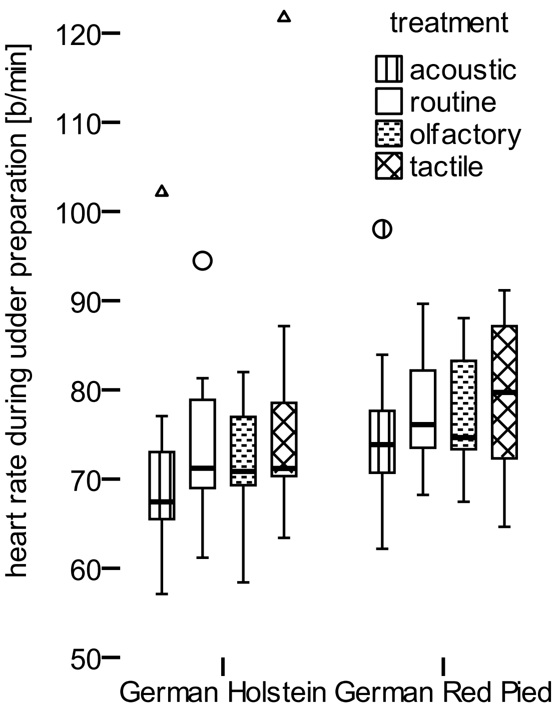

Figure 2: Heart rate (HR) at udder preparation in b/min during different treatments for the two breeds. Box-plots with median (lines in boxes), 25 and 75% quartiles (boxes), 10 and 90% range (whiskers), outliers (dots) and extremes (triangle)

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Bridging the gap - Impact matrix analysis and cost-benefit calculations to improve management practices regarding health status in organic dairy farming

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Key words: systemic approach, impact matrix, production diseases, farm level, complexity, animal health

Abstract

Animal health status in organic dairy farming does not in all respect meet consumers' expectations. Improvements are crucial to support consumers' confidence and their willingness to pay premium prices. Considering animal health as an emergent property of the whole farm system the presented project aims to increase the implementation of evidence based measures and to improve practice of health management. This will be achieved by a multidisciplinary and participatory approach to develop farm specific solutions regarding preventive measures and appropriate treatment strategies.

Introduction

Animal health status in organic farming, in general, does not differ from conventional production and as such does not meet the expectations of consumers with respect to healthy animals as a precondition of healthy food (Sundrum 2012; Cicconi-Hogan et al. 2013). Improvements are crucial to support consumers' confidence and their willingness to pay premium prices. These are urgently needed to cover the higher production costs in organic farming and thus ensure a viable European organic dairy production. Previous herd health planning has contributed to improving farm management and has prepared the ground for further advancements. However, recommended measures have often been implemented only to a low and unsatisfactory degree, differing widely between farms.

In general, production diseases are of complex aetiology. Within a farm situation health related factors are interconnected and influence each other. Accordingly, the animal health status of a farm is an emergent property of the whole farm system and cannot be explained sufficiently by single factors.

The aim of the IMPRO project (www.impro-dairy.eu) is to substantially overcome the weak points in current health management strategies on organic dairy farms and increase the possibilities for proactive herd health management. This will be achieved by a multidisciplinary and participatory approach to develop farm specific solutions regarding preventive measures and early treatment strategies.

The four years of research (2012 to 2016) will be carried out as different work packages.

Material and methods

Beside the workpackages (WP) for project management and dissemination the research topics of the IMPRO project are as follows:

<u>WP2: On-farm assessment of effective measures by an impact matrix</u>

A farm-centric approach, making use of a participatory process and an impact matrix, will be used to identify the measures that are likely to be the most effective to improve animal health status. This will be performed on a selection of 200 farms in four European countries. Regional workshops have been organised within a multidisciplinary framework, involving farmers' organisations, farm advisory services, veterinarians, and scientists of different disciplines to identify appropriate variables in relation to animal health on the farm level to be used in the impact matrix.

<u>WP3: Improving monitoring and prevention on the herd level</u>

A monitoring and adaptive prevention approach will be evaluated in 40 farms in two countries, after prior evaluation of farm specific constraints, options for management, initial health status and variables of interest in WP2. This will enable to determine the added-value of the monitoring and prevention protocols per se. Data necessary for cost-benefit analysis of the proposed protocols will be collected for WP5.

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WP4: Manageability of alternative treatments

Protocols or decision trees for prescribing and using homeopathic remedies will be developed on the basis of the best available scientific evidence. They will then be tested on a sample of farms and compared with the outcomes of more conventional protocols on a separate sample, in the specific case of mastitis.

WP5: Socio-economic implications of changes in the management

Considering the limited availability of resources on a farm, farmers allocate resources to the risk sources which are considered to be of the highest importance. Farmers need decision support to indicate those measures that will give them the highest economic net return within the farm's constraints. Based on the recommendations derived from the impact matrix and the insights on alternative measures a cost-benefit calculation models will be developed, which makes it possible to evaluate required resources and expected benefits of recommended measures and thereby optimises the allocation of available resources.

Furthermore, in WP5 the perceived importance of animal health problems will be evaluated in relation to other sources of production risks.

WP6: Development of a software-based decision support tool

Solutions, elaborated in different work packages, will be integrated into a coherent and easily manageable software tool to support the diagnostic procedure on the farm level with respect to multi-factorial syndromes, and to identify the most appropriate measures to improve animal health.

The integration of economic analysis into the herd management software and the inclusion of a participatory consulting approach by an impact matrix represent a challenge that will lead to an innovative product to disseminate the relevant results of the project.

Results and conclusions

The approach in the IMPRO project integrates information and knowledge gained from different sources into a coherent concept, striving for a high level of fitting accuracy at different scales to the specific health problems and farm specific conditions and constraints. The objective is to achieve a high level of fitting accuracy at different scales following the key-lock-principle.

The IMPRO project will combine a number of methodological approaches for characterising the health status profile of dairy farms. It will identify and validate related variables and specific risk factors in order to assess and implement appropriate measures to achieve an improved health status. Additionally, new farming techniques associated with preventive and proactive measures will be tested in well-defined organic farming systems.

Acknowledgement

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Controlling weeds with natural phytotoxic substances (NPS) in direct seeded soybean

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Key words: soybean, direct seeding, weed control, natural phytotoxic substances

Abstract

At IAPAR institute (Ponta Grossa, Paraná state, Brazil) soybean was direct seeded into residues of precrop black oats (Avena strigosa). Two formulations of natural phytotoxic substances (NPS) were tested for their weed control efficacy. Essential oils (pine oil or d-limonene at 50 L/ha = 8%) were formulated with 50 kg/ha NaCl (8%) and surfactant (1%) and applied at a rate of 600 L/ha. Each formulation was applied once, twice, or three times in weekly intervals starting one week after soybean emergence. A weedy and a clean plot (manually hoed) were used as control treatments. Weed control efficacy was rated visually (0-100 % scale, 70 % is considered "acceptable" in conventional herbicide testing). The single application treatments of limonene and pine oil scored 41 % and 52 %, two applications 53 % and 56 % and three applications 61 % and 67 % respectively. The grain yield for the 'clean' control treatment was highest with 4.07 t/ha and lowest for the untreated control treatment with 2.61 t/ha. The limonene treatments yielded 3.07, 3.22, 3.57, and the pine oil treatments 2.68, 3.00 and 2.96 t/ha with one, two and three applications, respectively. The lower grain yields of pine oil despite better weed control efficacy can be explained by phytotoxic effects of the applied formulation product which accidentally came in contact with soybean crop during application.

Introduction

In the humid tropics torrential rains on tilled soil can cause devastating erosion, Thus, loose-soil husbandry fails to be sustainable. Direct seeding systems prevent erosion, save labour and diesel costs (Holland, 2004). Hence, dense soil husbandry is of great interest to Organic Farming in the tropics. Nevertheless, omitting mechanical weed control direct seeding in Organic Agriculture is limited by the lack of efficient weed control measures such as herbicides, which are common in mainstream agriculture enabling weed control without risking soil erosion. High amounts of straw residues of allelopathic precrops (e.g. *Avena strigosa*) may limit weed infestation during the early development stages of crops considerably (Derpsch et al., 1988) and are one strategy to make occasional direct seeding viable for Organic Agriculture. Nevertheless, the initial weed suppression is often not sufficient and after crop emergence additional control measures are necessary. Labour cost for manual hoeing is high and mechanical hoeing cannot be performed successfully in direct seeding systems due to straw residues and the compact top soil. Hence, additional application of natural phytotoxic substances (NPS) may enable organic farmers to make use of direct seeding in the tropics.

Registered products for weed control that are approved in some countries for use in Organic Agriculture do exist. These products are based on citronella oil (e.g. Barrier H®), d-limonene (Avenger Organic Weed Killer®), Pine-Oil (Organic Interceptor®) (James et al., 2002), acetic acid or pelargonic acid (e.g. Finalsan®). Damage to cuticle and cell membranes is the mechanism of action of all products which leads to desiccation of aerial parts that come in contact with the product. As none of these products has a systemic effect weed meristems often remain intact and plants resprout. Compared with common synthesized mainstream herbicides the efficacy of available NPS is generally lower. Due to high costs use of NPS in agriculture is currently limited.

From 2011 to 2013 a research project on various aspects of the use NPS in direct seeding of grain legumes was conducted primarily at research stations of the Agronomic Research Institute of Paraná State, Brazil (IAPAR). In screening tests we found that mixing NaCl into formulations of known NPS (pine oil, d-limonene) enhances the effect considerably (data not shown). Therefore, the concentration of pine oil and d-limonene (cost critical ingredients) can be lowered and thus, the costs decreased. Also to some extent NaCl proved to have a systemic effect on weeds by destroying meristems that are not directly hit by the spraying solution, killing the plants more effectively or inhibiting resprouting for a longer period. This paper deals with the weed control efficacy and the effect of sequential NPS applications (1, 2 and 3 applications) of two different formulations containing d-limonene or pine oil mixed with NaCl on soybean grain yield.

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Material and methods

Soybean was planted with a direct seeding machine (model Kuhn PDM PG 700) at a seeding density of 30 grains per m² and 45 cm row width on November 6, 2012. Crop establishment occurred one week after. In former years the experimental site at IAPAR research station in Ponta Grossa (25°05'42"S, 50°09'43"W, 975 m a.s.l.) was used for trials on seed bank diminution. Therefore, a randomized split-plot experiment with two whole plot treatments ("Low" and "High" weed density - 30 and 120 weed plants per m² respectively), four replicates, and eight subplot treatments was established. The eight subplot treatments consisted of two NPS formulations, which were applied once, twice or three times in weekly intervals:

Limonene: d-Limonene 8 % (50 L/ha) + NaCl 8 % (50 kg/ha) + 2 % Emulsifier

Pine Oil: pine oil 8 % (50 L/ha) + NaCl 8 % (50 kg/ha) + 2 % emulsifier

The banded application was realized with a CO_2-pressured agricultural sprayer with a 110-025 nozzle at 1.9 bar at a rate of 600 L/ha. The nozzle was approx. 10 cm above ground and the spray fan covered approx. 35-40 cm of the 45 cm row interval (effective application rate approx. 500 L/ha). Eight days after emergence (DAE) the weed density was evaluated and the first application carried out. The second application followed 14 DAE and the third and last application 22 DAE. Weed control efficacy rating was done 14, 22, 27, and 36 DAE. 36 DAE the phytotoxicity effect on soybean resulting from the lack of a protective screen was evaluated too. 78 DAE (beginning to full pod stage) weed shoot and soybean shoot biomass (1.4 m² and 1.1 m² sample size per plot) were determined. Soybean grains were harvested 131 DAE (4.2 m² sample size per plot) and weight and grain humidity determined.

Results and Discussion

The most abundant weed species on the trial site were *Brachiaria plantaginea, Euphorbia heterophylla, Bidens pilosa and Alternanthera tenella*.

5 days after the third application (27 DAE) the weed control efficacy of Limonene and Pine Oil was 41 % and 52 % for one application. Two applications resulted in 53 % and 56 % and three applications in 61 % and 67 % weed control efficacy respectively (Figure 1). A 70 % rating is considered to be an acceptable result in conventional herbicide testing.

Grain yield average over both weed densities was highest in the "clean" treatment with 4.07 t/ha and lowest for the weedy treatment with 2.61 t/ha. The limonene treatments yielded 3.07, 3.22, 3.57, and the pine oil treatments 2.68, 3.00 and 2.96 t/ha with one, two and three applications, respectively.

Despite slightly better performance in the weed control rating the lower yields of pine oil can be explained by phytotoxic effects of the applied solution which came in contact with soybean during application without protective screen (data not shown). In following experiments an adapted protective screen was available that effectively avoided crop damage. Figure 2 shows the grain yield subdivided by weed density. Comparable yields to the "clean" treatment (hand weeded) were achieved with NPS, when weed density was not too high and application repeated two to three times.

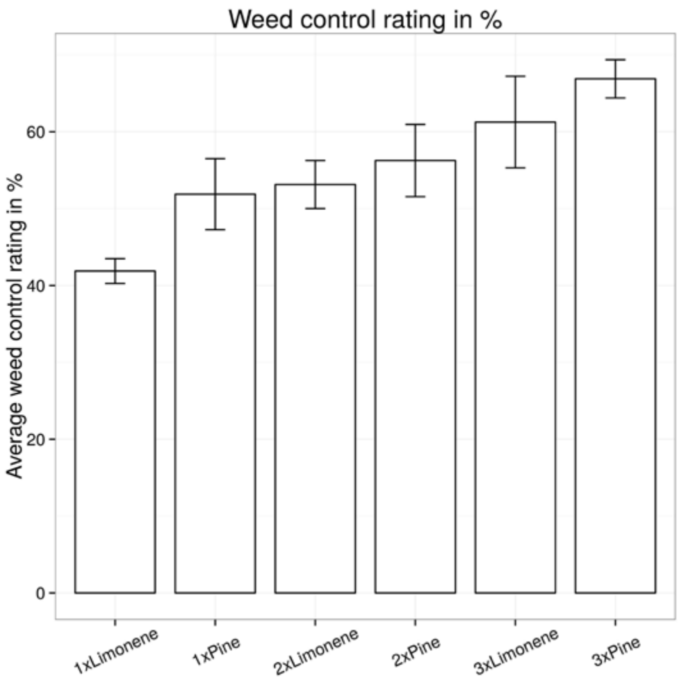

Figure 1. Weed control ratings after 3rd application

In later experiments we observed that an interval between applications of one week is too long for mid-summer conditions. Resprouting of most surviving weeds occured approximately 3-4 days after application. After one week some weeds will have regrown to their size before application. A shorter application interval of about 4-5 days would damage the sensitive sprouting tissues and increase the mortality of weed plants compared with a 7-8 days interval.

NaCl is cheap compared with ingredients like pine oil or d-limonene. Using NaCl can lower application costs considerably. Nevertheless, the application of NaCl to agricultural soils has to be examined critically. It is believed that there is no risk of accumulation of NaCl in the soil under humid tropical conditions, as salt is readily

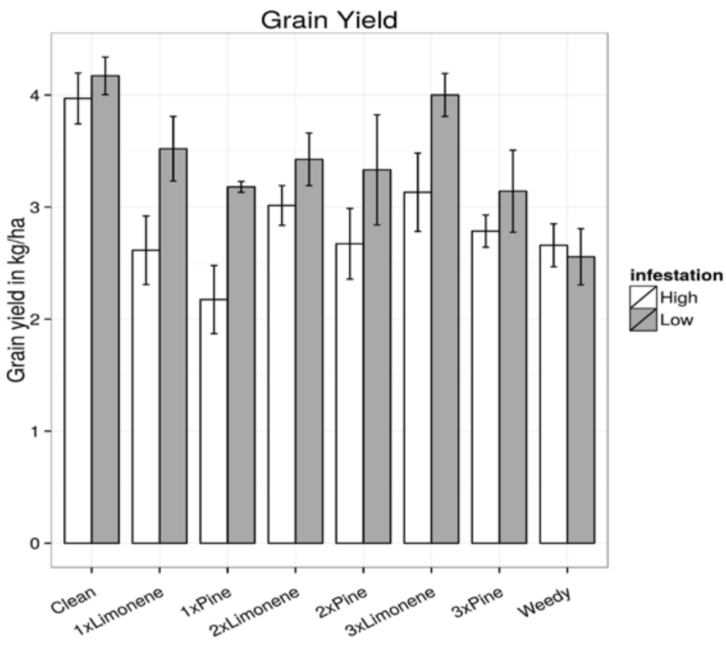

Figure 2. Soybean grain yield for low and high weed densities

leached out. No doubt that application of NaCl is not feasible under drier climates where the risk of salt accumulation would be too high.

Many aspects of NPS-application have to be elucidated further, but first results seem promising. Aspects such as formulation, application technique (nozzle type, pressure, protective screen, optimal application rate, application timing) and optimal environmental conditions (time of day, temperature, solar radiation) as well as sensor driven single plant application have to be investigated intensely.

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Earthworm abundance and species richness: contribution of farming system and habitat type

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Key words: agricultural habitats, natural habitats, alley cropping, rarefaction, extrapolation

Abstract

The aim of this study was to investigate whether earthworm populations in different habitats and under different farming systems (organic vs. integrated) are different. Arable land was compared with alley cropping systems, meadows and field margins. For comparison there were also investigations on the three natural habitats fallow, forest and forest edge. The field study yielded the following results: In the meadow, the tree row within the alley cropping system and in the natural reference habitats (with exception of the studied forest), the abundance and species diversity was higher compared with arable land. In addition the tree rows in the alley cropping system had a positive effect on the earthworm population. The arable fields in the alley cropping system stood out due to higher abundance and species diversity compared to similar arable land without tree row. Moreover, differences in the earthworm population became apparent in the consequence of organic or integrated farming. In all habitat types higher earthworm abundance was found in the organic farming system. Concerning species diversity, the results differed from each other in the different habitats.

Introduction

The goal of the paper is to reveal the differences in earthworm populations in different habitat types and farming systems concerning abundance and species richness. Whereas earthworm populations are well studied in most agricultural habitat types and farming systems, there are only a few studies on earthworms in agroforestry systems in temperate regions. Moreover information about species richness refers mostly just to the number of species found on the investigated plots. That could be problematic because number of species found within a single plot can depend on various factors. To deal with that problem we used species accumulation curves that ensure better standardization and comparability of the results (Gotelli & Colwell 2001).

Material and methods

The field study was conducted at the experimental farm in Scheyern (South Germany). As in Scheyern an integrated as well as an organic farming system was installed in 1992, both, organic and integrated sites were examined. Table 1 illustrates the management practices. Survey took place in following habitat types: Arable field, alley cropping system installed in 2009 (Poplar in the tree row, arable stripe), meadow and field margin as well as the natural habitats forest, forest edge and fallow. For this earthworms were extracted by a chemical expellant solution (0,01 % Allylisothiocyanat) from plots with an area of 0,09 m². This was followed by handsorting down to 30 cm soil depth. There were three replications per habitat with one replication containing of four individual plots measured. Sampling took place in spring 2012. Adult earthworms were identified to species level and number of individuals and biomass was measured. From plot size and number of individuals earthworm abundance (Individuals m^{-2}) was calculated. Statistical analyses were performed using R (R Core Team 2013) and the iNEXT version 1.0 package for R (Hsieh et al. 2013).

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Table 1:Management characteristics

	Integrated farming	Organic farming
Crop rotation	Potato – Winter wheat (Catch crop (CC): mustard) – Corn – Winter wheat (CC)	Alfalfa-grass-clover (AGC) - Potato – Winter wheat – Sunflower – AGC – Winter wheat – Winter rye
Pesticide use	Herbicides, Fungicides, Insecticides	None, except copper based fungicide in potatoes
Soil tillage	Conservation (Cultivator, 10 cm)	Inverting (Plough, 25 cm)

Results

With regard to the habitat type in the meadow, in the field margins, in the poplar within the alley cropping system and in the natural reference habitats (with exception of the studied forest), earthworm abundance was higher compared with the arable land. In addition the tree row within the alley cropping system had a positive effect on the earthworm population. The arable field within the alley cropping system stood out due to higher abundance compared to similar arable land without tree rows. Simultaneously all organic managed habitats showed higher earthworm abundance than the comparable integrated managed habitat types (Figure 1).

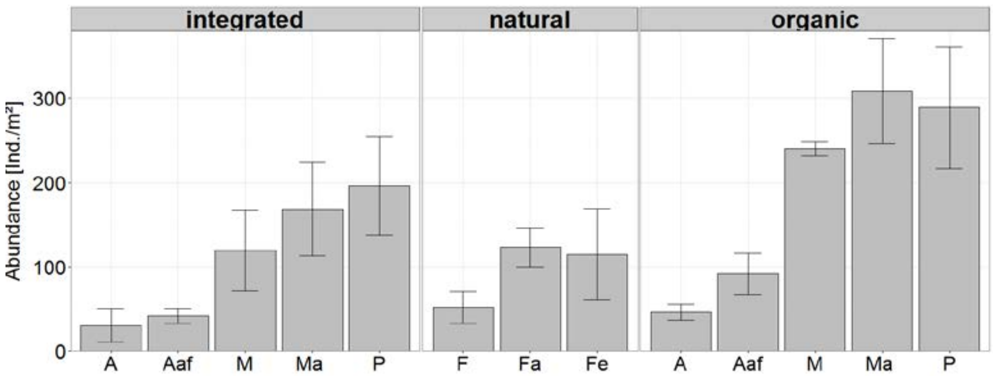

Figure 1: Overall mean earthworm abundance [Individuals m^{-2}] in various habitats (A= arable land, Aaf= arable land agroforestry, M= meadow, Ma= margin, P= poplar, F= forest, Fa= fallow, Fe= forest edge) in different farming systems. Error bars show ±standard deviation.

The evaluation of species richness showed the following results. The natural habitats (except the forest) as well as the margins, meadows and the poplar had higher species richness compared to the arable fields. By contrast the arable fields in the agroforestry system had higher species richness values as the arable fields without tree rows (Figure 2).

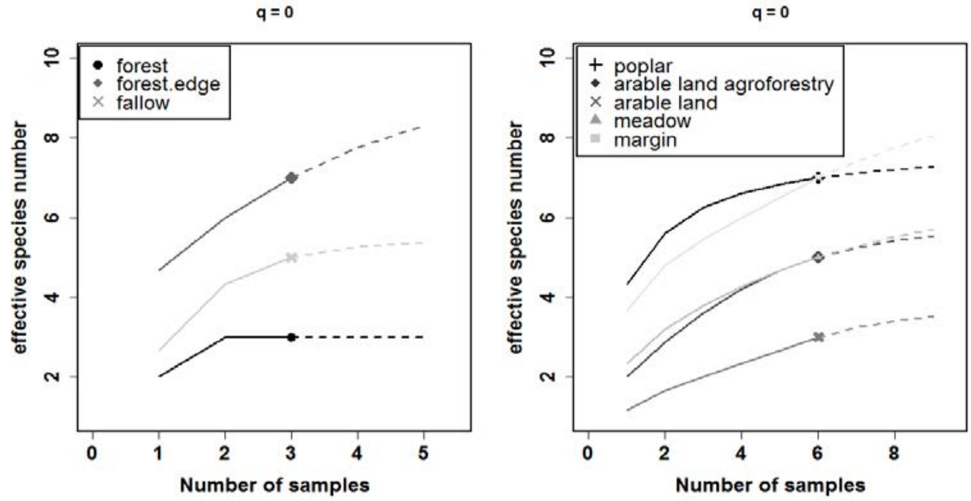

Figure 2: Sample-size-based rarefaction and extrapolation of accumulation curves.

Based on farming system the accumulation curves pointed out higher γ-diversity (overall species number within a management system) in the intergrated farming system whereas α-diversity (mean number of species per plot) was little higher in organic farming. If the analysis was conducted only on the intensive managed arable fields, there was higher species diversity on the organically managed arable fields (Figure 3).

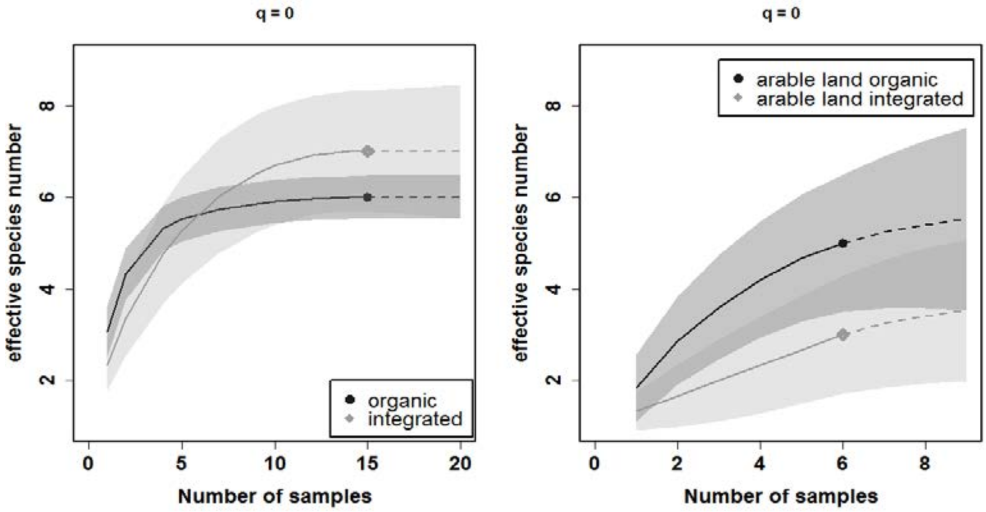

Figure 3: Sample-size-based rarefaction and extrapolation of accumulation curves with shaded 95% confidence regions.

Discussion

In Scheyern the positive effect of organic farming on the earthworm population is due to the favourable input of organic matter in terms of quantity and continuity of food supply throughout the year (see Riley et al. 2008). The negative effect of the plough reported in literature (Jordan et al. 2004, Johnson-Maynard et al. 2007 etc.) seems not to influence the earthworm population in this study. It seems that with increasing management intensity the habitat types differed more in species diversity due to organic or integrated farming.

Obviously the tree rows in the alley cropping system had a positive effect on the earthworm population not only in the tree row but also in the arable field. There´s possibly a positive influence from a changed microclimate, with the less climatic extremes and the additional organic matter from leaf fall (Price & Gordon 1999).

An enhancement of the earthworm population is especially important for organic agriculture which depends on ecosystem services like the promotion and regulation of soil fertility and its beneficial effects to plant growth or carbon and nitrogen cycling (Edwards & Bohlen 1996). Moreover the tree rows themselves could be a useful element in the landscape for nature conservation. They offer a biosphere that´s comparable to natural habitats.

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Root growth response of spring wheat (*Triticum aestivum* L.) and mallow (Malva sylvestris L.) to biopore generating precrops

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Key words: subsoil, biopore, root-length density, profile wall method, root architecture

Abstract

Little is known about root growth in biopores. The aim of this study was to quantify differences of root-length density (RLD) in biopores between a tap root system (mallow) and a fibrous root system (wheat).

A field experiment was undertaken near Bonn, Germany on a Haplic Luvisol developed from loess. Lucerne (Medicago sativa L.) and chicory (Cichorium intybus L.) were grown as precrops in a field trial followed by spring wheat (Triticum aestivum L.) and mallow (Malva sylvestris L.). Biopore density was measured on horizontal areas of 50 x 50 cm. RLD was estimated using the profile wall method to 160 cm soil depth. Roots growing in biopores with a diameter > 2 mm were recorded separately from the roots in the bulk soil.

Biopore density was higher after chicory compared to lucerne cultivation. RLD of wheat in the topsoil was higher and in the subsoil lower than RLD of mallow. RLD in biopores of mallow was higher than of wheat. Both crops showed higher RLD in biopores after chicory.

The results indicate that the response of root growth to the presence of biopores is more pronounced for tap root systems than for fibrous root systems.

Introduction

Biopores are created by roots or earthworms and/or other soil organisms and can possibly facilitate the access of roots to water stored in the subsoil (McKenzie et al. 2009; Gaiser et al. 2012). This might be of major importance in the future as it is predicted that climate change will lead to more frequent dry spells in middle Europe (Gornall et al. 2010). To date, few attempts have been made to quantify root growth in biopores (Kautz & Köpke 2010). For example it is unclear whether plants with different root systems (tap vs. fibrous roots) use biopores to a different extent.

In this study we quantify biopore density generated of two different taprooted precrops and compare the root-length density (RLD) of following crops (spring wheat and mallow) to determine the relevance of biopores for different root systems.

Material and methods

The field experiment was conducted on a Haplic Luvisol (WRB) derived from loess (loamy silt) on the research station of the university of Bonn Campus Klein-Altendorf, Germany (50°37'9''N 6°59'29''E) with a mean annual temperature of 9.6 °C and 625 mm annual rainfall.

The taprooted lucerne (*Medicago sativa* L.) and chicory (*Cichorium intybus* L.) were grown as precrops continuously for one or two years in order to increase the number of biopores. After these precrops two species with a contrasting root system were grown: mallow (*Malva sylvestris* L.) with tap roots and spring wheat (*Triticum aestivum* L.) with fibrous roots.

Only after the decay of blocking roots all the biopores established by these roots are visible (Jones et al. 2004). Therefore the areas designated for biopore quantification were excavated to 45 cm soil depth in 2010 after the precrops were plowed and a GeoTex-sheet was placed on the horizontal surface in order to prevent the creation of new pores through roots. After two years in spring 2012 when most of the roots of lucerne and chicory have decayed the biopore density of medium (2 – 5 mm diameter) and large (> 5 mm diameter) sized biopores was measured. The horizontal soil surface was cleaned from soil particles with a vacuum cleaner and the biopores were marked accordingly to their diameter on plastic sheets.

Root-length density (RLD) of spring wheat (July 27th to July 30th 2010) and mallow (August 18th to August 20th 2010) was estimated with the profile wall method (Böhm 1979). Observations were made in four treatments (spring wheat and mallow grown after lucerne or chicory) in two field replications. An excavator was used to install a trench (depth: 1.8 m). A 100 cm wide soil profile wall was smoothed transversely to the plant rows with a spade to the maximum depth of investigation in 1.60 m. Roots exposed from the wall were removed by scissors. With a fine spray of water at 3 bar pressure and using a small toothed scraper, a 0.5 cm thick soil layer was washed away along the vertical wall of the soil pit to expose the roots. A frame

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(inner dimensions 100 cm x 60 cm with a grid of 5 x 5 cm) was attached to the profile wall. Root-length units (RLU) equivalent to 0.5 cm root-length were recorded in each square. RLD (cm root cm^{-3} soil) was calculated based on RLUs for each cube with a volume of 5 x 5 x 0.5 cm.

Results

Density of medium (2 – 5 mm in diameter) and large (> 5 mm in diameter) sized biopores was higher after chicory cultivation compared to lucerne cultivation (Fig. 1). After chicory cultivation 126 large sized pores per m^{-2}, after lucerne cultivation 96 large sized pores per m^{-2} were measured, the difference was not significant. The density of medium sized biopores was 248 pores per m^{-2} after chicory (significant) and 169 pores per m^{-2} after lucerne cultivation.

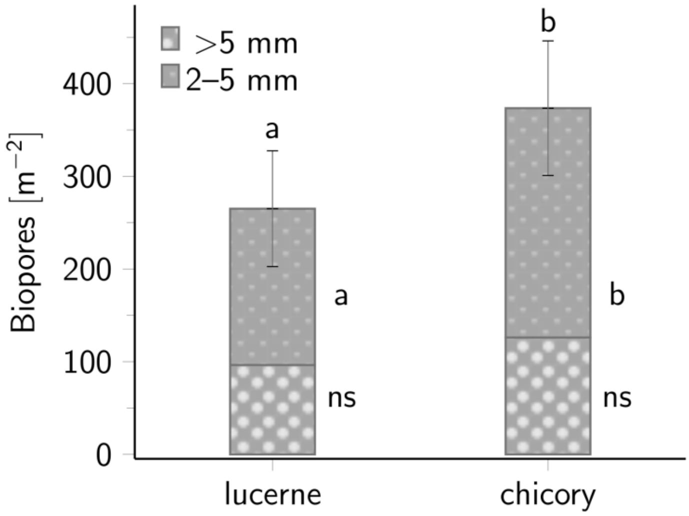

Fig. 1: Density of biopores (> 5 mm and 2-5 mm diameter classes) as a function of precrop (lucerne or chicory). Different letters indicate significant differences (t-test, α=0.05), ns: not significant, error bars show the standard deviation.

In the topsoil (above 45 cm soil depth) wheat had higher total RLD than mallow which changed for the subsoil (45-160 cm) as the decline of RLD with depth was steeper for wheat (Fig. 2). The relative amount of roots in subsoil biopores was for both crops highest after chicory and reached up to 18 % of the total RLD. Generally, the share of roots in biopores was higher for mallow than for wheat after both precrops.

Total RLD and RLD in biopores of mallow were tendencially, but not significantly higher after chicory precrop. In contrast wheat only showed higher RLD in biopores after chicory, whereas the total RLD was similar for both precrops.

Discussion

The results indicate that response of root growth to the presence of biopores is more pronounced for taproot systems than for fibrous root systems. This is also supported by visual impressions of barley and oilseed rape gained by endoscopy (Athmann et al. 2013). For mallow and wheat the amount of RLD in biopores was tendencially higher after chicory than after lucerne. This might be due to higher biopore densities (>2 mm) after chicory (374 m^{-2}) in comparison to lucerne (265 m^{-2}) (Fig. 1). It can be assumed that the differences of biopore density showed in 45 cm soil depth remain in deeper soil layers as it has been shown in the same field trial (Perkons et al. 2013).

The steep decline of root-length density in biopores below 105 cm might indicate that in the C-horizon biopores are less relevant than in the comparatively dense Bt-horizon.

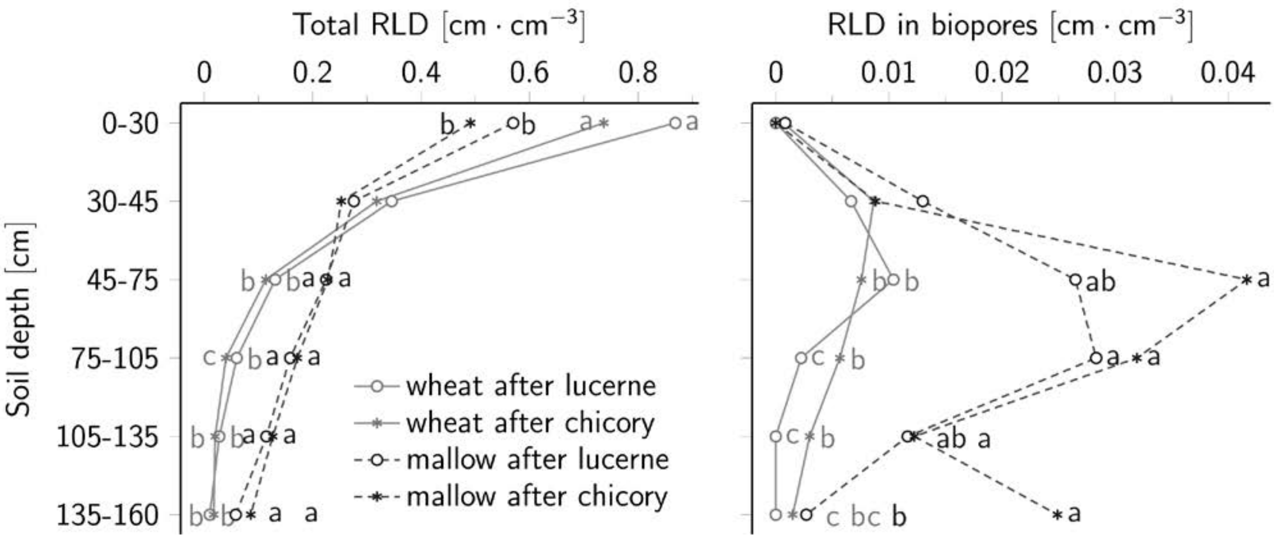

Fig. 2: Total root-length density and root-length density in biopores (diameter class >2 mm) of spring wheat and mallow grown in 2010 as a function of precrop (lucerne or chicory) and soil depth. Profile wall method. Different letters indicate significant differences (Kruskal-Wallis-test followed by stepwise multiple comparison procedures (Campbell & Skillings 1985), α=0.05).

Conclusions

It is concluded that the relevance of biopores in the subsoil for facilitating root growth depends on the specific characteristics of the root system. Spring wheat had a high RLD in the topsoil and less RLD in the subsoil whereas mallow had a significantly lower RLD in the topsoil but a significantly higher RLD in soil depths below 45 cm. Even though the RLD in biopores differed strongly between the root systems, spring wheat as well as mallow showed an increase in RLD in biopores with increasing biopore density.

Acknowledgments

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Knowledge transfer regarding animal health

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Key words: conflicting areas, stakeholder analysis, system justification, organic livestock farming, reflection, conflicting areas

Abstract

Barriers in the process of knowledge transfer in terms of animal health have been the topic of a study taking different stakeholder perspectives into account. Using instruments of communication science, the perspectives of farmers, agricultural and veterinarian advisors as well as animal scientists were brought together and discussed. The process revealed the following obstacles in the transfer of knowledge concerning animal health: diverging understanding of animal health, complexity of the processes leading to diseases, unclear responsibilities, and role conflicts. In face of these barriers we conclude that the targeted transfer of knowledge is considerably aggravated. Hence, restructuring of the communication process and framework conditions of knowledge transfer is required.

Introduction

Animal health is an issue of increasing interest by consumers in search of "healthy" products from animals' origin. Contrary to consumer expectations organic farms in general do not provide a higher animal health status than conventional (Cicconi-Hogan et al. 2013; Sundrum et al. 2010). Several studies revealed an unsatisfactory animal health status, varying more between single farms than production methods (Vaarst et al. 2008). Correspondingly, farm management plays a key role for improvements of the animal health status, relying on the perception of diseases and targets as well as on the decisions and implementations.

The enduring high level of production diseases questions the effectiveness of the previous approach of knowledge transfer with respect to animal health. Therefore, barriers in the process have been the topic of a study taking different stakeholder perspectives into account. The communication process was analysed using instruments of communication science.

Material and methods

Farmers, agricultural and veterinarian advisors as well as animal scientists were identified as primary stakeholder in the process of knowledge transfer on the topic of animal health. To assess their specific perspectives, separate workshops for each stakeholder group were held to start with and complemented in due time by a common workshop with all participants. To foster unbiased debates, the project team limited itself to an observer role, leaving the moderation of the workshops to a skilled and impartial communication expert.

Workshop topics included a brief estimation of different animal health situations by a questionnaire, discussions on sources of knowledge, individual environmental (stakeholder) analysis, and reflections on obstacles within the process of knowledge transfer.

In the final common workshop interim results from the first workshops, as well as a brief reflection from the communication expert were reported and discussed. Thereafter the participants worked in small groups on topics identified during the separate workshops and reflected on options of activity. Altogether 26 farmers, agricultural and veterinary advisors, and animal scientists participated in the project.

The outcome of the workshops was evaluated by qualitative content analysis, descriptive statistics, and inter-rater reliability, focussing on the communication structure including role models.

<u>Assessment of herd health situations:</u>

Five different animal health situations were presented to the participants by pictures (2), video (1), and data sheets (2). Questions on the situations were answered by the participants individually. Among others, one situation was presented by data on somatic cell counts, another situation by the results of the meat inspection at the slaughterhouse on lung affections in fattening pigs. The participants were asked to give an

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assessment on the herd health status on a visual analogue scale (VAS) by marking a point on a line between the end-points “very good” (0) and “very bad” (10).

Ranking of measures to improve a situation:

For each of the five situations a set of six to eight measures was ranked by the participants according to their estimation of importance. The ranking of measures was compared by Kendall's coefficient of concordance within and between the workshop groups.

Environmental stakeholder analysis:

All participants elaborated individual environmental stakeholder analysis (ESA) on the topic on animal health, showing stakeholders and environmental factors. Items were written on cards in three different sizes, referring to their importance. The cards were placed on posters showing their relation to the topic and each other. Following the steps of qualitative content analysis the items were condensed in categories and evaluated according to their size and position.

Results

Assessment of herd health situations:

The tables 1 and 2 show the assessments of the presented udder and respiratory health situations. For both the estimations differed considerably within the groups, showing more variation in the workshop groups of the advisors and scientists than the group of farmers.

Table 1: Assessment of a herd health status concerning udder health on a visual analogue scale (VAS)

Workshop	N	Min.	25th percentile	Median	75th percentile	Max
Advisors'	9	3,7	6,5	8,2	8,9	9,6
Farmers'	8	3,4	5,8	6,6	6,8	8,3
Researchers’	9	3,3	7,0	7,4	8,3	8,8

VAS end-points: 0 = very good, 10 = very bad

Table 2: Assessment of a herd health status concerning respiratory health on a visual analogue scale (VAS)

Workshop	N	Min.	25th percentile	Median	75th percentile	Max
Advisors'	9	2,9	4,9	7,8	8,5	10,0
Farmers'	7	5,3	6,4	6,7	7,0	7,5
Researchers’	9	3,8	6,3	6,9	7,6	8,2

VAS end-points: 0 = very good, 10 = very bad

Ranking of measures to improve a situation:

The level of agreement of the participants concerning the ranking of measures was assessed by Kendall's coefficient of concordance, which ranges from 0 (no agreement) to 1 (total agreement). The results presented in table 3 show varying agreement among all participants for different situations ranging from 0,129 to 0,435. Within workshop groups the ranking of measures in some situations was indistinguishable from coincidental accordance indicated by $p>0.05$.

Table 3: Agreement on importance of measures

Workshop	All			Advisors'			Farmers'			Researchers'		
Situation	N	W[1]	p	N	W[1]	p	N	W[1]	p	N	W[1]	p
1	26	0,129	0,01	9	0,221	0,08	8	0,248	0,78	9	0,118	0,38
2	24	0,435	0,00	8	0,566	0,00	7	0,517	0,00	9	0,372	0,01
3	26	0,350	0,00	9	0,448	0,00	8	0,281	0,03	9	0,440	0,00
4	25	0,265	0,00	9	0,299	0,02	7	0,331	0,04	9	0,232	0,06
5	26	0,300	0,00	9	0,376	0,01	8	0,269	0,06	9	0,437	0,00

1 = Kendall's W

Environmental stakeholder analysis:

In the ESAs (figure1) a total of 391 factors, institutions, groups and persons were named of which 300 (77%) were related to stakeholders. Beside the participating farmers, advisors, veterinarians, and researchers other important groups were families and neighbours, colleagues, consumers, suppliers, policy and administration, processors, and farmers organisations. In all workshops veterinarians, farmers and animals were identified as the most important actors. Advisors were located with some and researchers with big distance to the topic of animal health. While the pictures from the farmers' workshop included less terms and were focused on the farm situation, those from the advisors' and the researchers' workshop represented a broader environment including further actors and the farms business environment whereas factors on the farm level were missing.

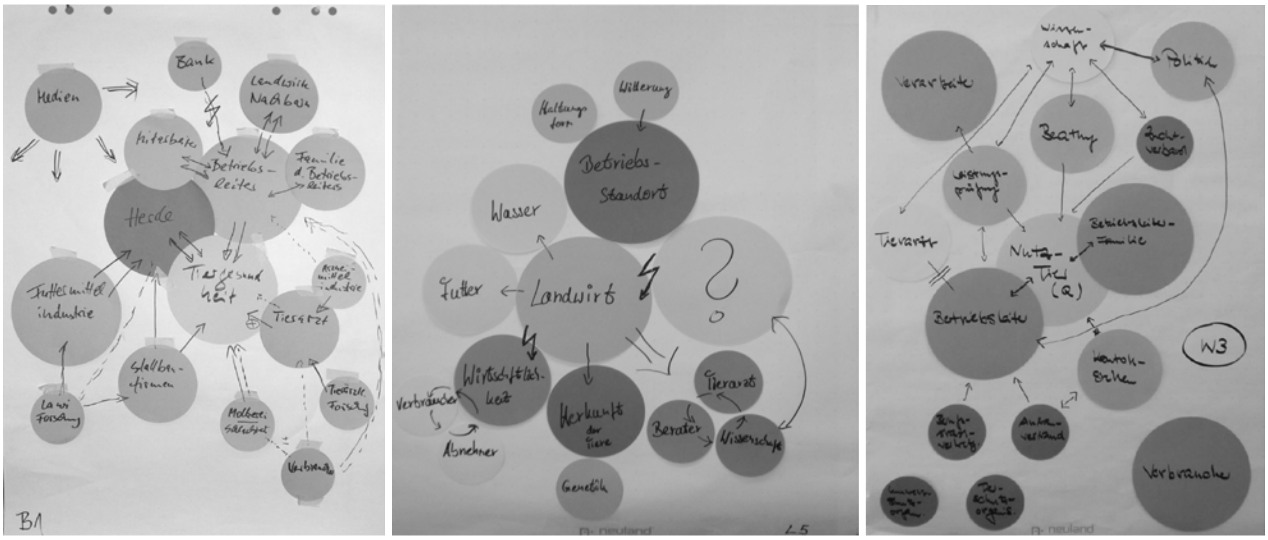

Figure 1. Examples for environmental stakeholder analysis from the workshops of farmers, advisors and researchers

In all three stakeholder workshops, animal health was identified as a significant value, desirable for all participants. Nonetheless, during the workshop process three main areas of conflict were identified (table 4).

Table 4: Fault lines in connection with animal health

Animal health	⇔	Economy
Detailed knowledge	⇔	Holistic view
Individual autonomy	⇔	Public interest

The conflict area of animal health and economy is an issue especially for the group of farmers. Striving for detailed knowledge and objectivity, a topic addressed to the researchers, contradicts with the complexity of individual farm conditions and impedes the applicability of findings. The farmers' claim to autonomy in form of independent decisions in their business conflicts with the public interest on animal health as a common good.

Aiming to resolve the conflicts and considering the opposite opinions simultaneously was expected to lead to intense discussions in the common workshop. However, the participants seemed to avoid to discuss the conflict areas and to change perspectives but persisted in previous argumentation lines.

Discussion

Findings from the workshop process revealed a quite complex situation due to the plurality of stakeholders, huge variation in statements between and within stakeholder groups, and the manifold parameters to be considered within the farm system.

The theoretical construct “animal health” was understood quite differently by the stakeholders emphasising the absence of accepted thresholds for prevalence and morbidity rates. Differences in role expectations and vague perception of responsibilities were identified as obstacles in the system of communication structures and conditions, depicted in the environmental (stakeholder) analysis. The analysis of communication processes uncovered a lack of leadership, self-referential und self-justifying judgements and role conflicts.

While the separate workshops were quite reflective, the common workshop gave hints for a relapse into self-referential perspectives on individual and group level. Confronted with other perspectives, the participants seemed to seek coherence within their corresponding peer groups to underpin their positions. This observation matches with the importance of coherence revealed for example by Kahneman (2012).

Discussions along fault lines deriving from different understanding of animal health and specific perspectives indicated the impossibility to solve the problem from “inside” the group of primary stakeholders, partly explaining why various efforts implemented in the past to improve animal health status largely failed so far.

We conclude that the current communication structure is not appropriate to enable a targeting transfer of knowledge on the topic of animal health. Hence, we assume that an impulse from “outside” is required to irritate the deadlocked situation and provide leadership and orientation.

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The knowledge transfer from science to practice – a survey with EU researchers

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Key words: knowledge transfer, implementation, EU member states, researchers

Abstract

Group members came from 12 European countries, six from new (BG, CZ, EE, HU, PL and SI) and six from old EU member states (DE, ES, FI, IT, NL, PT).

The aim of the work was (a) to analyze the role of the scientists in a dialogue between them and the practitioners within the organic production sector, (b) to find the best practice models of such dialogue as the examples to be followed by others. All project partners conducted surveys with 10 selected scientists from own country.

Key areas of the questionnaire were directed to the (A) person (gender, age, years of activity in teaching and/or researching), (B) number of projects, papers, trainings and interviews, (C) examples of best practice models, and estimates of (D) potential collaboration between scientists and stakeholders, (E) about the success of personal activities as to farming, processing, trading & marketing, (F) of the improvement of communication between science and practice, (G) of potential threats for knowledge transfer from scientists to practitioners.

Almost similar results were found for scientists from old and new EU member states. Clear difference was the higher contribution of training sessions for practitioners by scientists of new EU member states. True for both groups was the relatively low activity in writing popular papers.

Introduction

Due to increasing research activities around organic agriculture within the EU, thanks to EU, other International or national funds i.e. the German Federal Scheme Programme there is a recognizable progress of knowledge and understanding of organic agriculture. To which extent have practitioners an active part in that progress? Which best practice models can be found in various EU member states? Which strategies can be provided as final result of the mobility project within the Leonardo da Vinci partnership programme? That is the context out of which the data presented are derived.

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Material and methods

The survey was prepared, uploaded and administered by the software Grafstat 4.0. Data of the survey were collected in a database. Statistical evaluations were done by Minitab 16. Inputs per partner ranged between 6 and 12. The complete set of data consisted of 136 protocols.

Results

The 'person data' contained questions about gender, age, period of academic activity in the field of organic agriculture, position within the institution and type of institution. It became obvious that the share between male and female responses was more even in the NMS[15] (52 to 48 %) compared to the high male share in OMS[16] (71 to 29 %). Within NMS interviewees the share of younger persons (age between 26 and 45 years) was the double of OMS respondends of the same age whereas middle age persons were fourfold more to be found in OMS than in NMS (43 vs. 11 %). The distribution of type of working place was very much dominated by universities in OMS (75 %) compared to 55 % in NMS, coworkers of Research Institutes contributed to the survey more in NMS than in OMS (41 vs. 17 %). Parallel to the age of respondends the requested period of activities for teaching or researching OA matters resulted in more counts for 11 to 20 and >20 years in OMS (47 vs. 31 %; 19 vs. 10 %), but more counts for 1 to 10 years in NMS (59 vs. 35 %).

With regard to the knowledge transfer from science to practice Table 1 presents condensed data about the quantity of projects, papers, trainings and interviews conducted, written and initiated by the interviewees. Academic activities are not very much different between new and old EU member states. It differs more on the level of popular projects and corresponding papers. There is a relatively high share of zero activities in both group; although this type of activity seems to be less attractive in post communistic countries. Increasing demands for academic proofs and credits might be one possible explanation for that fact, access to funds for that type of activity another one. On the other hand within NMS there seems to be a higher willingness to spend time outside the academic live and provide training sessions for practitioners
(93 vs. 77 % are clear indications beside 23 % none within OMS).

Table 1: Counts (%) for scientific and public knowledge transfer related to old and new EU member states

Quantity	0		1-10		>10	
	NMS	OMS	NMS	OMS	NMS	OMS
Research projects	4	8	80	65	15	28
Research papers	1	6	55	52	44	41
Popular projects	38	17	58	75	4	8
Popular papers	8	8	55	60	37	32
Trainings	6	23	81	69	12	8
Interviews	23	28	65	58	12	14

With regard to estimations about the success of personal work and its promotative effects on the development of the various fields of work the answers were very moderate (see Table 2). The levels **good** and **excellent** never exceeded 20 %. It seems that the group of interviewees in the NMS was more linked

15 NMS = New member states

16 OMS = Old member states

into the areas around farming practice. That would explain the higher counts for potential benefits in processing, trading and marketing.

Table 2: Counts (%) for scientific and public knowledge transfer related to old and new EU member states

	Farming		Processing		Trading		Marketing	
	NMS	OMS	NMS	OMS	NMS	OMS	NMS	OMS
Good to excellent	16	15	11	8	13	3	11	3

Dialog and collaboration needs open-mindness from all sites. If this is really true the survey wanted to clarify by asking for the expected willingness of stakeholders (see Table 3). The closer contact to farmers and their advisors became very obvious by their related figures, ranging between 40 and 60 %. The estimates of OMS respondends were slightly (Farmers: 49 vs. 43 %) and distinctly (Advisors: 56 vs. 43%) higher then those of NMS. Similar comparisons could be drawn for processors and traders, but on a much lower level. Again, this result might reflect the specific background of the respondends which obviously was closer to farming practice than the other areas.

Table 3: Counts (%) for the estimated willingness of stakeholders for cooperation

	Farmers		Advisors		Processors		Traders	
	NMS	OMS	NMS	OMS	NMS	OMS	NMS	OMS
High	46	49	43	56	13	25	12	16

It is trivial to emphasize the urgent need of financial support for any kind of projects. Therefore the high estimates for the relevance of the different donors are confirming that fact (see table 4). EU and governmental sources are very high scored by both groups. NGO's are also relevant institutions, but their importance was scored lower. Other sources seem to be better accessible in OMS than in NMS (72 vs. 48 %).

Table 4: Counts (%) for the estimated necessity of financial support by various donors

	EU		Government		NGO's		Others	
	NMS	OMS	NMS	OMS	NMS	OMS	NMS	OMS
Important to very important	87	84	90	89	65	65	48	72

Beside the financial aspects the improvement of dialog and collaboration are also dependent upon other factors, i.e. contact between stakeholders, access to research sites and acknowledgement of universities for that type of projects and activities. The figures of important and very important scoring are presented in Table 5. In all cases the estimates reached around 80 % and more. The obstacle for more engagement of scientists for less scientific projects seems to be higher in NMS (89 vs. 80 %) and confirms the data of Table 1.

Table 5: Counts (%) for estimated improvement of knowledge transfer

	Debate among stakeholders		Access to research site		Acknowledgement by University	
	NMS	OMS	NMS	OMS	NMS	OMS
Important and very imporant	82	79	90	92	89	80

Which bottlenecks can negatively interfere with intended projects for better knowledge transfer? Four factors were requested in the survey: lack of (1) time, (2) interest and (3) money plus (4) relevance of a supportive political environment (see Table 6). There is a graduation of relevance from (1), (3), (2) to (4). Again the lack of money can be interpreted as most urgent factor in the NMS, followed by all others. Within the OMS all factors were scored less relevant compared to NMS with regard (3), (2) and (4).

Table 6: Counts (%) for estimated threats for the collaboration between science and practice

	Lack of time		Lack of interest		Lack of money		Political environment	
	NMS	OMS	NMS	OMS	NMS	OMS	NMS	OMS
Important to very important	76	81	68	50	82	62	53	48

Conclusion

On the one hand the need for more applied projects clearly interferes with the increasing demand of universities for more scientific outputs and approvals. On the other hand the knowledge transfer is very much dependent on engaged scientists, in specific when governmental institutions outside universities are missing for the conversion and transmission of existing scientific knowledge. Beside adequate political and academic environment the financial issue can be emphasized as the most urgent factor for the promotion and improvement of better knowledge transfer from science to practice.

Suggestions to tackle with the future challenges of organic animal husbandry

Animal husbandry as milk, meat and egg provider, as contributor to more efficient use of arable land and finally as continuous provider of organic matter for the improvement of humus plays an essential role in organic agriculture. Therefore animal production should be supported by proper regulations, subsidies and counselling. Animal welfare issues are highly demanding for organic practitioners which need competent advice. Regulations for processing should also be appropriate for smaller farms.

Leaf mass of clover-like legumes as a protein source in organic pig nutrition

HENDRIK SOMMER[1], ALBERT SUNDRUM[1]

Key words: protein supply, digestible crude protein, organic pig nutrition, clover, alfalfa

Abstract

Due to the outgoing transitional arrangements for the use of conventional protein sources for monogastric animals in organic livestock farming, alternatives are urgently needed. The aim of this study was to investigate the suitability of the leaf mass of clover-like legumes in the diet of pigs. Therefore the yields of digestible protein per hectare of the investigated plant samples were compared to those of faba beans, lupines and peas as established organic protein sources. The yields of digestible crude protein per hectare of the clover-like legumes are higher than those of faba beans and peas. Although the faba beans and peas have some higher crude protein digestibility of about 80%, the examined plant samples are due to the higher content of protein in the leaf mass rich in digestible crude protein. The results indicate that the recovery of the leaf mass is a lucrative protein source for organic pig farming.

Introduction

The availability of organically and regionally produced protein is becoming more and more important due to the expiring transitional arrangements for the use of conventional protein sources. The well-balanced dietary supply of organic held pigs especially with essential amino acids is restricted to the use of grain legumes and in individual cases of press cake derived from processing oilseeds (Baumgärtl et al. 2013). The current research project is designed to investigate the question under which conditions native clover-like legumes can contribute to cover the need of protein in the diet of organically fed pigs. It is mentioned that the separation of the leaf mass of alfalfa (Popovics et al. 2001) and other clover species selected from the stem will increase the concentration of crude protein content. Therefore the quality and quantity of digestible protein of the investigated leaf mass samples are compared to that of faba beans and peas as established organic protein sources.

Material and methods

Seeds of alfalfa, red clover, white clover, crimson clover and Persian clover have been harvested from 4 experimental field trials. The results are based on the harvest in 2012.The harvested fresh masses of the samples were weighed and charged with the area size of the trial plots. The fresh mass yield per hectare was determined in this way. Afterwards it was multiplied by the dry matter content of each sample to determine the dry matter yields. The fresh weight samples were packed in crispin bags and then dried at 60°C to constant weight. Each variety had a total of up to eight sample bags which were weighed and dried. Two samples were milled as whole plant. The remaining six samples were each separated in leaf and stem mass. The Penn State Forage Separator was used with two different sieve hole sizes (upper sieve 1.9 cm, middle sieve 0.75 cm). The crumbled sample was placed into the top sieve of the assembled screen box. On a smooth surface the screen box was shaken five times, then it was rotated by 90° and shaken again. The process was repeated until the box was once rotated 360°. Stem mass remained in the upper screen box. In the middle screen frame a mixture of stems and leaf mass accumulated and in the bottom box the leaf mass was sift out. For a second passage the procedure was repeated, omitting the upper screen frame. At the end of the procedure the separated stem mass as well as the leaf mass remaining in the bottom was weighed. Than the stem and leaf mass fractions were calculated.

The dry matter yields were subsequently charged with the leaf fractions for determination of leaf production yield. In the next step, the whole plant and leaf mass nutrient yields for crude protein were calculated from the respective dry matter yields in conjunction with the dry mass-based nutrient concentrations. The digestibility of the leaf mass was determined with the in vitro method according to Boisen and Fernández (1997), modified according to Sappok et al. (2009). After the enzyme treatment, the remaining feed residue is weighed and subtracted from the originally weighed material quantity. The difference is called the apparent digestibility of organic mass. In the remaining feed rest the crude protein content is determined and subtracted from the crude protein content in the feed sample. This difference characterizes the apparent

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digestibility of crude protein. The data for faba beans and peas have been reviewed by literature and the corresponding yields were calculated the same way.

Results

The proportion of leaf mass of the whole plant depends on the seed and cut number. For crimson and Persian clover a decreasing trend in leaf mass fractions from the first to third cut can be determined. In alfalfa and white clover the leaf mass fraction increased from the first to the second cut. For red clover the leaf mass fraction from the second cut was higher than at the first and third cut, however, were the only outlier here to watch. Figure 1 gives an overview of the leaf mass fractions of the species examined, differentiated by the cuts.

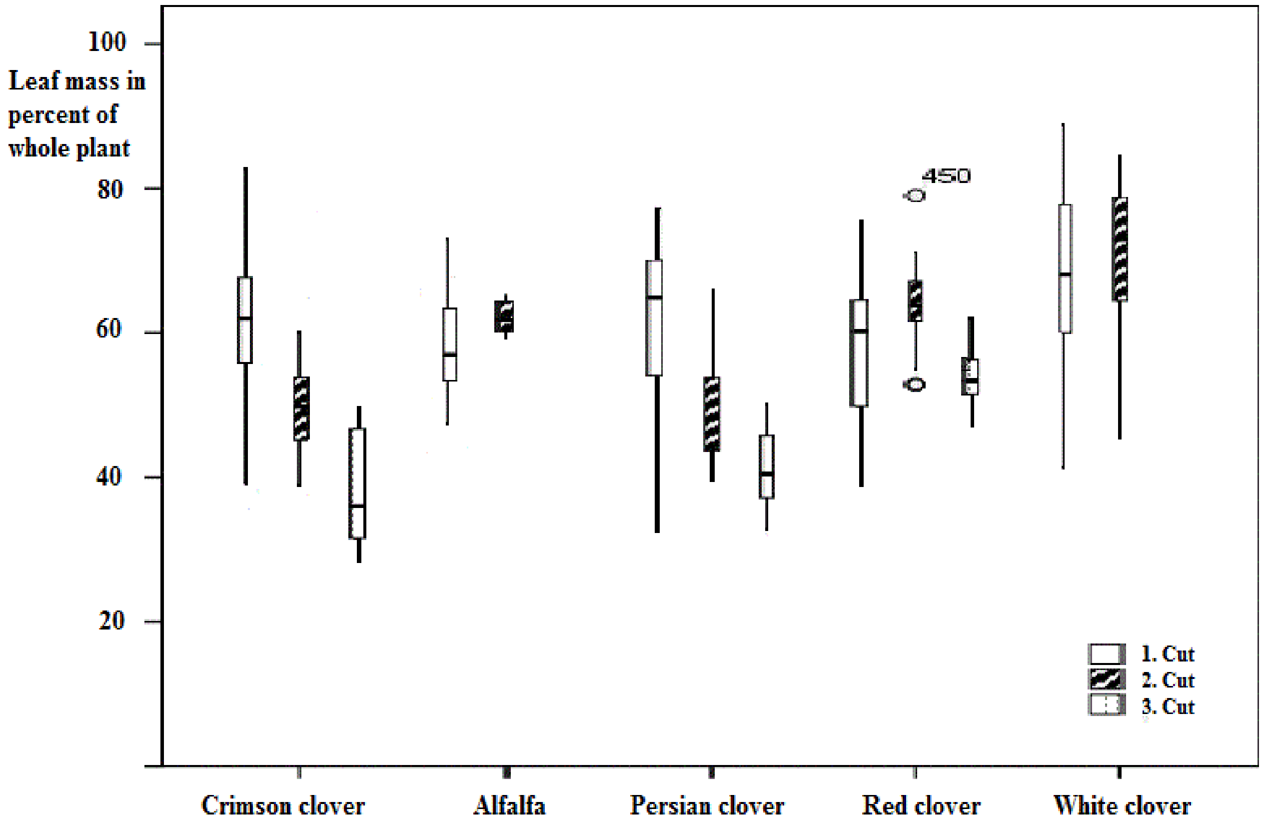

Figure 1: Proportion of the leaf mass on the whole plant differentiated into three cuts.

The digestibility of crude protein in whole plant (WP) and leaf mass (LF) differed only to a small extent. In Persian clover (79% LM - 74% WP), in alfalfa (74% LF - 70% WP) and in red clover (75% LM - 73% WP), the mean solubility was higher in the leaf mass than in the whole plant. While the solubility of crude protein in the leaf mass and the whole plant in white clover is identical (77%), in the whole plant of crimson clover (75%) it was at least 2 percent higher compared to the leaf mass solubility. However, the corresponding variability of the results relativizes these estimates.

The lowest cumulative dry matter yields of leaf mass were recorded in Persian clover and crimson clover. Here, the average dry matter yield was 35 dt ha^{-1} and 42 dt ha^{-1}, and is quite competitive to faba beans. The average dry matter yield of white clover was 48 dt ha^{-1}. The highest yields were observed on alfalfa and red clover with about 60 dt ha^{-1}. Due to the distribution of the yield to several cuts the yield risk is significantly reduced. The average yield of Peas was reported from Ehlers (2001) between 31.0 -34.0 dt ha^{-1}, Pietsch at al. (2003) between 14.4 – 20.8 dt ha^{-1} and Pietsch et al. (2004) between 11.0 – 19.00 dt ha^{-1}.

By separating the leaf mass, a concentration of crude protein in the leaf mass was found in all studied species. The highest mean leaf crude protein mass was observed in Persian clover with 28.3 g XP 100 g DM^{-1}, followed by alfalfa with 28.0 g XP 100 g DM^{-1}. The analyzed content of red clover was 27.0 g XP 100 g DM^{-1}, of white clover 26.3 g XP 100 g DM^{-1} and of crimson clover 25.4 g XP 100 g DM^{-1}. The crude protein content of faba bean was assumed with 25 g XP 100 g DM^{-1} (23.1 – 26.0 g XP 100 g DM^{-1}, Sauermann et al. (2013 a) and that of pea with 20 g XP 100 g DM^{-1} (19.6 – 22.8 g XP 100 g DM^{-1} Sauermann et al. (2013 b)).

The cultivation of clover-like legume for the production of leaf mass leads to higher leaf mass crude yields compared to faba beans and peas (see Table 1). The cultivation of faba beans leads to a crude protein yield of 8-10 dt ha^{-1}, depending on location and weather influence. The cultivation of Peas leads to lower crude protein yields in the range of 2.2 to 7.8 dt ha^{-1}. The crude protein yield of leaf masses of crimson clover and Persian clover are of the same order of magnitude as is the case in the field bean.

Table 1: Crude protein yield (dt ha^{-1}) of the leaf mass of the studied species differentiated into cuts and accumulated compared to the range of faba bean and pea.

	Alfalfa		Red clover		White clover		Crimson clover		Persian clover		Faba	Pea
	dt ha^{-1} *min-max*	∂ n	*dt ha^{-1}* *min-max*	∂ n	*dt ha^{-1}* *min-max*	∂ n	*dt ha^{-1}* *min-max*	∂ n	*dt ha^{-1}* *min-max*	∂ n	*dt ha^{-1}* *min-max*	*dt ha^{-1}* *min-max*
1. Cut	5.6 *3.8 9.5*	1.8 *40*	5.8 *0.0 10.9*	2.7 *48*	4.8 *3.0 6.9*	1.1 *24*	3.9 *2.1 6.3*	1.2 *40*	6.2 *2.5 11.9*	2.0 *42*		
2. Cut	5.9 *4.6 8.1*	0.9 *12*	5.4 *4.1 7.2*	0.8 *28*	4.0 *3.2 4.7*	0.4 *18*	2.5 *1.8 4.0*	0.8 *12*	3.0 *2.2 4.3*	0.6 *24*		
3. Cut	5.5 *4.6 7.2*	0.8 *18*	4.0 *1.9 6.0*	1.2 *36*	3.8 *2.1 7.4*	1.4 *40*	2.0 *0.7 2.9*	0.9 *18*	2.6 *1.5 5.2*	1.2 *24*		
∑	**17.0** ***13.0 24.8***		**15.2** ***6.0 24.1***		**12.6** ***8.3 19.0***		**8.5** ***4.6 13.2***		**11.8** ***6.1 21.4***		**9** **8 10**	**4.2** **2.2 7.8**

The yields of digestible crude protein are also higher than that of faba bean and pea in the clover-like legumes (see Table 2). Although the faba bean and pea have some higher solubility of about 80%, the examined plant samples are due to the higher content of protein in the leaf mass rich in digestible crude protein.

Table 2: Digestible crude protein yield (Mean, dt ha^{-1}) of the leaf mass of the studied species differentiated into cuts and accumulated compared to the range of faba bean and pea.

	Alfalfa	Red clover	White clover	Crimson clover	Persian clover	Faba	Pea
	dt ha^{-1}	*dt ha^{-1}*	*dt ha^{-1}*	*dt ha^{-1}*	*dt ha^{-1}*	*dt ha^{-2}*	*dt ha^{-3}*
1. Cut	4.1	4.4	3.7	2.8	4.9		
2. Cut	4.4	4.1	3.1	1.8	2.4		
3. Cut	4.1	3.0	2.9	1.5	2.1		
∑	**12.6**	**11.4**	**9.7**	**6.2**	**9.3**	**6.8**	**3.1**

Discussion

The main problem in the cultivation of legumes is the large variation of the feed value and yield. Factors of the type, location and methods of cultivation are the main sources of variance. The higher the qualities of usable protein sources, the better are they suited to be part of the feed ration. So far, the use of clover-like (green) legumes in monogastric rations is of minor importance. The suitability of appropriate feed for pigs is mainly limited by the fiber content and the associated reduction in the digestibility of the organic mass (Schubiger et al., 1998). The leaf protein yield obtained here is considerably higher than the yield of protein from beans or peas (Sommer 2010). The results indicate that the recovery of the leaf mass is a valuable and expandable protein resource for organic pig nutrition because of increasing the concentration of crude protein. It provides a considerable potential as a regional source of protein and requires further examination.

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Examination of Different Earliness Effects on Harvest Point and Yield of Soybean (*Glycine Max*)

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Key words: soybean, earliness effect, yield

Abstract

In 2011 and 2012 a field experiment to study the influence of different earliness strategies on the yield of soybean was realized in Osnabrück, Northern Germany. This study was done in a randomized strip design with four repetitions, realizing two earliness strategies, dissolving film and fleece cover, and additionally the control variant.

In both years, it was possible to increase the germination rate of the plants. There were no statistically significant differences between the yield of the three variants. However, in 2012, differences between the protein concentrations could be detected. The protein concentrations of the variants which were realized with dissolving film and fleece cover were significantly higher than those of the control variant.

Introduction

Because of climate change and the associated rise in temperature there is the possibility of cultivating soybean in Northern Germany (JKI 2008). Soybean ripens in those areas where maize can also be cultivated and the soil and temperature requirements of the soybean are generally similar (Hoeft et al. 2000). One of the problems of cultivating soybean in Northern Germany is the slow juvenile development of the plants. In order to extend the possible vegetation period, the experiments with fleece cover and dissolving film were carried out. According to Lütke Entrup (2011) a minimum germination temperature of the soil of 8-10°C is extremely important. The use of either dissolving film or fleece cover causes the soil temperature to rise earlier and faster.

In Germany, there is an increasing demand for high-protein non- genetically modified soybean for human consumption (Taifun 2013). In order to satisfy this demand, the goal of the project is to expand soybean production in Northern Germany by examining earliness effects on soybean. Similarly to maize, where dissolving film and fleece cover are used to accelerate the growth of the plants, soybean should ripen and be harvested earlier.

Material and methods

The studies were accomplished in 2011 and 2012 at the experimental organic farm Waldhof (University of Applied Sciences Osnabrück) in a randomized strip design with four replications and were repeated in 2013. Currently, the results are not available because the harvest is still being processed. In this experiment, the variety Gallec 000/00 was cultivated. Apart from the control variant, dissolving films as well as a fleece cover were used in order to accelerate the growth of the plants.

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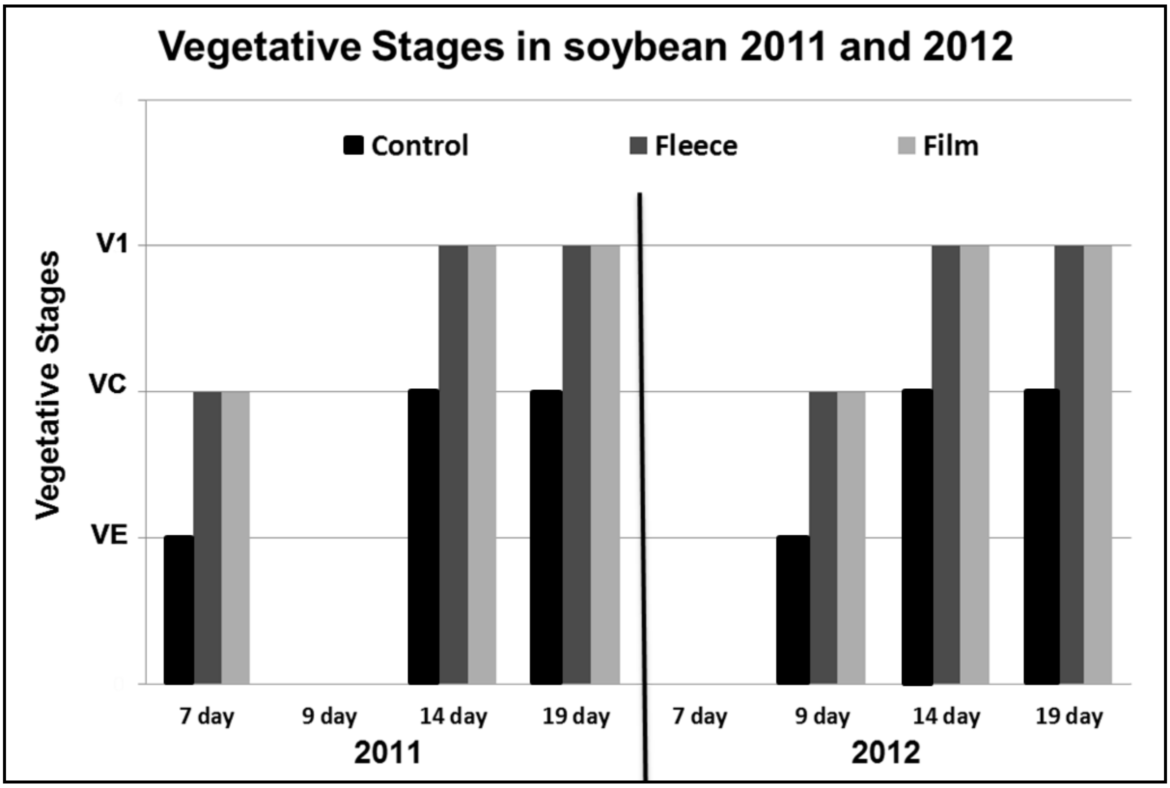
Table 1: Technical data in soybean production (2011 and 2012)

	2011	2012
Seedtime	27-04-2011	02-05-2012
Seeds per m²	65	70
Sowing depth Row distances	4cm 37,5cm	4cm 37,5cm
Germination rate	7 days with fleece and film 12 days in control	9 days with fleece and film 16 days in control
Removal of the cover	05-05-2011 8 days after seedtime	18-05-2012 16 days after seedtime

The three variants were investigated concerning germination rate and the yield of the different variants was measured.

Results

The application of dissolving films and fleece covers led to a tendency of earliness effects in the years 2011 as well as 2012. However, the control variant was able to catch up with the other variants due to the growth conditions. In 2011 the harvest of the variants with dissolving film and fleece covers was brought in a few days earlier than the control. This effect could also be observed in 2012, where the control variant was ripe one week later than the other two variants. In spite of this, the harvest had to be brought in at the same time due to the weather conditions. As shown in figure 1, in both years the yield of all three variants was similar, but there is a noticeable tendency that the yield of the control variant was slightly lower.



VE: emergence, VC: cotyledon stage, V1: first trifoliolate

Figure 1. Vegetative stages in soybean in Osnabrück 2011 and 2012

Concerning the protein concentration, no statistically significant differences between the different variants in 2011 could be measured. In 2012 it is obvious that the protein concentration of the control variant was somewhat lower than that of the other variants. This might be caused by the fact that the soil of the control variant was less warm than the soil that was covered by the dissolving film or fleece. Additionally, in 2012, the air temperature which was measured during the two-weeks period from May 1 to May 15 after the seeding was in averaged 1.5°C higher than the year before.

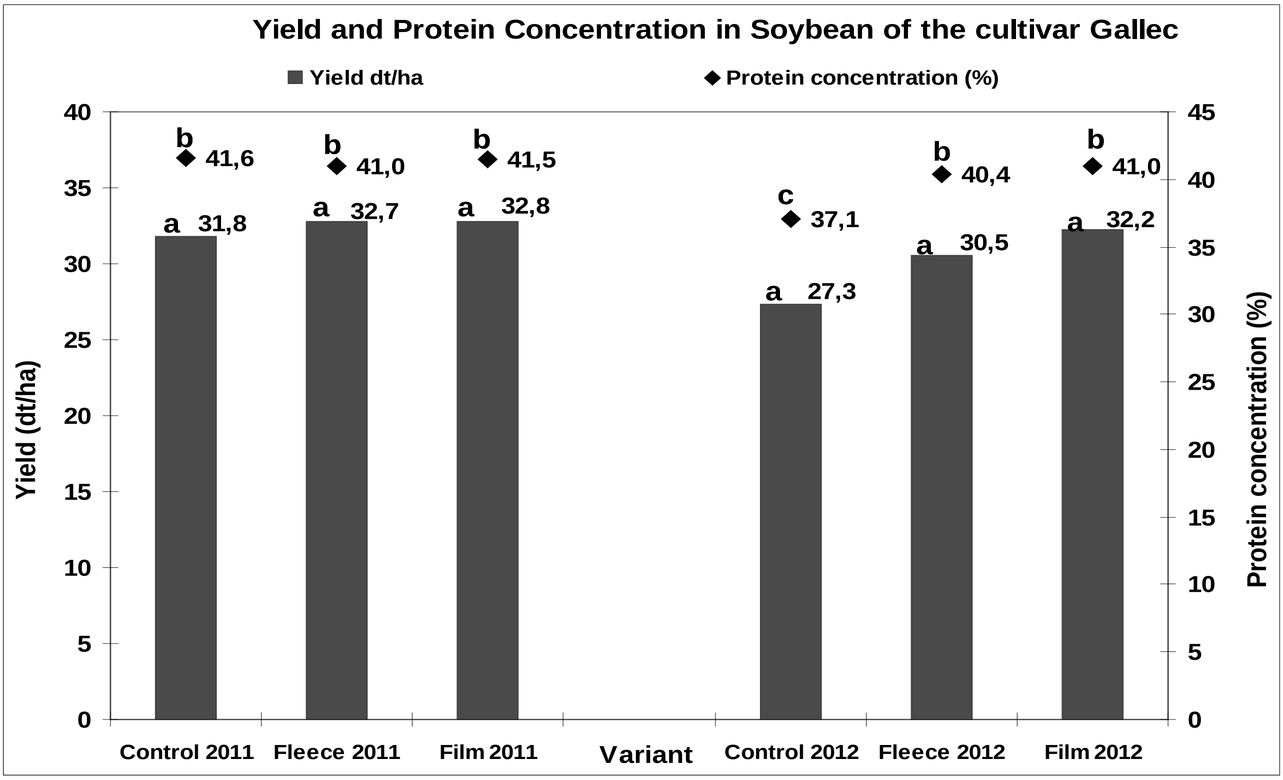


Figure 2: Yield and protein concentration in soybean of the cultivar Gallec

Discussion

The application of dissolving films and fleece covers in soybean shows an earliness effect and furthermore protects the plants from feeding damage.

There were no significant differences concerning the yield of the different variants, but in 2012 a difference in the protein concentration could be detected. This might be due to the fact that the average air temperature in 2012 was lower than one year before. These lower temperatures might have been the reason why the soybean profited from the application of dissolving film and fleece covers. In 2011 the average temperatures could have been high enough that neither fleece cover nor dissolving film had any earliness effects on the development of the plants.

Sponsorship

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Quality Assessment of integrated, Organic and Biodynamic Wine using Image forming Methods

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Key words: Wine quality, image forming methods, cultivation systems

Abstract

Nine encoded wine samples from a German long-term field trial on the comparison of different cultivation systems were examined with the image forming methods biocrystallization, capillary dynamolysis and circular chromatography. The images of the encoded samples were i. differentiated into three groups of images with similar form expression, ii. characterised as 'fresh – aged' based on a catalogue of reference images, iii. ranked (according to the quality characterization) and iv. assigned to the different cultivation systems (classified). Images gained with samples from integrated farming showed more structures indicating enhanced aging compared with the samples from organic and especially from biodynamic origin. Based on these observations, a correct assignment of all encoded samples to cultivation systems was possible. These results are interpreted as indicating higher product quality of biodynamic and organic wine compared to wine from integrated farming.

Introduction

The global production area of organic and biodynamic viticulture has almost tripled within the last ten years (Willer 2010). Following this notable interest in organic and biodynamic viticulture expressed by winegrowers and consumers, a long-term field trial was established in Geisenheim, Germany, in order to compare integrated, organic and biodynamic cultivation systems with respect to soil, plant development, pests and diseases as well as the product quality of grapes and wines (Meissner 2010). Wine quality was assessed with extensive chemical analyses and sensory analysis (Meissner et al. 2010), and, as shown in this study, also with the image forming methods biocrystallization, capillary dynamolysis and circular chromatography.

As described in Fritz et al. (2011a), in these methods structural features are formed as a function of the reaction of the food matrix with inorganic salt solutions. Characteristic qualitative traits of the food, e.g. the degree of freshness and the ripening stage, result in typical and reproducible image structures. Hence, samples have been characterized with respect to food quality by linking image structures to physiological processes such as maturation and aging (Balzer-Graf and Balzer 1991, Fritz et al. 2011a).

Material and methods

The wine samples analysed were from harvest year 2010. The Riesling grapes were taken from the cultivation systems integrated, organic and biodynamic farming of a long-term field trial in Geisenheim, Germany (Meissner et al. 2010, Meissner 2010). The samples were mixed together from four field replications for each treatment. Samples were each encoded by co-workers of Geisenheim Research Center and then analysed using the three image forming methods biocrystallization, capillary dynamolysis and circular chromatography in the laboratory of the Institute of Organic Agriculture in Bonn (methods see Fritz et al. 2011a). Nine samples (three repetitions per farming system) were assessed, based on several series with varying concentrations of wine per image, fresh and after 1, 2, 6, 9, 16, 23, 38, 43, 114 days of aging in the open bottle at room temperature.

Analysis

The images of the encoded wine samples were differentiated into three groups of images with similar form expression, and then characterized as 'strong – weak form expression' and 'fresh – aged' based on a catalogue of reference images with i. varying stages of wine amount per plate and ii. different deterioration stages.

Based on these characterizations a qualitative assessment of the generated images was made, where (a1) wine with strong form expression and (b1) fresh wine was ranked higher than (a2) wine with weak form

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expression and (b2) aged wine. Based on experience from earlier investigations, the encoded samples were then assigned to cultivation methods (classification).

Statistical Analysis

The agreement between correct grouping / classification and the grouping / classification based on the results of the image forming methods was tested using Fisher's Exact Test for grouping and the simple Kappa coefficient for classification (Agresti 2002). The test is based on a 3x3 contingency table, comparing a set of given categories to the ones determined in the investigation (see Tab. 1).

Results and Discussion

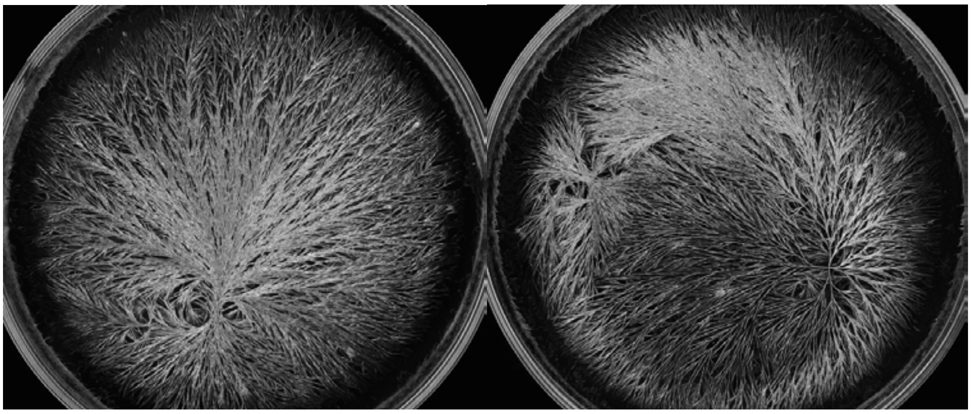

Figure 1: Biocrystallization of wine samples from biodynamic (A) and integrated production (B), aged for two days, 1.4 ml wine and 0.2 g $CuCl_2$ per image.

Based on the experiences gained from earlier investigations on various foods (Athmann 2011, Fritz et al. 2011a) it was known that organic and especially biodynamic products usually show fewer signs of aging and stronger form expression than samples from conventional or integrated production. Figure 1 shows two biocrystallization images of samples from biodynamic and integrated production after two days of aging. The cross-like centre and the more irregular needle structures in the image developed by the integrated sample indicate enhanced aging based on the reference series (not shown). The organic sample was in between the biodynamic and the integrated sample with respect to signs of aging in the image.

Based on these observations, all encoded samples were correctly grouped and assigned to production methods. Grouping and classification of the encoded samples was significant (Table 1). The samples later decoded as originating from the biodynamic production system were ranked highest in the quality assessment, followed by organic and integrated production. These results are interpreted as indicating higher product quality of biodynamic and organic wine compared to wine from integrated farming.

Table 1: Contingency table of Fisher's Exact Test (test for grouping of encoded samples) and Interrater Agreement (classification of encoded samples). From left to right i. samples needed more juice per sample for similar form expression, and ii. samples showed more pronounced structural features that indicate enhanced aging.

		Correct grouping					Correct classification		
		G1	G2	G3			D	O	C
Grouping of encoded samples	G1	3	0	0	Classification of encoded samples	D	3	0	0
	G2	0	3	0		O	0	3	0
	G3	0	0	3		C	0	0	3
Significance		p = 0.004			Significance		p = 0.001		

G1 – G3: sample group 1 to 3. D: biodynamic system, O: organic system,
C: integrated system.

After beetroot (Mäder et al. 1993), apples (Weibel et al. 2000) rocket lettuce (Athmann 2011) wheat (Mäder et al. 2007, Kahl et al. 2008, Fritz et al. 2011a) and grapes (Fritz et al. 2011b) this is the first study discriminating wine from different production systems using image forming methods. On the site under study, the reduction in vegetative growth of the vine by organic and especially biodynamic as compared to integrated production (Meissner, unpublished) was accompanied by higher grape (Fritz et al. 2011b) and wine quality. Further studies with different sites and varieties are necessary to see if these results can be generalized.

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Aboveground woody biomass production of different tree species in silvoarable agroforestry system with organic and integrated cultivation in Southern Germany

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Key words: agroforestry, allometry, biomass production, short rotation coppice

Abstract

The increasing demand for bioenergy and the combination of agricultural production with conservation has made agroforestry to a sustainable land-management option. Aboveground woody biomass plays a decisive role considering the economic value of the agroforestry systems as well as the carbon storage. With the objective to study aboveground woody biomass production of agroforestry systems with different cultivation methods (organic/ integrated), short rotation plantations of different tree species were established 2009 and coppiced in 2012. The studied tree species were black alder (Alnus glutinosa), black locust (Robinia pseudoacacia), poplar "Max 3", (Populus maximowiczii x Populus nigra) and willow "Inger" (Salix triandra x Salix viminalis). At the end of each growing season biomass production was estimated by an allometric model that predicted individual tree biomass from stem diameter. At the end of the rotation biomass was estimated directly by harvesting. Biomass production ranged from 3.9 to 10.9 t_{DM} $ha^{-1}a^{-1}$ *with poplar and locust having highest growth rates. Significant variation was observed between tree species, but not between management (organic/ integrated), what indicates that organic and integrated agroforestry systems can have a comparable tree biomass production. Small-scale differences of the soil caused high intraspecific variation and suggest the inclusion of further soil investigations.*

Introduction

Agroforestry systems have the potential to combine agricultural production, the supply of woody biomass and the provision of numerous environmental services, such as carbon storage, conservation of biodiversity and soil protection (Jose 2009). Aboveground woody biomass plays a decisive role considering the economic value of the agroforestry systems as well as the carbon storage.
The aim of this study was to measure aboveground woody biomass production of four year old agroforestry systems in southern Germany and to compare between organic and integrated cultivation. Furthermore, different tree species were studied.

Material and methods

The study was conducted at the Research Platform Scheyern (40 km north from Munich; 445 - 498 m altitude). Mean annual temperature is 7.5 °C; mean annual precipitation 833 mm (Auerswald et al. 2000). Occuring soil types are classified as Cambisol, with thin layer of loess, with sand and gravel subsoil and partially small-scale clay soils embedded (Scheinost et al. 1993). The agroforestry systems were set up on four fields, two with integrated and two with organic cultivation. Three rows of different tree species for bioenergy production were planted 2009 on every field with a spacing of 30 m for the field crops (Figure 1). The studied tree species were black alder (*Alnus glutinosa*), black locust (*Robinia pseudoacacia*), poplar "Max 3", (*Populus maximowiczii x Populus nigra*) and willow "Inger" (*Salix triandra x Salix viminalis).* At the end of each growing season aboveground woody biomass was estimated by an allometric model that predicted individual tree biomass from stem diameter. In the last year of the four-year rotation, biomass was estimated directly by harvesting.

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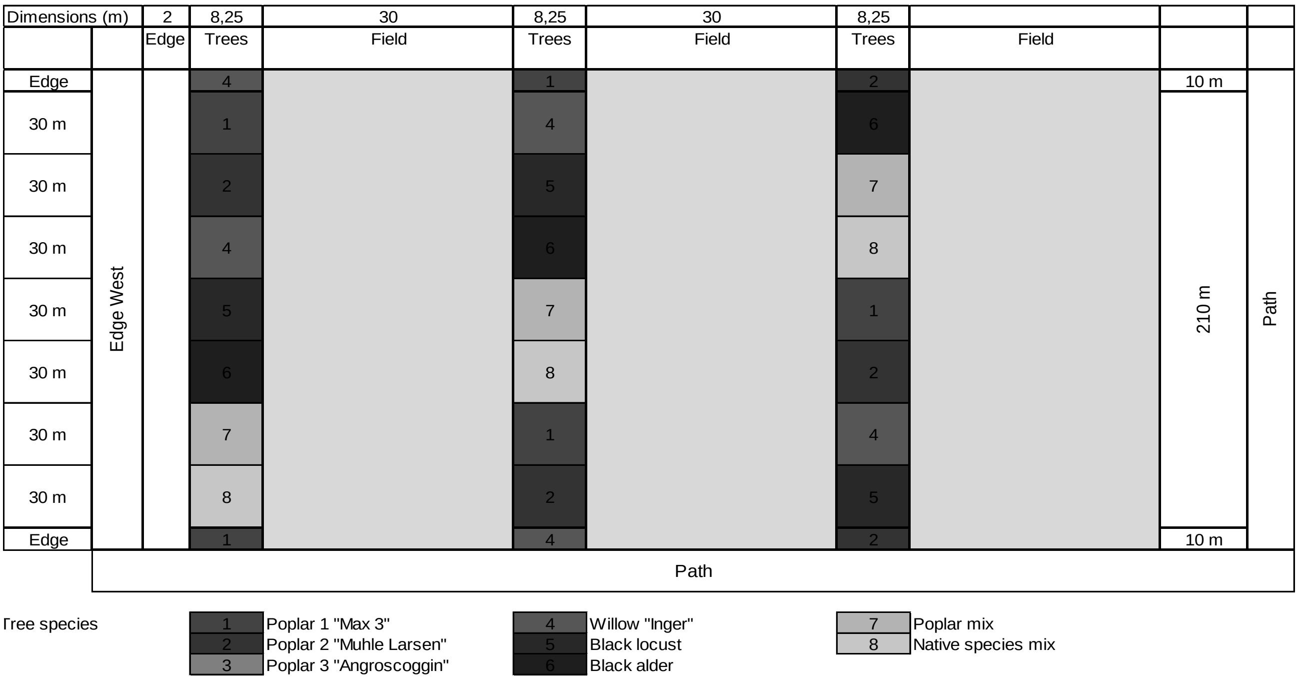

Figure 1: Experimental design of the agroforestry systems at the Research Platform Scheyern

Results

Mean annual growth rate varied from 3.9 to 10.9 t_{DM} $ha^{-1}a^{-1}$ across the species and the cultivation method (Table 1). On the fields with integrated cultivation, locust had the highest growth rate of 9.7 t_{DM} $ha^{-1}a^{-1}$, followed by poplar, alder and willow. But only willow differed significantly. On the fields with organic cultivation, poplar had the significantly highest growth rate of 10.9 t_{DM} $ha^{-1}a^{-1}$, followed by locust, alder and willow. Aboveground woody biomass production varied with tree species, but not with farming system. Small-scale differences of the soil caused high intraspecific variation (indicated by standard deviation) and suggest further investigations of the soil properties.

In the last growing season, mean biomass increase was 100 % (not shown here), what indicated that tree growth rate has not yet reached its maximum. Furthermore, the second rotation is expected to have higher biomass production than the first and especially willow is assumed to have higher biomass production after coppicing due to increasing the number of stems.

Table 1: Aboveground woody biomass production of four-year old agroforestry systems (first rotation) with organic and integrated cultivation; mean and standard deviation (SD)

Tree species	**Aboveground woody biomass**			
	Integrated cultivation		**Organic cultivation**	
	mean [t_{DM} ha^{-1} a^{-1}]	SD [t_{DM} ha^{-1} a^{-1}]	mean [t_{DM} ha^{-1} a^{-1}]	SD [t_{DM} ha^{-1} a^{-1}]
Alder	7,6[a]	2.0	7.4[a]	1.6
Locust	9.7[a]	3.7	8.1[a]	1.2
Poplar	8.5[a]	2.0	10.9[b]	3.1
Willow	3,9[b]	2.0	6.4[a]	1.2

[a,b] significant differences between species (Tukey-Test, $p < 0.05$)

Discussion

Production systems like agoforestry have to meet ecological and socio-economic sustainability as a condition for acceptance and implementation by producers and society (Abrahamson et al. 1998). Aboveground woody biomass of plays a decisive role for the assessments of the economic viability and several ecosystems studies on carbon sequestration, energy and nutrients flows, forest and greenhouse gas inventories (Afas et al. 2008).

Mean annual growth of the trees was 3.9 to 10.9 t_{DM} $ha^{-1}a^{-1}$. However, tree growth rate has not yet reached its maximum. Aboveground woody biomass production varied significantly with tree species but not with farming system. It could be shown that, contrary to the crop yields, in Scheyern the agroforestry systems with organic cultivation can have the same tree biomass production as the agroforestry systems with integrated cultivation.

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Greenhouse Gas Emissions of organic and conventional dairy farms in Germany

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Key words: greenhouse gas emissions, dairy farms, organic, conventional

Abstract

The article presents a model to calculate the greenhouse gas emissions of German dairy farms. The model was tested in 12 organic and 12 conventional farms in Southern and Western Germany. The results show that there is no significant difference between the greenhouse gas emissions per kg milk of the organic and the conventional farms. The lower milk yield of the organic farms is compensated by the lower fossil energy input and the higher carbon sequestration in the fodder production. It can also be seen that a raise of the milk yield from a medium level does not lead to a mitigation of greenhouse gas emissions per kg milk.

Introduction

Dairy farming is an important contributor to the greenhouse gas (GHG) emissions of agriculture (FAO 2010). The mitigation of GHG-emissions from dairy farming requires integrated models for the assessment of GHG-emissions on a single-farm-scale. Up to now there were no methods to assess the emissions of real dairy farms in Germany. We developed a model to calculate complete GHG-balances including the energy-balance of farming systems. The model was tested in 12 organic and 12 conventional dairy farms in Southern and Western Germany.

Material and methods

The model dairy farming (Frank et al. 2013) bases on the model REPRO (Küstermann et al. 2008). It is a process analysis of the farming system that includes all inputs and outputs of energy, nutrients and products and GHG-emissions. The energy balance includes all direct (e.g. fuel, electricity) and indirect (e.g. fertilizer, machinery, buildings, purchase of fodder) energy inputs into the system. The system boundary is the farm. The process steps are defined as the fodder production (on farm fodder production and purchase of fodder), the storage of fodder, the housing system, the storage of manure, the breeding of heifers and the milking process. The inputs are assessed by GHG-equivalents that reflect the GHG-emissions during the production of the inputs. Furthermore we compute the GHG-emissions from land use (N_2O from nitrogen fluxes, CO_2 from carbon-sequestration), CH_4 from enteric fermentation (digestion of ruminants), CH_4 and N_2O from the storage of manure and the emissions from indirect landuse change (iLUC) from the import of soybeans (IPCC 1997, Kirchgessner et al. 1995, FAO 2010). The emissions are allocated by the energy output to the products milk and meat (calves and cows), manure is supposed to stay in the production system.

The model was tested in 12 organic and 12 conventional pilot farms in Southern and Western Germany. Each organic farm has a conventional partner farm nearby. So it can be assumed that organic and conventional farms have comparable site conditions. Farm data are shown in table 1.

Table 1: Management data of the pilot farms

		organic			conventional		
		mean	min	max	mean	min	max
Farm area	ha	73	30	186	57	30	109
Number of cows		42	18	91	50	29	73
milk yield	kg ECM cow^{-1} y^{-1}	6360	4236	7510	8354	6273	10274
first calving age	Months	31	27	35	29	27	33
use time	months	41	29	60	28	24	34

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Results

The computed GHG-emissions from the farms are shown in table 2. The emissions per kg energy-corrected milk (ECM) have no significant difference between organic and conventional farms.

Table 2: GHG-emissions of the pilot farms (g CO_{2eq} (kg ECM)$^{-1}$)

	organic		conventional		
	mean	SD	mean	SD	
Fodder production	121	63	289	62	*
On-farm fodder production	100	60	178	44	*
Energy input	38	12	49	21	n.s.
Nitrous oxide	156	17	121	38	*
C-sequestration	-94	72	8	51	*
Purchase of fodder	21	26	111	61	*
Energy input	7	7	32	15	*
Nitrous oxide	6	9	26	15	*
C-sequestration	8	16	16	15	n.s.
iLUC	0	0	37	39	*
Methane from digestion	419	43	326	18	*
Manure management and storage	130	39	129	30	n.s.
Energy input	14	5	11	2	*
Methane and nitrous oxide	116	39	118	28	n.s
Breeding of heifers	257	85	257	79	n.s.
Storage of fodder, housing system, milking	79	4	66	3	*
Total emissions	1006	157	1067	85	n.s

The results show that the CH_4- emissions from digestion are the biggest source of GHG-emissions in dairy farming. They depend on the feeding strategy and the milk yield. Organic farms have higher CH_4- emissions due to the lower milk yield and the higher content of roughage in the ration. The GHG-emissions from fodder production are per kg milk higher in the conventional farms. The reason is the input of mineral fertilizer (fossil energy input) that is not compensated by the higher yields. The carbon-sequestration is lower than in organic farms. It means that CO_2 from atmosphere is fixed in the soil as humus. The organic farms have a high carbon sequestration due to their positive humus balance by the cropping of clover grass and other legumes. The conventional farms have an equated humus balance. Also the higher purchase of fodder leads to higher emissions in the conventional farms. The breeding of heifers is an important source of GHG-emissions, too; their amount depends on the usage time of cows and the management in breeding. The emissions per kg milk are equal in the organic and conventional farms. The reason is the lower intensity in organic farms with higher breeding time versus the higher intensity and faster growth in conventional farms.

The comparison of the total GHG-emissions with the milk yield of the farms is plotted in figure 1.

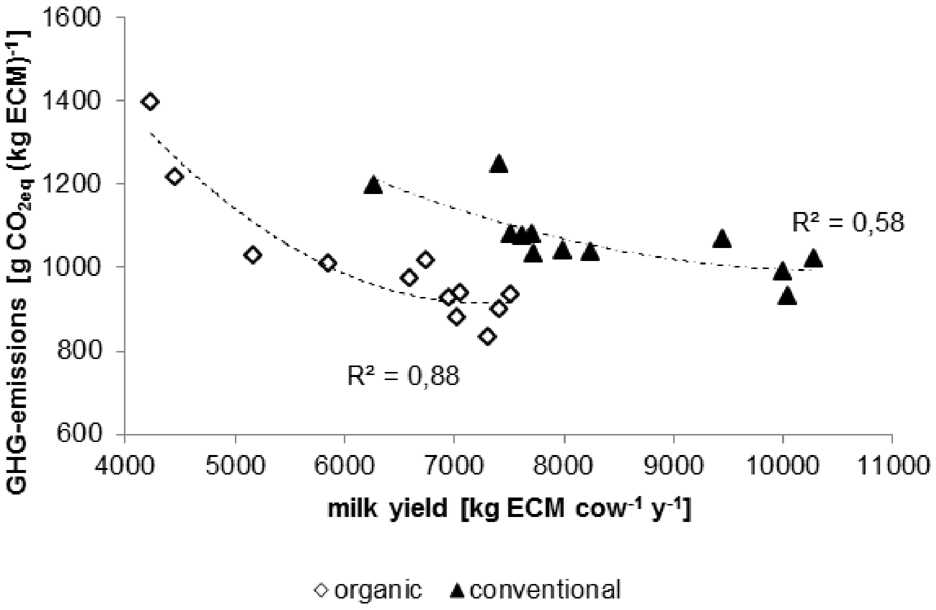

Figure 1: GHG-emissions per kg milk and the milk yield

The rising of the milk yield leads to a reduction of GHG-emissions per kg milk. The rising from 7,500 to 10,000 kg ECM cow^{-1} y^{-1} has no further effect on the mitigation of GHG-emissions. That can be declared by the development of the different emissions sources. The methane emissions from digestion are sinking with rising milk yield, even the emissions from manure management. But the higher milk yield needs higher amounts of concentrates and purchased fodder. Concentrates have usually higher emissions in production than roughage. So there is a raise of the emissions from fodder production with rising milk yield. From a certain point on they are balanced so there is no further mitigation of GHG-emissions with rising milk yield.

Discussion

The new developed model is able to cover a holistic GHG-balance of dairy farms. The view on the complete dairy system shows the great evidence of all emission sources to the carbon footprint of dairy farming. It is necessary to asses all of them to make sure conclusions. This allows a sophisticated view on the comparison of organic and conventional dairy farming.

The results show that organic and conventional dairy farms have comparable emission per unit of product. The reasons are that the lower milk yield of organic farms is compensated by the lower energy input, the lower nitrous oxide emissions and the higher carbon sequestration in fodder production. The interactions between the emissions sources is the reason (Rotz et al. 2010). It can also be seen that the rising of milk yields has no significant effect on the GHG-emissions per kg milk. Under German conditions with comparable high milk yields the rising from 7,500 to 10,000 kg ECM cow^{-1} y^{-1} is expected to have no significant reduction of GHG-emissions in dairy farming.

The model and the results can contribute to develop farm specific GHG-mitigation strategies. It is the basic for the deduction of advisory concepts for more sustainable agriculture.

Acknowledgements

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Compatibility of Automatic Milking Systems with animal welfare in organic dairy farming

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Key words: automatic milking, welfare, organic dairy farming, pasture

Abstract

Automatic milking systems (AMS) expand not only in conventional farming but also on organic dairy farms. As animal welfare is one of the most important aims of organic livestock it must not be impaired by introducing AMS into organic herds. In this study the pasture use, as an important element of species-appropriate husbandry of ruminants, on farms before and after the introduction of AMS was evaluated. The survey of 41 organic dairy farms using AMS in Germany and the Netherlands revealed that about half of the farms (54%) used pasture after the introduction of AMS. But almost one third (29%) of the farms that had used grazing before implementation of the AMS have ceased pasturing afterwards. This shows that AMS is not always compatible with pasture use. On organic dairy farms, where the introduction of an AMS would lead to cessation of pasture use, this should account for a decision against the purchase of this system.

Introduction and Aims

The distribution of automatic milking systems (AMS) on dairy farms has increased significantly worldwide since the last millennium. The number of farms that use an AMS was about 1,000 in the year 2000 and rose continuously to 10,000 in 2010 (Harms and Wendl, 2012). Also in Germany there is a trend towards AMS: While the sales figures for milking parlours and carousels have declined, those for AMS are showing a clear upward trend. For organic farms there has been increased interest in the use of this system, as organic dairy farms often have herd sizes between 50 and 150 cows, a size which is best suited for automatic milking systems. Automatic milking systems lead to less physical workload and to more flexible working hours compared with twice daily milking. This amounts to an interesting future perspective both for many aging farmers as well as for potential farm successors.

Main objectives of organic animal husbandry and consumers' expectations on organic livestock production are a high animal health and welfare status (Oekobarometer 2012). Since grazing is a distinct behaviour in ruminants, pasturing could be regarded as crucial for cattle welfare. The EU regulation for organic agriculture (CEC, 2007) recommends pasturing for ruminants if possible, but implementations in national law are different. E.g. grazing for cattle is obligatory for organic farms in the Netherlands but in Germany, farmers may provide a whole-year outyard for their herds.

The implementation of AMS does not only bring along changes in terms of the milking process, but also affects the entire housing system, management and feeding. AMS is

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often connected with a restriction of pasturing and indirectly the risk of lame cows may increase (von Keyserlingk et al., 2009; Hernadez-Mendo et al. 2007).

The aim of this study was to clarify whether the use of AMS is compatible with animal welfare in organic dairy farming, paying particular attention to impacts on pasture use.

Materials and Methods

In an online survey, 41 organic dairy farmers with AMS have been asked for their feeding and pasture system before and after AMS implementation on their farms. Farms were spread over western Germany with a main area in southern Germany. Additionally two farms were located in the Netherlands.

Results

Herd data

Average herd size of the 41 farms was 75 with a range of 42 – 170 with an average milk yield of 6,638 (± 1,066) kg per cow per year. Most of the farms (74%) have implemented an AMS with free cow traffic. Since the introduction of the AMS, dairy herd sizes on some farms increased sharply. Four farms have doubled their herd size since the introduction of the AMS. Another four farms quadrupled the number of their cows. On average, the herds have grown by 37% from 55 (±25) before to 75 (±26) after AMS implementation.

Grazing and pasture before and since the introduction of the AMS

Before AMS introduction 28 out of the 41 dairy farms (68%) provided their cows access to pasture. 13 farms had a pure stable-feeding system. On 22 farms (54%) the cows had the possibility to graze since the use of the AMS while 19 farms (46%) fed their cows only in the stable. 11 of them performed no grazing also before AMS implementation. Eight companies had ceased the pasture use with the introduction of the AMS. This corresponds to 29% of the 28 companies that had pastured before the AMS. Two farms have started a pasture based feeding system with the implementation of AMS (see Figure 1).

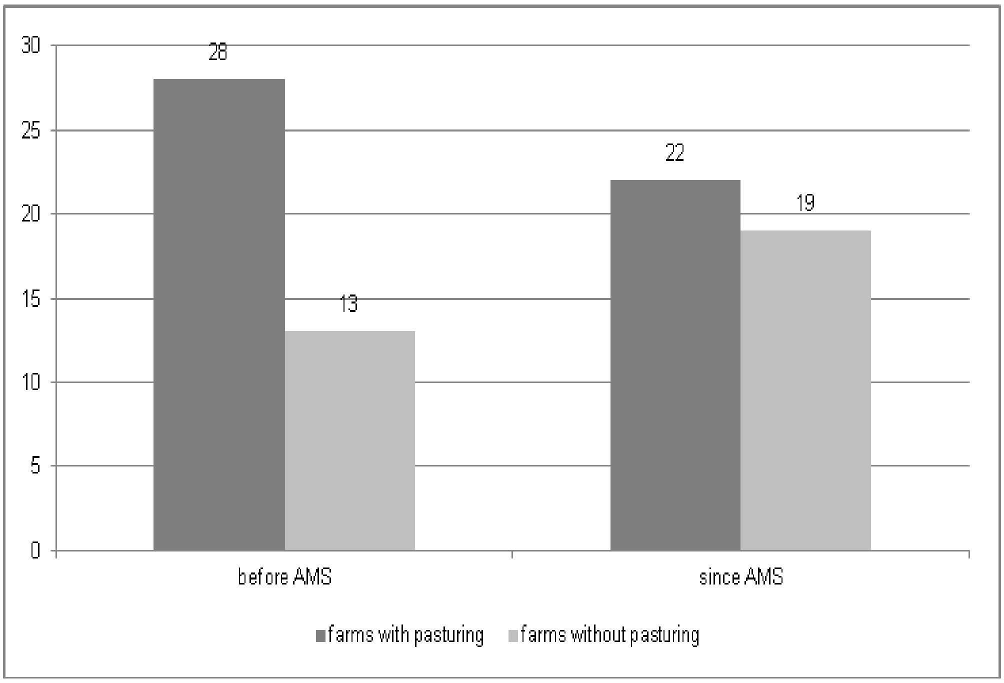

Figure 1: Number of farms with and without pasturing before and since the introduction of the AMS (n = 41)

The AMS introduction led to a decline of the average pasture area from 0.35 to 0.2 ha per cow (with a range of 0.01 to 1 ha per cow after AMS implementation; see Figure 2).

Grazing time, pasture systems and distance between pasture and barn

The extent of the grazing time in herds that had access to pasture both before and since the introduction of the AMS has hardly changed.

An obvious change of grazing systems after AMS implementation was described by the farmers. The most common pasture system prior to the AMS was rotational grazing, while this grazing system was practiced only by 15% of the farms after the introduction of the AMS. In contrast, the number of farms that performed continuous grazing had increased from 25% prior to the AMS introduction to 65% afterwards.

On most farms, the pastures were in the immediate vicinity of the stable building: on 20 farms the distance between stable and pasture area was at least 25 m. The maximum distance between the rearmost side of the pasture and the stable amounted to an average of approximately 500 m. Among these farms, on three farms the cows had to walk up to 1,000 m from the AMS to the farthest edge of the pasture.

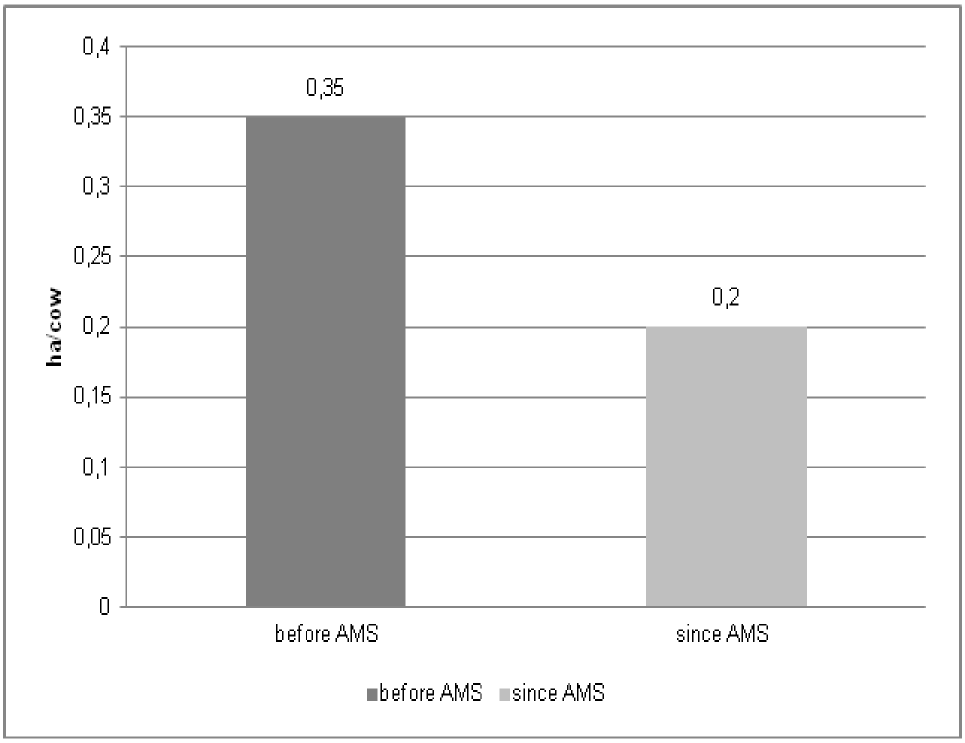

Figure 2: Average total pasture area per cow on the surveyed farms with grazing before and after the introduction of the AMS (n = 20)

Depending on the farm situation, namely location of the pastures in relation to the stable with the AMS, a permanent access from pasture to the milking robot was not always possible. However, a temporary separating of the cows from the AMS was only practiced on three of the surveyed farms. The cows on these farms were separated up to three, four and five hours from the AMS. On all other farms that are performing a grazing system, the cows had permanent access from the pasture to the robot.

Concentrate feeding

All farms fed concentrates in the AMS. On average, the farms fed 3.055 g of concentrates per cow per day. 51% of the surveyed farms stated that since the introduction of the AMS they have been fed more concentrates than before. Only 10% have been fed less concentrates.

Conclusions

The survey of 41 organic dairy farms with AMS showed that the herd size had partially grown significantly since the introduction of the AMS. The herd growth led to a significant decrease in the average grazing area per cow on the farms with pasture use. In addition, total area used as pasture decreased on the majority of the farms. Some farms had even completely ceased pasture use.

In summary, the impact of the AMS on animal welfare depends significantly on the housing conditions and the management of the farmers. In organic dairy farming, impairments of animal health and welfare by AMS have to be avoided. Especially the implementation of AMS should not be connected with ceasing grazing for cattle. Further research is needed on how to combine AMS with grazing.

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The organic food and farming innovation system in Germany: Is specific lobbying justified?

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Key words: innovation system, research, organic food and farming, innovation requirements, representation of interests

Abstract

This study's goal is to identify starting points for improving how the interests of the organic agro-food innovation system are represented in Germany. The status quo of research for the sector, the sector's innovative ability and innovation requirements and the framework conditions for research funding were analysed. The study shows that research is often applied and inter- or transdisciplinary and thus contributes to the sector's innovative ability. The structural capacity of the sector and research funding, however, lag behind its requirements. Professional representation of the needs of the organic agro-food innovation system may strengthen it

Introduction

The organic agro-food sector is setting the course for dealing with various key problems currently faced by the agro-food sector: e.g. adapting to climate change, improving soil fertility and increasing food security (Niggli et al. 2008). Effective innovation systems in which research plays a key role support the further development of innovation systems. Yet the overall framework conditions for innovation do not adequately reflect the potential that lies in the organic agro-food innovation system (ibid.). Based on the assumption that the innovation system as a whole could be strengthened by improving the overall framework conditions through effective lobbying, this paper has the following objectives:

- Identifying starting points to improve how the interests of the organic agro-food industry are represented in Germany.
- Analyse the status quo of research relating to the organic agro-food sector in Germany.
- Analyse the ability of the organic agro-food sector system to innovate.
- Identify core innovation requirements in the industry.
- Analyse the overall framework for public and private research funding and the decision-making processes for designing funding programmes and selecting which research projects deserve funding.

Methods

Research and innovation in the organic agro-food sector were examined from different points of view, mainly by qualitative expert interviews. Interview guidelines with different focal points and mainly open questions served as a basis. These were supplemented by a few enquiries of quantitative data. In total more than 100 interviews were conducted. The interviews were digitally recorded and then a summary transcribed. The interview material was then gradually evaluated based on the criteria of the qualitative content analysis (Mayring 2011).

To determine the status quo of research in Germany, 24 institutions and researchers were randomly selected based research results on the organic agro-food sector in Germany published in „Organic-Eprints" and „ISI-Web-of-Knowlege" between 2005 and 2010. This sample included researchers who focus on the organic agro-food sector in their work as well as researchers who occasionally deal with issues related to this area. Expert interviews of up to 90 Minutes were conducted on the following aspects: topics, approaches, used methods, methodological innovation, cooperation, knowledge transfer, output, funding and ideas for a representation of interests of the innovation system.

The innovative ability of the organic agro-food sector was assessed on the basis of 33 interviews with advisors and researchers working in the fields of crop farming, livestock and food. The experts were randomly selected on the basis of conference papers and a list of recognised advisors working in the organic food and farming sector. Interview of up to 45 minutes were conducted covering the following aspects:

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innovations important for the development of the sector, users and fields of application of research results / innovations and criteria for successful adaptation and diffusion.

Finally, the innovation requirements of the sector were identified based on a secondary analysis of existing studies (see BÖLW 2012, Kuhnert et al. 2011, Röhring 2009) and research and innovation requirements mentioned in the interviews about innovative ability and the status quo of research.

The general research framework was analysed with respect to opportunities for public and private sector funding. To this end, information about public research funding at federal and state level was gathered and supplemented by selected expert interviews. In addition, interviews were also conducted with 44 foundations that could be considered to fund research in the organic agro-food sector.

Results

Research approaches in the organic agro-food sector are mainly applied and often applied and inter- or transdisciplinary and thus contributes to the sector's innovative ability and can, therefore, make an important contribution to innovation processes in the organic agro-food sector. Usually a range of actors are involved in the innovation process, who often work together in inter- and transdisciplinary partnerships. The research pursued at universities, government research institutions and private institutions only represents one part of the innovation system. Advisory services and practitioners make important contributions to the innovation process, including knowledge transfer.

However, the structural capacity, i.e. the current number of scientists who work on issues related to the organic agro-food sector, is not consistent with the relevance of the research field. Furthermore, certain research projects cannot be carried out due to funding practices. Short funding periods and a lack of basic financing impede the innovation process: system-oriented research, long-term projects that deal with specific issues (e.g. breeding livestock and crops) or projects that require co-funding are only possible to a limited extent. In addition, expedient knowledge transfer is prevented if there resources available are insufficient to communicate the results to potential users after a research project is over.

Results provide substantial proof of the innovative ability of the organic agro-food sector. The innovation system has given rise to numerous innovations in crop farming, livestock and food processing, some of which have made their way into the conventional farming and food system. The spectrum of innovations spans specific process and product innovations (e.g. new breeding varieties or animal feed systems) through to complex organisational and social innovations (e.g. sustainable concepts in production and marketing). These successes, however, are neither adequately communicated within the industry nor to the outside. This can be attributed, at least in part, to a lack of awareness of the innovative ability among the actors themselves.

In addition, adaptation and diffusion of research results still needs to be improved. On the one hand, practitioners are often not aware of problem or lack motivation to participate in the innovation process. On the other, researchers still have to improve how they communicate their research findings. Inadequate resources on both sides hinder the diffusion of results.

Research and innovation requirements in the organic agro-food sector have been collected in the past by governmental and non-governmental institutions. The results of the expert interviews conducted over the course of this study also underscore the huge need for innovation in the sector. Improving or maintaining soil fertility, developing alternative plant breeds and dealing with climate change are examples of the requirements they identified.

Even though there are numerous public and private funders with different programmes that would provide a framework for researching issues relevant to the organic agro-food sector, there are only a few funding programmes specifically designed for this area that would reflect its relevance.

The analysis of the decision-making processes of funders showed that the structure of support programmes and the assessment of research projects to determine whether they are worthy of funding is not always transparent. Networks of key individuals within the organisations largely determine who sits on the committees of the funders analysed. The decisions made by the committees about programme structure and the selection of topics worthy of research are subject to both the personal assessment of the committee members as well as the political and financial pressure to take action.

Conclusions and recommendations

The findings described show that research makes an important contribution to the ability of the organic agro-food sector to innovate. The structural capacity of the innovation system and research funding, however, lag behind the industry's innovation requirements. The overall framework for research and innovation needs to be improved. Professional representation of this sector's interests may help. First steps in the representation of the agro-food innovations systems interests would include (see Häring et al. 2012)

- Continuous communication with individuals and institutions and participation in committees that influence the overall conditions for research in the agro-food sector on the innovative ability and the specific requirements of the organic agro-food sector. These include representatives of governmental and non-governmental institutions, companies and associations that fund research.
- Ensuring that information is shared within the innovation system of the organic agro-food sector. This includes regularly discussing innovations in the sector, the innovative ability of the sector, innovation requirements, communicating funding opportunities and motivating the actors to participate in the committees mentioned above.

While this study only looked at the innovation system in Germany, it is clear that the key problems the organic agro-food sector is facing are global. An effective international innovation system could help the sector to further develop. An improved representation of the sector's interests would be a starting point to achieve this.

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INCLUFAR – Inclusive Farming
A new educational approach in Social Farming

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Key words: Social Farming, Green Care, training, disability, inclusion.

Abstract

Social farming puts the multifunctionality of farming demanded by policy makers into practice. Across Europe social farms offer social services for different client groups. They integrate people with disabilities or offer Green Care services for disadvantaged people, but also for children or senior citizens. Three European projects – DIANA, MAIE and INCLUFAR – have been initiated to deal with training needs of professionals offering social services on farms. DIANA developed training tools for practitioners and MAIE elaborated a curriculum for training farmers basic knowledge to start social services on their farms. The INCLUFAR project focusses on transferring experiences from two already existing training programs – the German FAMIT and the Scandinavian "Baltic seminar" – into other target countries. These projects meet a demand for professionalization and quality insurance of social farming activities.

Introduction

"Social farming" and "Green Care" are being developed throughout Europe: farms which put the "multifunctionality" demanded by the policy makers into practice, contributing to the creation of jobs in rural areas through the creation of social services. Social farming includes agricultural enterprises and market gardens which integrate people with physical, mental or psychological disabilities; farms which provide opportunities for the socially disadvantaged, for young offenders, those with learning disabilities, addicts, the long-term unemployed and active senior citizens; school and kindergarten farms and much more besides. Social farming includes elements such as provision, inclusion, rehabilitation, training and a better quality of life (van Elsen & Finuola 2013). Starting with the European Community of Practice (CoP) Farming for Health (Hassink & van Dijk 2006), research activities were set up: the COST Action 866 Green Care in Agriculture (Braastad et al. 2007) and the EU research project SoFar (Di Iacovo & O'Connor 2009).

Which educational demands result out of the growth of Social Farming in Europe? Which training approaches ensure a professionalization and quality insurance of social farming activities? Three European projects have been carried out to elaborate training tools for practitioners.

Material and methods

Within two "Leonardo-Projects" supported by the European Lifelong Learning scheme educational needs were identified: The DIANA project (Disability in sustainable agriculture – a new approach for training of practitioners, www.projectdiana.eu) dealt with the demands of practitioners with different professional background working on social farms. The MAIE project (Multifunctional Agriculture in Europe - Social and Ecological Impacts on Organic Farms, www.maie-project.eu) developed a curriculum for farmers being interested to integrate social work into their farming concept. In both projects demands of practitioners were identified by interviews with experts first. In DIANA training tools were developed and tested as a piloting on social farms. In MAIE a curriculum for farmers has been developed based on experiences in countries with advanced Social Farming networks (especially The Netherlands and Italy).

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Lifelong Learning Programme

A next step is the new INCLUFAR project (2013-2015, www.inclufar.eu): The team of authors has applied successfully to run the project "Inclusive farming – transfer of concepts, experiences, skills and training tools for Social Farming and eco-social inclusion" within the "Leonardo da Vinci - Transfer of Innovation" scheme. Based on the experiences above and two 3-years curricula (FAMIT and BALTIC seminar) a participatory transfer to "target countries" in Eastern Europe is planned. In each of the target countries the demands will be identified and a strategy to implement a training course will be elaborated in a participatory process together with local stakeholders.

Demands and educational approaches in European Social Farming

The results of the MAIE-project have shown clearly that there is no European wide standard or curriculum available to qualify entrepreneurs and employees of organic green care farms working with disabled people. The state of the art and the limitations of existing pedagogical materials in this area is documented in the executive summary of the DIANA project which aimed to fill a serious double gap: the lack of technical competencies of the trainers / tutors with psychological or educational background and the lack of educational and psychological competencies of agricultural technicians. To fill these gaps is extremely relevant because social farming has positive effects for social inclusion and protection of environment and already offers extraordinary possibilities of training and jobs for large groups of disadvantaged persons. DIANA developed an integrated and joint training programme for practitioners in order to make them able to face the complex reality of social farming. This approach to train workers with technical background and practitioners with socio - educational - psychological background together will be a basic approach of the INCLUFAR curriculum. To activate a proper training several requirements must be present:

Figure 1. DIANA project logo

Figure 2. Logo MAIE project

- technical knowledge, ability to mix competences
- ability to tackle ecologic, social and economic questions simultaneously
- assessment of every individual
- activities, kind of training and contents must be at an high research level and specific to the staff
- experiences in co-operation.

Although green care enterprises started emerging and getting public awareness in the past decade there is a lack of qualified staff specialised on both agriculture and horticulture on one side and nursing related professions on the other side. The results of the past EU-funded green care projects SOFAR, DIANA, MAIE and others reflect this fact where - among other findings and objectives - development of appropriate VET curricula is a concern.

The approach of the INCLUFAR project

The INCLUFAR project is based on 30 to 40 years practical and conceptual experience of organic farms in different countries (e.g. DE, NL, AT, FIN) working with disabled people. Especially the combination of organic and bio-dynamic agriculture with its demand for a healthy soil and nature and an integrated social work is very effective and provides a positive impact on people, nature and landscape. These farms consider disabled people not as being ill, but as real co-workers with specific ranges of performance, able and willing to contribute to an added value of the society and the farm. It is obvious that this demanding issue needs specific education and skills. So the project focuses on the transfer of two innovative training concepts:

1. The 3-years curriculum for „Fachkraft für Milieubildung und Teilhabe – FAMIT" which means „Expert for social farming and inclusion". This training concept has been practiced for 12 years and is accredited by the government of Schleswig-Holstein equally with other social professions;
2. The 3-years curriculum of the BALTIC Seminar, which is a 3-years training course developed by experts working in the area of social farming targeted to trainees from Norway, Estonia, Finland and Russia.

The project will merge these two concepts to the INCLUFAR curriculum and transfer these innovative products and adapt them systematically for the needs and the VET structures in the partner countries.

Figure 3. Logo Inclufar project

The new multilateral transfer of innovation project aims to meet the need for appropriate curricula suitable for entrepreneurs and staff of social farming and green care farms interested in inclusive training and participation of disabled co-workers in organic farming, food processing and craftsmanship.

The previous projects showed clearly that there is a crucial demand on curricula for social farming enterprises for both, staff and entrepreneurs. To address this demand, the project aims to transfer a well-established and approved curriculum and the gathered experiences to green care enterprises which link both areas:

a) inclusive care for individuals with special needs and

b) inclusive work with nature in organically cultivated farm land

to ensure professional didactics, material and capacity resources in vocational education and training (VET).

The INCLUFAR curriculum will combine these two areas of work and life providing competencies to link social work and welfare within the rural areas. As a following emerge better labour opportunities fostering rural economic development. Exploiting the specific agricultural work/life-setting provides more and improved social welfare structure in rural locations where service coverage is traditionally weak. The training shall meet the demand for professionalization and quality insurance of social farming activities.

Objectives are:

- To meet the needs for well-established teaching methods in social farming enterprises making the innovative INCLUFAR curriculum available. This allows VET trainees to improve their skills while formally retaining their already existing professional capacities. Trainers shall find new professional resources to participate in and to carry out inclusive training.
- To improve the qualification and the quality of work for staff working at green care farms in Europe by introducing the curriculum on seminars and workshops to green care farms applying the inclusive approach.
- To compile an accessible, practically applicable occupational profile with the didactic material and human VET resources needed to implement it. The didactic content is based on experiences in the partner countries and the distinct pedagogic characteristics of the partner countries with the aim to balance knowledge acquisition and skills formation.
- To introduce both the occupational profile and the INCLUFAR curriculum to formal VET institutions in the agricultural sector and the social therapeutic sector in European countries by establishing contacts to municipalities and other authorities via green care competence centres like MTT.

Figure 4. Harvesting branches for winter fodder on a social farm in Germany

Thus the multilateral transfer project prioritises the encouragement of cooperation between VET and the world of work by improving the supply of professional work in the area of agriculture and social work and the demand of the labour and employment market.

The INCLUFAR transfer strategy

The project aims to work across sectors as it address not only the agricultural VET training programs but at the same time VET in social care. Whereas well defined VET programs exist in each sector, a combined training strategy, functioning programs or best practice in VET covering both sectors are not available yet.

The INCLUFAR project will address this issue, and is adopting a transfer strategy based on two pillars:

(1) Adaptation (linguistic, cultural, sectoral) of the existing training curricula to the needs expressed by “target partners”. The experiences and the achievements at green care centres involved as source partners in DE and NO will be combined, adapted to cover the demands and prepared for transfer focusing on:

(a) The rural development resp. farming sector

(b) The social care sector, focussing on care for people with special needs and elderly.

(2) Participatory transfer to “target countries” where pilot organisations from the different sectors in Eastern and Southern European countries will participate. Based on their demands the transfer will be initiated through active learning experiences, a kind of “community of practice" approach.

The project will proceed through four methodological steps:

1. Assessment and definition of the transfer approach, analysis of existing needs and expressed demands from other previous projects will be reviewed, and the optimal transfer approach will be defined in consultation with the project partners.
2. Innovative curricula adaptation and combination. The existing FAMIT and Baltic Seminar curricula will be adapted, best elements selected, and lead to the INCLUFAR curriculum suitable for each partner organisation and country need.
3. Compiling of a structured handbook. The existing elements of social farming, green care and inclusive farming information will be collected, structured and made available to all stakeholders. The results will be focused in a curriculum and course content for in-service training
4. Transfer of the INCLUFAR curriculum. Through an innovative inclusive coaching approach the exporting partners transfer the handbook and the INCLUFAR-curriculum to the target partners.

The central work package of the project is the transfer through an innovative inclusive and participative approach based on coaching and mentoring elements which in turn base on the idea of forming in-service training and of learning. For this purpose eight task force teams from two partner countries each are selected to implement the transfer process

Figure 5. INCLUFAR kick off meeting on Hardebek Farm, Germany

The implementation focus is the transfer of existing experiences form experienced partner enterprises to recently founded partner enterprises. First phase of this process is the assessment, revision and adaptation of existing curricular practice and tools and methodologies. A systematic transfer and coaching process during the initial implementation steps in the target countries forms the core activity of the INCLUFAR project. The methodology applies the principles of action research and participation with all partners involved. Inclusion and inclusive farming is not only the main topic of the INCLUFAR project, but will actively play a key role in all workshops and the transfer process implementation. An active, participative and inclusive approach builds the core element of the transfer process. The consortium will integrate in all steps the final beneficiaries. Actors with special care needs will pro-actively be integrated in the main project activities and work programs.

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Fatty acid composition of organic goat kid meat from dairy goat and crossbred meat goat kids

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Abstract

In contrast to the increasing demand for dairy goat products in Germany, a market for goat kid meat as a related product does not exist. Thus, the objective of this study was to develop a concept for organic goat kid meat production for dairy goat farms. In collaboration with a wholesaler, organic dairy goat farmers and marketing research the experimental part of this study was to find out if cross-breeding of meat-goats could improve meat quality and performance of fattening goat kids together with other factors like concentrate ratio of the diet, genotype, sex, housing vs. pasture as well as raising strategy during milk feeding period. Our results indicate that even a low input level of concentrates (10 % of total dry matter intake per goat kid and year) is sufficient to achieve the requested carcass weight of 12 kg at slaughter when goat kids are kept on pasture. Dressing percentage in both experimental years was affected by concentrate level, the more concentrates (40 %) the higher dressing percentage. Comparing years 2011 and 2012, dressing percentage was 4 % higher in 2012 for both concentrate levels. Daily weight gain per kid ranged from 122 to 133 g/d significantly influenced by concentrate level and sex, in 2011 as well by genotype. A low concentrate level (KF10) resulted in higher contents of Omega 3 fatty acids, male KF10-goat kids had highest omega 3 content of 1.19 g/100 fatty acid. The raising of "Capretto" type kids for slaughter indicated, that artificial rearing of kids using cow milk is beneficial compared to mother bonded rearing.
Results indicated, that rearing and fattening of goat kids even under low input production levels on pasture can be realized und will produce higher meat qualities regarding fatty acid composition.

Introduction

Scientific literature of the production of goat meat focuses predominantly on fattening performance and meat quality of goat kids from the intensive fattening or the meat goat keeping specialized. There aren't examinations which take into account the criteria of the organic farming especially the conditions of professional dairy goat farms.

A study of the structure of dairy goat farms in southern Germany shows, however, the great importance of the organic farming in the goat milk production sector. Almost 77 % of dairy goat farms in Bavaria and Baden-Wurttemberg were managed according to the guidelines of the organic farming (Herold et al., 2007). Most of the dairy goat farms kept goats in herd sizes between 50 and 100 animals only a few farms raised more than 100 dairy goats (Hesse, 2002). Unlike from the increasing demand for goat milk products, the market for goat kid meat in Germany does not exist. Goat kid meat and goat kid meat quality is unknown to (german) consumers. Dairy goat farmers try to sell or even give away goat kids when they are 14 days old, often to obscure and unethical destinations. Thus, new concepts and knowledge is needed to raise goat kids under the premises of welfare and sustainability of organic livestock farming.

Animals, Materials and Methods

The experiment was carried out at the experimental farm of the Thünen-Institute of Organic Farming in Trenthorst/Germany from February 2011 until September 2012. The dairy goat herd consisted of 50 goats of the dairy breed German Improved Fawn (BDE). For the two-year fattening experiment half of the goat herd were bred using a BDE buck, whereas the other half was crossbred with Boer bucks as meat breed. After kidding, kids were raised by their dams for 45 days and selected by sex, genotype and weight to form groups of 9 – 10 goat kids each. As an additional treatment, concentrates from pure pelleted wheat coarse meal were fed either 10 % of total dry matter intake per goat kid and year (KF10) or 40 % of total dry matter intake per goat kid and year (KF40). Concentrates were increased from 80 g/lamb/day (KF 10) to 320 g/lamb/day (KF 10) or from 160 g/lamb/day (KF 40) to 640 g/lamb/day (KF 40) during the grazing season (see Table 1). The concentrates were dispensed twice a day individually, all residuals were weighed in 2011. At the end of the grazing season (3 weeks before slaughter) goat kids were housed indoors for a final fattening period with ad libitum hay and concentrates fed according to Table 1.

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Table 1: Concentrate feeding regime

Genotype	Sex	Concentrate feeding group	n	Wheat coarse meal per animal and day [g] till 7/21/2011	7/21/2011 - 9/13/.2011	Final fattening period 13.9. - slaugther
BDE	femal	KF10	10	80	120	160
		KF40	10	320	480	640
	male	KF10	9	80	120	160
		KF40	10	320	480	640
Boer	female	KF10	9	80	120	160
		KF40	10	320	480	640
	male	KF10	10	80	120	160
		KF40	10	320	480	640

Goat kids were weighed every two weeks, parasites were controlled according to www.weide-parasiten.de. Animals were slaughtered at a commercial slaughter plant under scientific supervision and evaluation of the carcasses. Measures of pH 24, conductivity etc. were taken at the slaughter house, a sample of *longissimus dorsi* was taken and frozen for further analysis of tenderness and fatty acid profile.
Experimental data was recorded in the field using Excel sheets. Statistical analysis was conducted by using SAS statistical package version 9.3 and proc GLM.

Results

Daily weight gain per kid ranged from 122 to 133 g/d significantly influenced by concentrate level and sex, in 2011 as well by genotype. As an example of fatty acids, a low concentrate level (KF10) resulted in higher contents of Omega 3 fatty acids, where male KF10-goat kids had highest omega 3 content of 1.19 g/100 fatty acid (Figure 1 and Figure 2.)

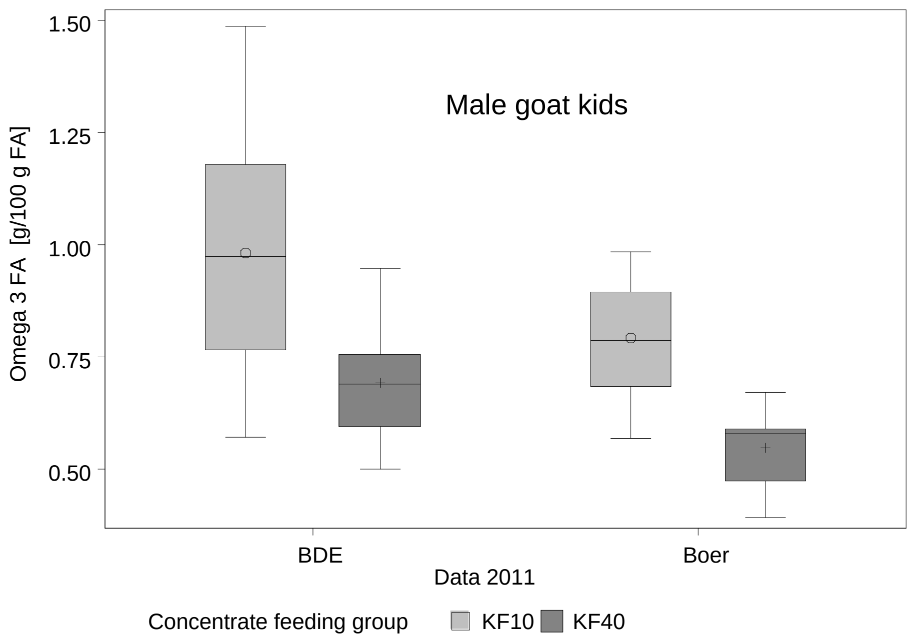

Figure 1 : Omega 3 fatty acid contentof male goat kid meat depending on breed and concencrate feeding level (Data 2011)

An analysis of variances (Table 2) shows that genotype, concentrate feeding level and sex are significant factors for the Omega 3 fatty acid content of *the longissimus dorsi* of the studied goat kids. In contrast to that, interactions between the factors mentioned above where not significant.

Table 2 : Analysis of variance of Omega 3 fatty acid content in *longissimus dorsi* depending on genotype, concentrate feeding level and sex (data2011)

Source	DF	LSMeans	F-Statistic	Pr > F	Sign. (α=0.05)
Genotype	1	1,01	10,06	0,0023	***
Concentrate feeding level	1	4,20	41,80	<,0001	***
Sex	1	3,01	29,96	<,0001	***
Concentrate feeding * Sex	1	0,07	0,75	0,3909	n.s.
Genotype * concentrates * Sex	3	0,17	1,65	0,1867	n.s.

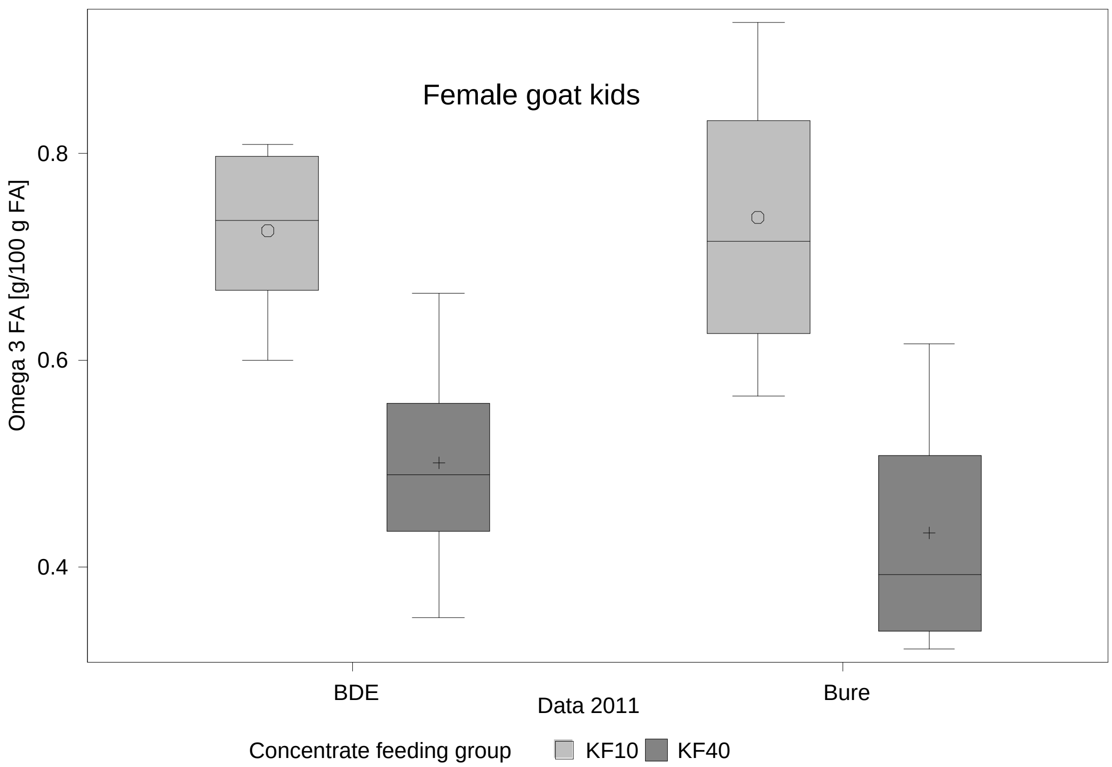

Figure 2 : Omega 3 fatty acid content of female goat kid meat depending on breed and concentrate feeding level (Data 2011)

Conclusions

It can be concluded, that fattening of organic goat kids is feasible even with dairy breeds. The high quality of the meat (e. g. Omega 3 fatty acid) should be paid more attention when marketing products to the consumer.

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Landscape Aesthetics as an indicator for social sustainability of crop rotations

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Key words: evaluation, landscape aesthetics, sustainability

Abstract

The goal of this study was to evaluate different crop rotations in terms of landscape aesthetics using Klostergut Scheyern as an example. Therefore, people living in the vicinity of Klostergut Scheyern were shown photos of each crop at different periods of the year. Additionally, a questionnaire containing quantitative as well as qualitative questions was developed. Each crop was given a grade, the best one being 1 and the worst one being 4. People were allowed to justify their ranking. The use of agricultural machines was also presented on photos. For each crop, participants could decide whether they liked or disliked the use of the machines.

In summary, all crops have been evaluated rather positively; the grades reach from 1.4 to 2.6. The use of machines has hardly ever influenced people's opinions. Taking qualitative comments into consideration, the survey revealed the difficulty to separate purely visual aspects from moral attitudes towards a certain crop.

Introduction

Within the last 20 years, many attempts have been undertaken to evaluate the sustainability of farms. In most cases, the focus has been put on ecological indicators. In this approach, we have tried to integrate landscape aesthetics as an indicator of social sustainability. As landscape aesthetics depend on many factors and are difficult to evaluate, there is a tendency to underestimate their importance and rather ignore them. At the same time, the general public seems to get more conscious about agricultural production. Complaints about the increased number of maize fields as well as resistance against plans to construct new stables come up over and over again.

The goal of this study is to develop a sustainable crop rotation for the ecologically managed fields of Klostergut Scheyern, an experimental site in southern Germany, 40 km north of Munich. Currently, the crop rotation is economically unreasonable. The new rotation shall not only bring in more money, but also consider ecological and social aspects. Most evaluation systems work on farm level; therefore, we had to develop indicators that are sensitive to changes in the crop rotation. For example, phytosanitary aspects are closely linked to crop rotations, yet they are not considered in evaluations on farm level.

Talking of landscape aesthetics temporary aspects play a predominant role at the level of crop rotations since the fields look differently in the course of the year. Furthermore, perception and evaluation of landscape can vary from place to place. Hence, the target group is limited to people living in the vicinity of the farm. In Scheyern, this is particularly interesting because in the near past a new housing estate has grown around the Klostergut.

Material and methods

The survey is based on a questionnaire containing quantitative as well as qualitative questions. Since the target group is small, statements going beyond the actual questions are gathered as well.

Participants have been visited at home and shown photos of different crops at different periods of the year (Figure 1). Additionally, photos of different stages of the machines at work have been presented (Figure 2). In a complementary questionnaire, people were asked to rate each crop with a grade. The crops in question for the new rotation are potato, winter wheat, sunflower, grass-clover-mixture, rye, field bean, soya bean and oat. The participants had to decide how much they would like to see each crop be planted in Scheyern using the grades 1 "very good", 2 "good", 3 "less good" and 4 "not at all". In the next question, the participants had to tell whether the use of machines had influenced their evaluation. The final question has been how much

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diversity of the cultivated plants, crop cover and use of machines influenced the participant's scenic experience. Again, there are the grades 1 "positive", 2 "rather positive", 3 "rather negative" and 4 "negative".

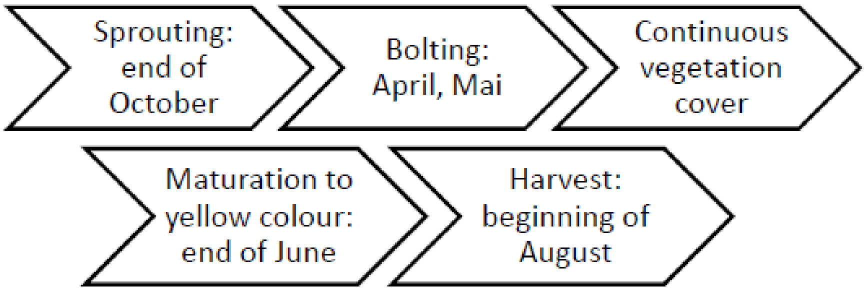

Figure 1: Different periods in the cultivation of winter wheat that have been shown on photos

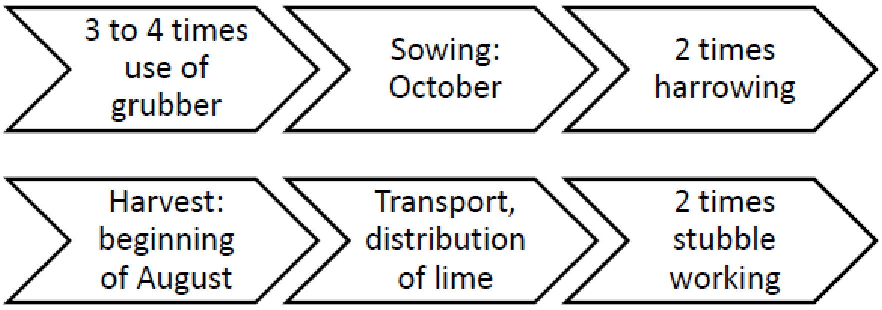

Figure 2: Different working steps in the cultivation of winter wheat that have been shown on photos

Results

The survey was carried out on the 11th of June 2013 between 3 and 8 pm in the vicinity of Klostergut Scheyern. There were 13 participants, eight female and five male. Of the participants, 11 people could see the agricultural fields of the neighbouring farm from their houses.

Overall, the evaluation is rather positive. All crops have grades between 1.4 and 2.6 with Sunflower having the best evaluation of 1.4 whereas grass-clover-mixture for later use in biogas plant achieves the worst grade of 2.6. Sunflower, potato, rye, oat, wheat and field bean are situated between 1.3, representing "very good", and 1.8, "good". Soya beans, grass-clover-mixture for mulching and biogas plants are less popular, reaching grades between 2.3 "good" and 2.6 "less good". The null hypothesis that grades and crops are independent cannot be refuted at a 5 % level (p=0,083).

The use of agricultural machines hardly influences the evaluation. Only in case of the grass-clover-mixture, more than three people felt this was the case. The use of machines in the cultivation of grass-clover-mixture for mulching disturbed four participants whereas one person said he appreciated the machines. However, this person did so for every crop in the survey. Coming to grass-clover-mixture for biogas plants, five people (corresponding to 38 % of the participants) gave a negative evaluation for the use of machines whereas two people liked it.

A high diversity of crops and a complete vegetation cover throughout the year are aspects people like, so the grade for each of these aspects is 1.2. The use of machines has the grade 2.5, which indicates that people are indifferent about it. This fits well to the finding that the use of agricultural machines hardly influences the evaluation of the crops.

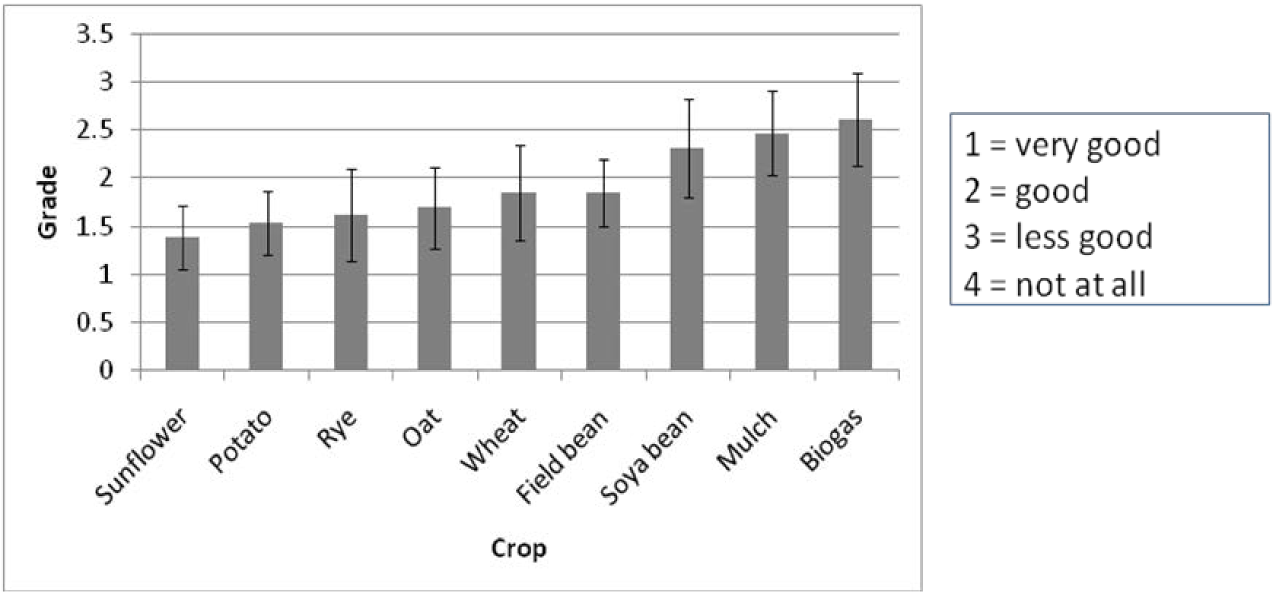

Figure 3: Chart showing the results of the survey

Some qualitative comments shall also be mentioned: Soya beans are not considered as being indigenous plants and awake some negative connotations due to the debate on genetically modified plants. Currently, there is a lot of grass-clover-mixture in the rotation that is only used for mulching. Therefore, it is sometimes less appreciated.

Sunflower is the favourite crop since its flowering is very popular. Potatoes scored second best. Many times, this has been explained by the fact that they are sold in Scheyern and people like buying local products.

Discussion

In summary, the survey revealed the difficulty to separate purely visual aspects from moral attitudes towards a certain crop. However, this might not be a real drawback since all connotations influence the perception and evaluation of agricultural fields. In fact, they are indeed included in the broader definition of aesthetics. Therefore, the overall feedback gained in our survey is probably more valuable than a simple grading of visual aspects. Moreover, people claim that environment and global food issues matter more to them than visual appearance. They might, however, misjudge the ecological relevance of different farming systems, so that a more intense exchange on agricultural issues is crucial.

The International Federation of Organic Agriculture Movements (IFOAM) defines the promotion of "a good quality of life for all involved" as a goal. Eventually, landscape aesthetics shall no longer be ignored but must be considered as an important aspect of quality of life.

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Anecic, endogeic, epigeic or all three - acknowledging the compositional nature of earthworm ecological group data in biodiversity analysis

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Key words: count data, functional groups, ternary diagram, soil fertility, ecosystem services

Abstract

Agriculture influences soil biodiversity through management activities whilst benefiting from services provided by the soil ecosystem. In this context, earthworms are particularly important as ecological engineers. Management systems and different habitat types can influence the provision of ecosystem services by soil organisms. Common biodiversity analyses did not show large differences in earthworm diversity in this study. Impacts on earthworm populations can also be assessed by analysing changes in the relative proportions of their three ecological groups. New statistical methods for compositional analysis revealed habitat class as a major factor influencing earthworm functional group composition. Management system impact was not significant and varied within different habitats. In conclusion, the methods used are recommended for studies involving the analysis of compositional data such as assessing changes in relative proportions of several components.

Introduction

Biodiversity loss has become a prominent issue in agriculture, which is said to exert considerable pressure on biodiversity. Consequently, there is public and political pressure on agriculture to become more sustainable and minimize its impact on biodiversity. Simultaneously, production systems need to be developed that utilize the benefits from biodiversity and related ecosystem functions. In this context one challenging task is to understand, monitor and manage soil biodiversity and its functions like maintaining soil fertility, soil structure or water infiltration.

To clarify these complex relationships and thus develop optimized management strategies, knowledge about species distribution and composition is crucial. Additional information on the presence, absence or proportion of specific species traits, e.g. their affiliation to functional groups that are relevant for the supply of ecosystem services, need to be assessed. Hence, species samples are collected for which various diversity measures or multivariate distance measures (e.g. Shannon diversity index) can be calculated. This applies in particular to appealing organism groups like earthworms, which are known to be good direct biodiversity indicators providing useful information on soil biodiversity and fertility.

One aspect frequently analysed in this context is the relative proportion of the three different ecological groups of earthworms. However, this is done either in a qualitative way by interpreting graphics like stacked box plots or by using standard statistical methods. This latter approach is problematic because it does not take into account that these datasets have special characteristics. For example, proportional data of ecological groups always adds up to a constant such as 100 % and thus, at the very least, the last component is not independent. Aitchison (1986) noted the problems with this kind of data, which he called compositional data, and developed a new mathematical framework to analyse such datasets. These methods recently became available with standard statistical software. We therefore apply a compositional data analysis to earthworm data collected on farmland to gain a better understanding of the relationships between management system, habitats and the functional composition of soil biodiversity.

Material and methods

Data was collected for the EU FR7 project BIOBIO (www.biobio-indicator.org). The German case study region was located in southern Bavaria. Within this region eight organic (org) and eight non-organic-respectively conventional (con) managed mixed dairy farms were randomly selected. In total 127 plots, representing the different habitat types found on these farms, were sampled (Herzog et al. 2012).

Earthworms were assessed with a combination of an expellant solution and a time-restricted hand sorting procedure according to BIOBIO standards (Dennis et al. 2012). All individuals were counted and weighed.

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The adult specimens were identified to species level. For each species the trait information on its ecological group was stored.

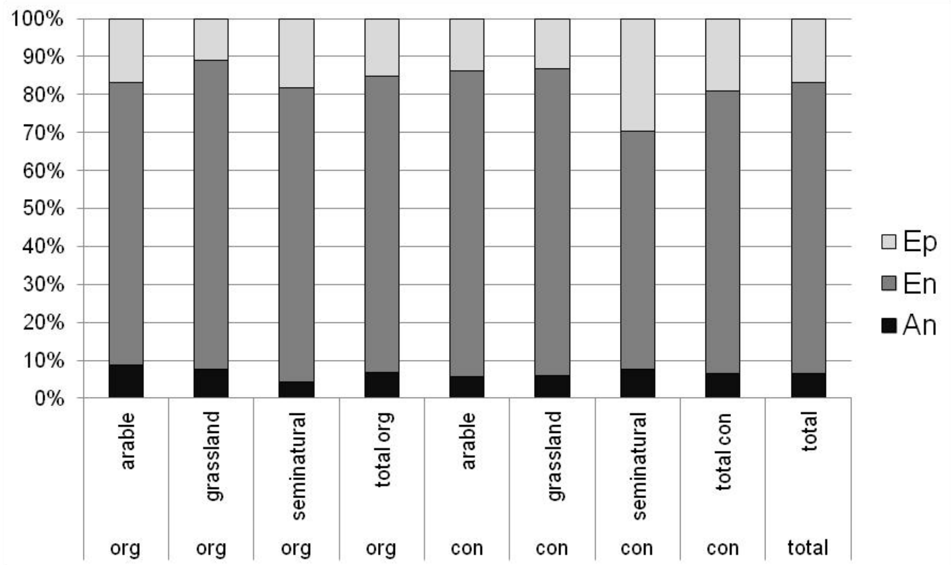

Figure 1. Classical stacked bar chart showing the different relative proportions in abundance of adult individuals within three ecological groups (Ep=epigeic; En=endogeic; An=anecic) for organic (org) and conventional (con) managed plots and three habitat classes (semi-natural; grassland; arable).

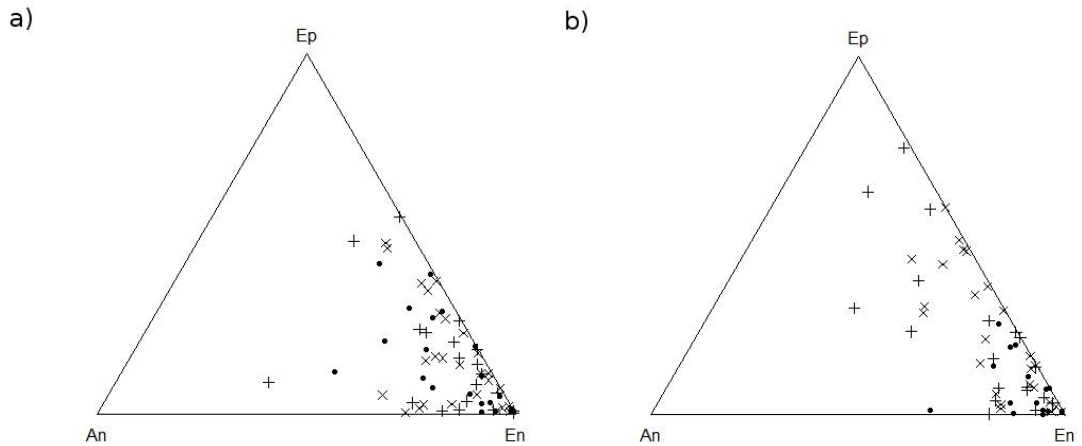

Figure 2. Ternary diagrams calculated in R. The corners of the diagrams represent a 100 % dominance in abundance of adult earthworms of the respective ecological group (Ep=epigeic; En=endogeic; An=anecic). Points are placed in the diagram according to the specific composition of the three ecological groups for each plot. a) shows the organic plots and b) the non-organic plots. Solid dots mark semi-natural plots, plus marks grassland plots and crosses mark arable plots.

For the analysis presented here only the data on abundance of adult specimens was used. Juveniles were excluded because these specimens cannot always be determined to species level, and thus the exact ecological group cannot be assigned. As for one plot no adult specimens could be found, it was treated as an outlier and therefore also excluded from the analysis.

For the statistical analysis in R 2.15.2 (R Development Core Team 2012) the package “compositions” (van den Boogaart et al. 2009) was used. Because numbers of earthworm individuals were recorded the function “ccomp” for count compositions was used to represent the data. To visualize the compositional data ternary diagrams were created. For detailed analysis on the relation between the count composition and the two factors management system and habitat class, a linear modelling approach as described by van den Boogaart et al. (2013) was applied.

Results

In total 9106 individuals were found and 11 species identified. 70 % of individuals and 42 % of biomass was comprised by juveniles. In organic plots eight species and in non-organic plots nine species were found. For both management systems an exponential Shannon index of 4.3 and an inverse Gini-Simpson index of 3.1 for organic and 2.7 for non-organic plots was calculated.

A qualitative assessment of both the stacked bar chart (Figure 1) and the ternary diagrams (Figure 2 & 3) suggested only small differences between the two management systems. In contrast, differences between habitat classes were perceptibly larger.

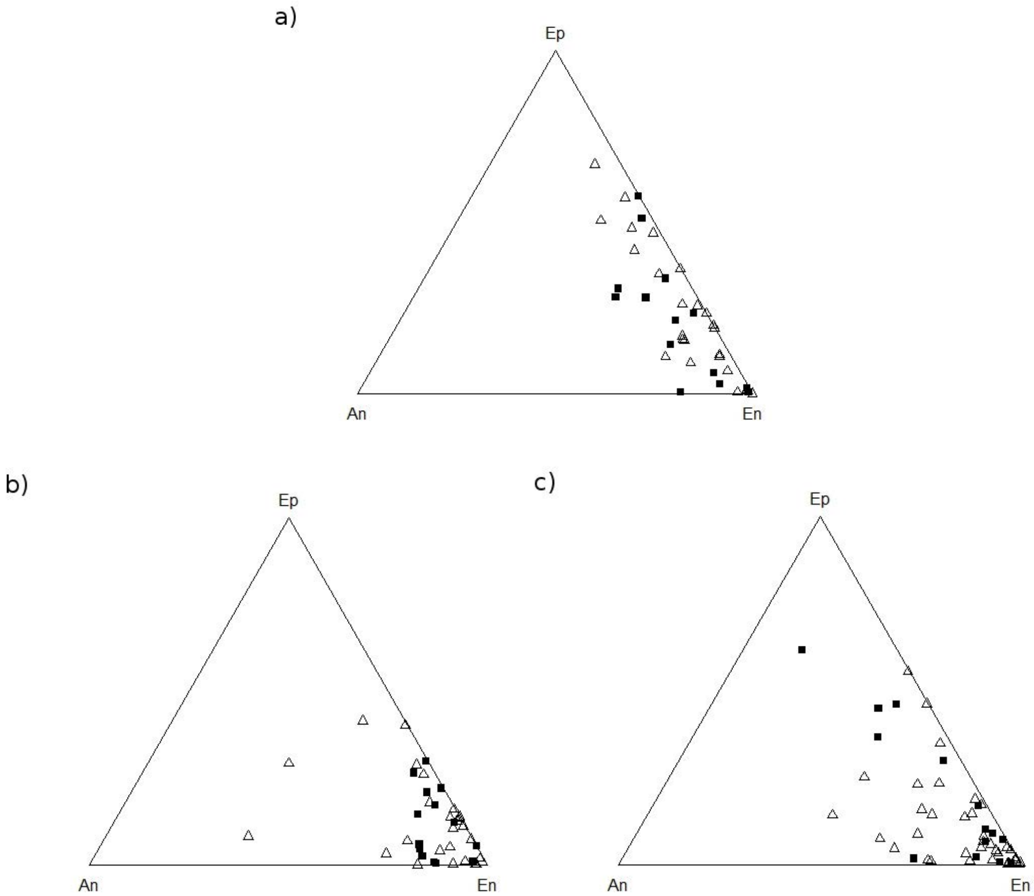

Figure 3. Ternary diagrams calculated in R. The corners of the diagrams represent a 100 % dominance in abundance of adult earthworms of the respective ecological group (Ep=epigeic; En=endogeic; An=anecic). Points are placed in the diagram according to the specific composition of the three ecological groups for each plot. a) shows semi-natural plots, b) the grassland plots and c) the arable plots. Solid squares mark organic plots and triangles mark non-organic plots.

To support visual interpretation six linear models with the earthworm ecological group composition as response variable and management system and habitat class as independent variables were tested. Only the intercept term and the habitat class produced highly significant results (Table 1). The impact of management system was not significant. Nevertheless, the full model revealed an interaction between management system and habitat class; however this interaction was not statistically significant. All models performed reasonably well. Taking into consideration the R^2 values of the models, the model considering habitat class only performed best.

Table 1: Results for analysis of variance of full linear model ($R^2 = 0.338$).

	Df	Pillai	approx F	num Df	den Df	Pr(>F)	Significance
Intercept term	1	0.745	114.868	3	118	< 0.001	***
Management system	1	0.012	0.493	3	118	0.688	n.s.
Habitat class	2	0.328	7.784	6	238	< 0.001	***
Interaction term (Management : Habitat)	2	0.089	1.847	6	238	0.091	.
Residuals	120						

n.s. not significant; **.** not statistically significant (p<0.1); * significant (p<0.05); ** very significant (p<0.01); *** highly significant (p<0.001)

Discussion

Common biodiversity analyses did not show large differences in earthworm diversity between organic and non-organic plots. With a total number of only 11 species, one additional species in non-organic plots may have been due to chance. However, higher values for the inverse Simpson index in organic plots gave evidence for higher evenness in the species' relative abundances. Crowder et al (2010) found a similar pattern in studies of natural enemies and concluded that the higher evenness in organic systems may foster the provision of beneficial ecosystem services.

A closer look at the impacts of management system and habitat class on the relative proportions of earthworm ecological groups revealed noteworthy relationships. Compared with the values of semi-natural habitat the results of the model suggested a positive influence of grassland on anecic earthworms but a negative influence on epigeic earthworms. Arable land had lower values for all three groups. For this dataset, although not significant, organic farming seemed to have a positive influence only on endogeic earthworms. For anecic earthworms a slightly negative and for epigeic worms even a perceivable negative impact was observed. The habitat classes seemed to be much more important for earthworms than the management system. However, the almost statistically significant interaction effect suggests that the effect of organic farming is dependent on the habitat class. Accordingly, results indicated that organically farmed arable land had a lower negative impact on endogeic earthworms and even a positive impact on anecic and epigeic earthworms. Managing grassland organically also promoted anecic and epigeic earthworms but seemed to hamper endogeic worms. These results may be partly explained by differences in tillage and fertilization practices, as well as different treatment of crop residues.

In terms of methods, this study proved that the new methods for the analysis of compositional data provide a good framework for investigating species data. In particular, for the analysis of earthworm ecological group data, the approach yielded better and more useful results than a mere graphical interpretation. In addition, pitfalls due to the compositional structure of the data were avoided.

Organic farming is dependent on utilizing beneficial ecosystem services related to biodiversity. An objective assessment of functional biodiversity components and scientifically sound methods to relate these components to site and management parameters is therefore of particular importance. In conclusion, the methods used are recommended for studies involving the analysis of compositional data such as assessing changes in functional group proportions or the relation of crop biomass in roots, shoots and fruits.

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Benefit of sulfate fertilisation in Alfalfa- and clover grass mixtures in organic

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Key words: sulphur, legumes

Abstract

*In this study, alfalfa- and clover-grass mixture was fertilized with MgSO4 and CaSO4 (treatments: 1: no treatment, 2: MgSO4 80 S * ha^{-1}, 3: CaSO4 80 kg S * ha^{-1}). The yield, N-content and S-content of the alfalfa- and clover-grass-mixture was clearly positive affected by sulphur fertilization.*

Introduction

Alfalfa- and clover-grass-mixtures are of high importance for organic farming systems. Their ability to fix atmospheric nitrogen results in high N input into the farming system. It is well known, that nitrogen fixation and plant growth of legumes is affected by sulphur (S) deficiency (Scherer et al. 2007, Varin et al. 2010).

Because of the clean air act 91, a decline in S deposits on agricultural crops has been observed throughout Europe during the last decades (Zhao et al. 2002). In consideration of these facts it seems to be obvious, that S-shortage is a common problem in practice of organic farming systems in many regions of Europe.

Material and methods

In the years 2010 and 2011, S response trials were at Gladbacherhof, organic trial station of the University Gießen (Villmar Hesse Germany, mean annual temp. 9.3°C, annual precipitation 670 mm, soil texture: clayloam, dairy farm, 1 LU cattle ha-1).

Two sulfate fertilization treatments (80 kg S ha-1 resp. as MgSO4 or CaSO4) were compared with a control (no S) in alfalfa-clover-grass. The experiment was conducted in the second year after establishment (underseed in summer barley) of the alfalfa-clover-grass, and was repeated in two series (2010 and 2011 on different fields). Fertilization was split in 60 kg S ha-1 at the beginning of the growing season (25.03.2010 resp. 10.03.2011) and 20 kg S ha-1 after the first cutting (10.06.2010 resp. 06.06.2011). The experiment was conducted with 4 replications in a randomized block design. Each plot was 3 m x 10 m.

Soil samples (0-60 cm depth) were taken at the beginning of the vegetation period (March) and by harvest. Samples from each plot were analyzed for available S (Smin) using the 0,0125 mol L-1 CaCl2 extractable S method and ICP-OES at 181,972 nm.

Results

In both years (2010 and 2011) S fertilization increased plant available S in the 0-60 cm soil layer (Table 1).

Tab. 1: Smin kg ha-1 0-60 cm depth, different S treatments, Gladbacherhof

	after fertilizing	first cut	second cut	third cut	fourth cut
2010					
Control S 0	2,0	2,8	3,0	0,0	no result
$MgSO_4$ S 80	40,5	120,1	59,0	44,7	no result
$CaSO_4$ S 80	20,0	39,4	48,0	38,5	no result
2011					
Control S 0	7,15	4,1	4,6	9,2	28,8
$MgSO_4$ S 80	87,9	51,7	139,2	85,9	77,3
$CaSO_4$ S 80	49,9	33,3	93,3	60,9	74,2

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The dry matter yield in the control was with 7,6 t ha^{-1} and 9,8 t ha^{-1} in 2010 and 2011 respectively significant lower than in the sulfate fertilized treatments (Table 2).

Tab. 1: Smin kg ha^{-1} 0-60 cm depth, different S treatments, Gladbacherhof

	treatment	first cut	second cut	third cut	fourth cut	Σ
2010						
yield DM mixture (t ha^{-1})	Control	2,72	1,66	2,01	1,24	7,63 a
	$MgSO_4$	3,13	2,97	3,88	2,08	12,06 b
	$CaSO_4$	3,44	2,74	3,56	2,06	11,08 b
S concentration % DM legumes	Control	0,33 a	0,16 a	0,16 a	0,13 a	
	$MgSO_4$	0,35 a	0,43 b	0,29 b	0,20 b	
	$CaSO_4$	0,35 a	0,38 b	0,28 b	0,21 b	
S concentration % DM grass	Control	0,44 a	0,20 a	0,22 a	0,21 a	
	$MgSO_4$	0,44 a	0,67 b	0,50 b	0,34 b	
	$CaSO_4$	0,41 a	0,64 b	0,52 b	0,35 b	
N concentration % DM legumes	Control	3,76 a	2,36 a	2,89 a	2,64 a	
	$MgSO_4$	4,39 b	3,38 b	3,49 b	2,97 b	
	$CaSO_4$	4,21 ab	3,42 b	3,54 b	3,01 b	
N concentration % DM grass	Control	2,19 a	2,05 a	2,55 a	2,00 a	
	$MgSO_4$	2,49 a	2,58 b	3,30 b	2,82 b	
	$CaSO_4$	2,36 a	2,51 b	3,46 b	2,78 b	
N yield mixture (kg ha^{-1})	Control	89,24	38,15	56,30	29,11	212,80 a
	$MgSO_4$	120,96	96,08	134,87	59,80	411,71 b
	$CaSO_4$	124,01	88,85	125,75	64,73	404,34 b
2011						
yield DM mixture (t ha^{-1})	Control	3,82	2,01	2,73	1,23	9,79 a
	$MgSO_4$	4,86	4,43	2,27	2,35	13,91 b
	$CaSO_4$	4,50	3,90	2,26	2,56	13,22 b
S concentration % DM legumes	Control	0,15 a	0,12 a	0,14 a	0,16 a	
	$MgSO_4$	0,19 b	0,24 b	0,24 b	0,33 b	
	$CaSO_4$	0,18 ab	0,25 b	0,25 b	0,31 b	
S concentration % DM grass	Control	0,14 a	0,17 a	0,18 a	0,20 a	
	$MgSO_4$	0,26 b	0,41 b	0,41 b	0,45 b	
	$CaSO_4$	0,24 b	0,45 b	0,48 b	0,52 c	
N concentration % DM legumes	Control	2,59 a	2,61 a	2,79 a	3,19 a	
	$MgSO_4$	3,17 b	3,09 b	3,12 a	3,66 a	
	$CaSO_4$	3,07 b	3,13 b	3,12 a	3,79 a	
N concentration % DM grass	Control	1,81 a	2,09 a	2,27 a	2,54 a	
	$MgSO_4$	2,16 b	3,26 b	3,78 b	4,28 b	
	$CaSO_4$	2,14 b	3,03 b	3,58 b	4,29 b	
N yield mixture (kg ha^{-1})	Control	85,67	49,19	73,90	37,75	246,52 a
	$MgSO_4$	140,60	137,13	70,87	86,71	435,31 b
	$CaSO_4$	125,08	121,07	71,21	97,55	414,91 b

Discussion

S levels of soil

The S availability in the unfertilized control arranged during the growing periods on a very low level (from 2,0 kg S ha^{-1} to 9,2 kg S ha^{-1}). Only in September 2011 (not shown) there was an increase of S up to 28,8 kg S ha^{-1} in the control. This might be a result of enhanced mineralization processes due to higher microbiological activity in the later vegetation period (Scherer 2009).

Yield and quality

Fertilizing S increased yield 2010 about 50 % and 2011 about 30 %, both MgSO4 and CaSO4. Particular the legumes were positively influenced by S fertilization, whereas the grass was not affected.

S fertilization increased S concentration in the shoots (legumes and grass) and in connection with higher yield the harvested S amount, in the sum of the four cuts 18,3 kg S ha-1 in the control plots and about 40 kg S ha-1 in the S-fertilized plots. The S concentration in the shoots clearly increased only after the first cut (< 0,2% (DM) no S; > 0,2% (DM) with S).

Sulfate fertilization resulted in considerable increased N yield of the alfalfa clover grass mixture. This was mainly a result of higher N concentration in the leguminous plants in combination with higher growth of this fraction. The control mostly failed below 3 % (DM) while N concentration in fertilized plots reached up to 3,5 % (DM). In both years S fertilizing led to a surplus of 200 kg N ha-1 in the shoot mass compared to no S fertilizing.

The results suggest that adequate S supply is of crucial importance for leguminous forage crops. Under S deficiency growth and N accumulation was significantly decreased and resulted in a dramatic reduction of N yield. That means a decline of N input into the whole production system. Providing adequate amounts of plant available S to leguminous forage crops is therefore an important tool to maintain productivity of ecological production system.

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ProEcoWine: Development of a Novel Plant Protection Product to Replace Copper in Organic Viticulture

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Key words: organic viticulture, fungal diseases, biofungicides, copper fungicides, antifungal activity, microalgae

Abstract

Fungi like downy mildew and *Botrytis* reduce wine yield and impair wine quality. In conventional as well as organic viticulture, grape growers commonly apply copper to prevent and treat infection despite the harmful effect of its accumulation in soil and plant tissue. In the ProEcoWine project, a novel plant protection product is being developed to replace copper fungicides. Microalgal strains with antifungal properties have been cultivated to be processed into a plant protection product enriched with micronutrients. Strains with the most efficient control of at least 90% over downy mildew and *Botrytis* have been identified and selected for validation in greenhouse and field experiments, while cultivation methods for high density growth are being established. The optimal formulation of microalgal concentrate will be determined after downstream methods required for the activation of antifungal activity are evaluated, optimizing the process for the manufacture of ProEcoWine.

Introduction

At present, there are no efficient alternatives to replace copper fungicides in organic viticulture, although its use is limited by EU Council Regulation on Organic Agriculture. Therefore, an economical solution is required to support the development of the organic market. ProEcoWine is a project funded by the European Commission formed by a trans-European partnership of three research performers, five small and medium enterprises supported by a large company and an association for organic agriculture. The project's objective is to replace copper fungicides in organic and conventional viticulture by developing a novel plant protection product. To achieve this, different microalgal strains which reliably inhibit fungal properties of downy mildew and *Botrytis* are being cultivated and processed into a plant protection product enriched with micronutrients. The optimal formulation and dosage will be validated in greenhouses and field trials in Spain and France.

Results and Progress

I. Results

a. Identification of Effective Strains

Several microalgal strains effective against downy mildew and *Botrytis* were cultivated by the University of West Hungary (UWH) under different conditions to produce sufficient biomass samples for screening. After several months of intensive *in vitro* screening, the UWH has successfully identified the microalgal strains with the most efficient control (more than 90%) over downy mildew and *Botrytis*.

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Figure 1. Antifungal activity against *Botrytis* as shown on the right in contrast to unprotected grape clusters on the left.

In Figure 1, an example of microalgal antifungal activity can be observed: on the left, a control group without microalgal treatment is infected by *Botrytis*, while grape clusters on the right are protected by application of microalgal extract. The two successful strains then moved on to the next stage of *in vivo* experiments, where their antifungal activity was validated in greenhouse and field experiments.

II. Progress

a. Biomass Production

Fraunhofer IGB has focused on establishing effective and economic cultivation methods for high density growth using flat-panel airlift photoreactors. The photobioreactor system is equipped with a control system for airflow, temperature, pH and light intensity. At the moment, the cultivation of the two selected strains is being optimized towards the maximization of biomass productivity. The results of this task will be further delivered to Algafuel SA (A4F), which is responsible for the scale-up of microalgal biomass production. Furthermore, biomass separation processes will be aided by the technology of Alfa Laval Corporate AB to optimize separation methodologies and avoid the use of additional chemicals.

b. Downstream Production and Formulation

Next, the evaluation of downstream methods required for the activation of antifungal activity will be carried out by Fraunhofer IGB to establish the most cost-effective process. The optimal formulation of microalgal concentrate containing micronutrients and natural preservatives will be determined, resulting in developed ProEcoWine products with enhanced shelf life. This will be possible with the contribution of project partners Kürzeder & März and IAU Service and their extensive experience with micronized micronutrients and product formulation. The effectiveness of developed products will be monitored *in vitro* by project partners UWH and Phenobio, followed by an analysis of the antifungal induction mechanisms under greenhouse conditions by Phenobio.

c. Product Validation

Field trials are anticipated to begin at the start of May 2014, where the application of the final ProEcoWine products will be first demonstrated against downy mildew and then *Botrytis*. This determination and validation of antifungal efficiency will be carried out in two different European viticultural regions by current wine producers Les Vignerons de Buzet Societe Cooperative Agricole in France and Viñedos de Aldeanueva Sociedad Cooperativa in Spain, each representing the temperate and Mediterranean climates, respectively. The association for organic agriculture Naturland will provide feedback by comparing the results to field trials performed with other products in the past while providing quality assurance for the product certification process and publicizing the results amongst its members.

Discussion

This innovative microalgal plant protection product enriched with micronutrients will enable the replacement of copper fungicides in organic and conventional viticulture, increasing yield in organic vineyards by up to 30% and decreasing production costs per unit by up to 20%. In light of the harmful effects of copper accumulation in soil and plant tissue as well as the restricted application of copper fungicides in organic agriculture, the production of ProEcoWine is expected to increase the competitiveness of European wines and support the development of the organic market in Europe. Within 6 years of project completion and after 5 years of product marketing, a 16% share of the fungicide market is anticipated for the primary application of treatment and prevention of downy mildew and *Botrytis* in grapevines, which will be sales of an estimated €52 million.

Suggestions to tackle with the future challenges of organic animal husbandry

The replacement of copper fungicides in organic agriculture has significance not only in the agricultural sector, but in organic animal husbandry as well. The introduction of copper compounds into the environment has resounding effects in the form of soil quality degradation by reduction of useful soil microorganisms and nutrient leaching from runoff, which in turn may easily reach livestock by contact with and consumption of contaminated soils, feed and water. Thus, an eco-friendly biofungicide holds great promise in preventing such future challenges of organic animal husbandry.

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Development of a nature conservation standard for enhancing biodiversity and marketing in organic farming systems

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Key words: wildlife protection, environmental services, on-farm research, reward system, advisory services

Abstract

Organic farms are proven to yield highly beneficial environmental services for nature. But consumer appreciation of these services is nearly non-existent. Furthermore, governments do not offer sufficient financial support in this field. As a result, many farms cannot tap their nature conservation potential due to economic constraints, even though the will to do so is very high. To bridge the gap between limited consumer interest and government financial support, a nature conservation standard connected with offering nature conservation advisory services and rewarding farmers for facilitating environmental services by marketing organic+biodiversity products has been developed. The goal of this conservation standard is to achieve a higher value-added component for organic farmers. Additionally, consumers will be exposed to more information about the positive effects on biodiversity by buying these products.

Introduction

Intensive agriculture is considered to be one of the most detrimental factors contributing to the loss of biodiversity throughout Europe's countryside (MA 2005). Nearly 50% of wild animal and plant species are dependent on this landscape. At present, biodiversity loss is even more arising due to increasing cultivation of subsidized energy crops on already extensively cultivated areas. Concurrently, agricultural land prices and rents are rapidly increasing. Such high economic pressure has even led some farmers to reconvert to conventional farming. This is an alarming development, as organic farming has proven to have very positive effects on biodiversity. An international meta-analysis (396 evaluations) showed that in 83% of evaluations, organic farms have higher biodiversity than conventional farms (Rahmann 2011). Conflicts that arise because of e.g. early and frequent mowing of leys can be met by integrating special nature conservation methods into day-to-day farming practices (Stein-Bachinger & Fuchs 2012). Many farmers are willing to do more for nature conservation even though most of these measures lead to more work and less yield, however they are often limited in their actions due to financial constraints. Against this backdrop, a cooperation has been started between WWF Germany, the organic association Biopark, the Ministry of Agriculture, Environment and Consumer Protection of Mecklenburg Western-Pomerania, and a retailer. Specific nature conservation measures have been formulated and a new standard for nature conservation has been defined ("organic plus biodiversity") for which a certification system is being developed. The standard shall support long-term biodiversity on farms and enable better marketing of organic products by documenting farmers' compliance with the new standard.

Material and methods

A pilot region has been chosen with approximately 280 Biopark farms and a total area of ca. 68,000 ha in Mecklenburg Western-Pomerania, in north-east Germany. In 2012, a cooperation was started with 12 Biopark farmers interested in working towards greater biodiversity, and a group of experts, consisting of advisors, farmers, scientists and representatives from associations, administrations and the state ministry. As a base for the certification system a comprehensive catalogue of nature conservation measures for grassland, arable land and landscape elements has been developed and recorded in a database. A point system evaluates the conservation value per measure for wild species as well as the occurrence of target species and the quality of different habitats for flora and fauna based on Biopark's organic farming standards. Those farmers that achieve the certificate will be able to sell their products at a premium price. Conservation advisory services, independent control structures, and monitoring for scientific evaluation of selected measures will be developed to support the farmers in reaching the nature conservation standard.

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Results and discussion

Until now, there are 50 farms participating in the project. Farm sizes vary between <10 ha and nearly 4,000 ha. The region is marked by low precipitation (<600mm) and low to medium soil quality. Most of the farms are dominated by grassland and keep suckler cows. According to the soil quality, the yield of grain crops averages 3 t/ha (Fig. 1) which offers good conditions for nature conservation.

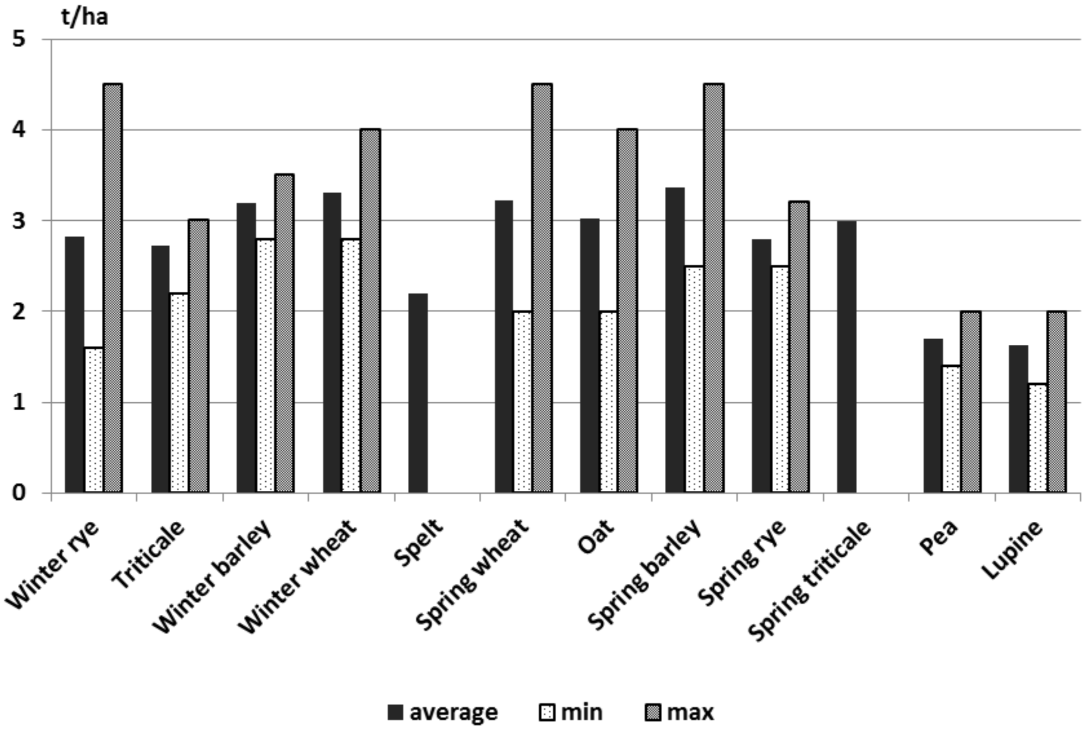

Figure 1. Yields of grain crops of pilot farms (n = 20, 2012)

Farmers can choose from a list of 75 nature conservation measures (Table 1). They are given advice as to which measures are most suitable to implement and informed about which achievements they have already completed through common agricultural practices. The most positive nature conservation impact can be found where wild animal and plant species, which are to be supported, have access to good general living conditions. Therefore, the integration of special nature conservation measures should be applied only to those areas which are well-suited for dedicated species conservation, e.g. fields with low to medium soil quality without surrounding forest for skylarks (Fuchs & Stein-Bachinger 2010). From an acceptance point of view, low productive areas are generally the most favourable ones for nature conservation measures.

Table 1: Database of nature conservation measures and conservation performance (extract) AL=arable land, GL=grassland, LE=landscape elements, E=success oriented evaluation for the occurrence of target species and habitats

AL	A1-A5	Grain crops	Harrowing, stubble breaking, sowing density etc.	⇨
	A6-A10	Legume-grass	Basic cultivation, cutting height, unmown strips etc.	⇨
	A11-A14	All crops	Blossom strips, set aside, old varieties etc.	⇨
	A15-A16	Crop rotation	Diversity of crop rotations, share of maize, field size	⇨
GL	G1-G2	Basis	Extensive grassland management – baseline options	⇨
	G3-G4	Maintenance	Rolling, leveling, fertilizing, etc.	⇨
	G5-G11	Use	Times, close season, higher cut, unmown strips, etc.	⇨
	G12	Others	Converting arable land to grassland	⇨
LE	L1-L3	Groves	Hedges, orchards, bushes, old and dead trees etc.	⇨
	L4-L7	Water bodies and wetlands	Kettle holes, lakes, buffer strips, wet-spots in fields	⇨
	L8-L10	Field margins, special locations	Small margins, protection strips, stone walls etc.	⇨
	L11-L12	Buildings	Nesting boxes, access to stables and barns etc.	⇨
E	E1	FFH, Red Listed animals	Endangered and valuable animal species	⇨
	E2	Endangered segetal flora	Valuable segetal species	⇨
	E3	Valuable grassland habitats	Valuable plant species and biotopes	⇨
	E4	Special conservation measures	Nest protection for ground breeding birds etc.	⇨
Free conservation performance				⇨

Each farm must achieve a minimum number of points composed of existing measures of nature conservation and additional measures. With that database especially designed for this project (Table 1), farmers can calculate the number of points they have based on their nature conservation performance. If the necessary point sum cannot be reached, the farmer, together with a nature conservation advisor, can consider which measures are suitable for the farm in order to achieve desired targets in the future. Many farms achieve the largest part of their necessary points through extensive farming practices (e.g. limited to no fertilisation of grassland, partial grassland maintenance, reduced mechanical weed control in cereals, diverse crop rotation, already existing hedges or ponds). After a nature conservation advisor surveys a farmer's fields, additional measures are suggested. Often suggestions pertain to preservation or creation of small area structures like unmown strips at the edges of trenches and blossom strips. For farmland birds, a focus is placed in specified areas on creating sufficiently long periods without use during breeding time (8 weeks). This is necessary even in extensive pasture farming for sufficient breeding success. Success orientated evaluation is not yet completed in the system of points, but will be continued in the future. Challenges have arisen due to the fact that there are varying levels of knowledge regarding species on farms, and compiling species lists requires relatively high levels of input.

Conclusion and future challenges

Compliance control according to the newly formed nature conservation standard is necessary as a base for farm certification and subsequent marketing of products under an "organic+biodiversity logo". In the beginning, the focus will be on meat products from ruminants, cereals and potatoes. Concerning additional future challenges of organic animal husbandry, the project concept can support extensive grassland grazing with ruminants, e.g. suckler cows as they highly contribute to nature conservation issues on grassland while meeting consumer and tourists' wishes to see cattle grazing in the countryside.

For the success of this project it is important that the feasibility of nature conservation measures is convincing and transparent for the public. The new conservation standard shall be a model for the organic agriculture movement and shall be applied in other regions. It shows that existing organic farms are viable and can motivate conventional farms to convert to organic farming. The rating system will be adapted and refined by the experience with further farmers which will participate in the project. It is important that the rating system is suitable for different farming types and geographical circumstances. Further measures can be added in the course of enhancing the project and introducing it in other regions.

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Rates of photosynthesis and transpiration of wheat and barley as influenced by fodder precrops and their cropping period

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Key words: rooting depth, water accessibility, dry periods

Abstract

*Long term cultivation of fodder crops can enhance water accessibility in the subsoil by creating biopores which can make rooting easier. In a factorial field trial we cultivated lucerne (*Medicago sativa *L.), chicory (*Cichorium intybus *L.), and tall fescue (*Festuca arundinacea *SCHREB.) each with duration of one, two, and three years (2007 – 2009). Spring wheat (*Triticum aestivum *L.) in 2010 and winter barley (*Hordeum vulgare *L.) in 2011 were first and second subsequent crop, respectively. Rates of photosynthesis and transpiration of both cereals were investigated using a porometer. Series of measurement covered for spring wheat as well as for winter barley a dry period in early summer. Spring wheat showed higher rates of gas exchange after perennial precropping compared with annual precropping. In contrast to this winter barley was not influenced by the precrop's cropping period. Results suggest that spring cereals grown under dry condition can profit by perennial fodder precrop more than winter cereals.*

Introduction

Perennial fodder cropping as compared to rotations including annual ploughing can increase the number of medium and large sized biopores in the subsoil (Kautz *et al.* 2010). This can result in potentially facilitated root growth followed by increased accessibility of water in the subsoil. Additional plant-available water can enable stands to cope with dry periods in early summer, which will take place more often in future due to climate change. In this context we investigated whether crop species or cropping period of forage cropping influenced rates of photosynthesis and transpiration as indicators for water availability of spring wheat (*Triticum aestivum* L.) and winter barley (*Hordeum vulgare* L.).

Material and methods

On a Haplic Luvisol (WRB) derived from loess (loamy silt) in Klein-Altendorf near Bonn, Germany (9.6 °C mean annual temperature, 625 mm annual rainfall), from 2007 to 2009 lucerne ('*luc*'; *Medicago sativa* L.), chicory ('*chi*'; *Cichorium intybus* L.), and tall fescue ('*fes*'; *Festuca arundinacea* SCHREB.) were cultivated each for one, two, and three years. The fodder crops were mulched four times a year. The field trial was arranged in a three-factorial strip-design with four field replicates. The plots had an area of 60 m². In 2010, spring wheat was cultivated as first subsequent crop following each precrop treatment. In the next year, winter barley was grown as second subsequent crop following the first subsequent crop spring wheat. In spring of both years, plant available mineral soil-N of the treatments was measured and equalized by adjusted fertilization.

Using a porometer (CIRAS 2, PP Systems), rates of photosynthesis (RP) and rates of transpiration (RT) were measured as follows: in case of spring wheat in seven precrop treatments (*luc* 1, 2 & 3 years, *chi* 1, 2 & 3 years, *fes* 1 year) six measurements (BBCH 59 to 84) were conducted by testing five flag leafs per plot. In case of winter barley, in six precrop treatments (*luc* 1 & 2years, *chi* 1 & 2 years, *fes* 1 & 2 years) in five measurements ten leafs per plot were chosen.

Series of measurement both of spring wheat and winter barley included periods of dry conditions. In June and early July 2010 42 mm rainfall was determined, *i. e.* 20 mm below the long term average. In April and May 2011 a dry period occurred (60 mm rainfall, *i. e.* 47 mm less than on long term average).

Flagleaves were placed in the cuvette, strictly separated from environmental air and light conditions. An adjusted air-similar gas mixture with a CO_2-concentration of 400 ppm and a flow rate of 200 mL min^{-1} was applied. LEDs illuminated the tested leaf area with a photon flow rate of 1500 µmol m^{-2} s^{-1}. The rates of photosynthesis and transpiration increased under these conditions and reached their maximum after 1 – 3 minutes. Determined data were stored, averaged per plot and statistically analysed.

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Results

RP and RT of spring wheat following *luc* and *chi* differed when comparing annual *vs*. perennial cultivation of fodder crops. RT of spring wheat following one year fodder cropping was lowest in all measurements, compared with spring wheat following perennial fodder cropping. Both RP and RT of spring wheat following annual *vs*. perennial fodder cropping were significantly lower in the last three measurements (fig. 1).

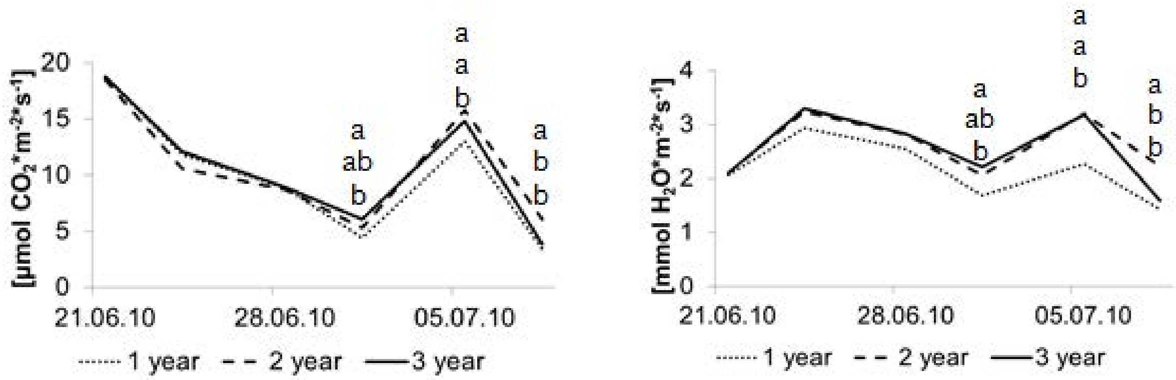

Figure 1: RP (left) and RT (right) of spring wheat following one, two, and three year fodder cropping (*luc* and *chi* averaged). Data with different letters are significantly different (Tukey α=5%).

After one year fodder cropping no influence of the fodder crop species on RP or RT of spring wheat was found (fig. 2).

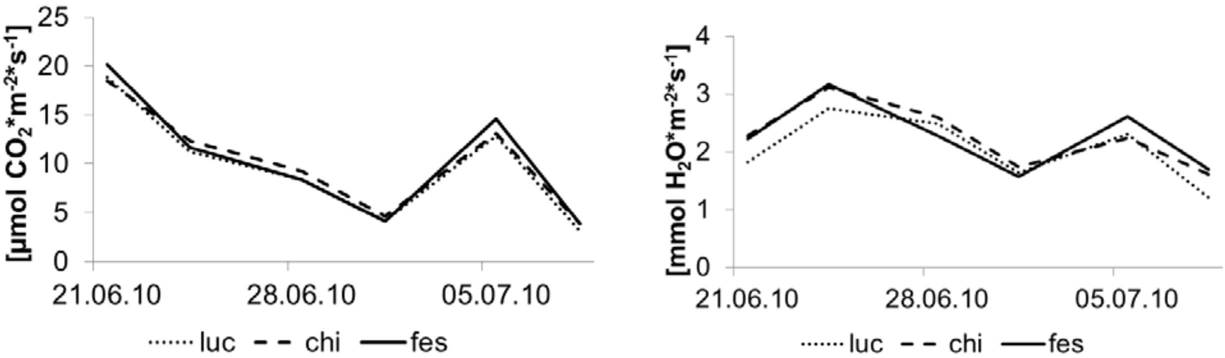

Figure 2: RP (left) and RT (right) of spring wheat following *luc*, *chi*, and *fes* (only one year cropping). Data with different letters are significantly different (Tukey α=5%).

Neither precrop species nor duration of their cultivation influenced RP or RT of winter barley except the fifth measurement, when a higher RP of winter barley following *luc* was determined (fig.3 and 4).

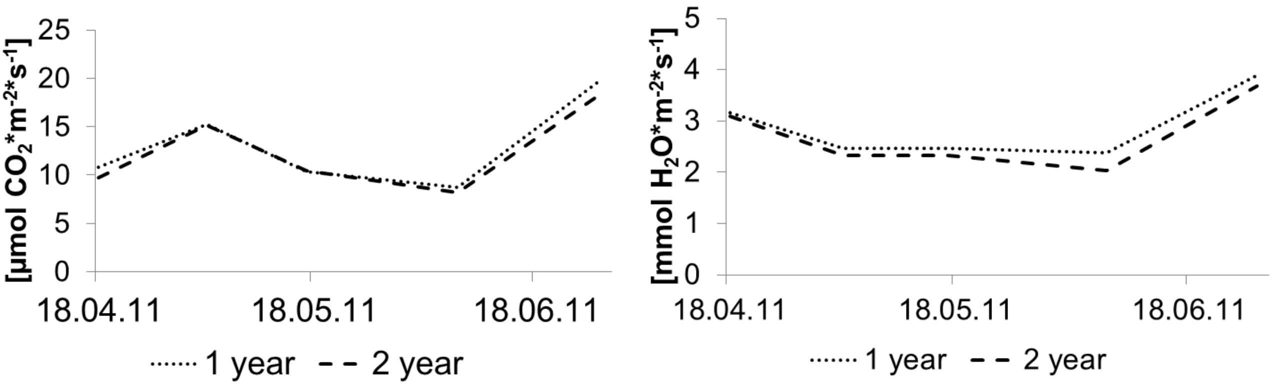

Figure 3: RP (left) and RT (right) of winter barley following one, two, and three year fodder cropping (*luc*, *chi* and *fes* averaged; 2007 – 2009) and spring wheat (2010). Data with different letters are significantly different (Tukey α=5%).

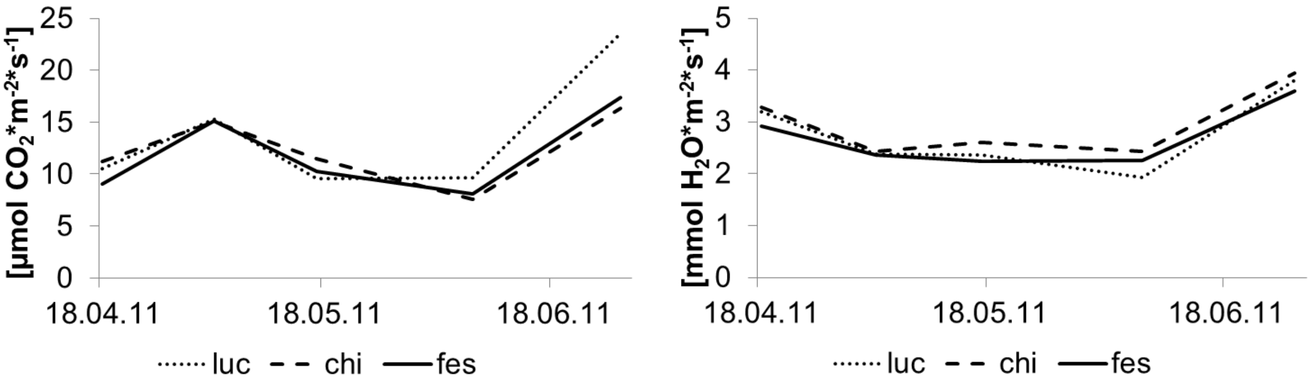

Figure 4: RP (left) and RT (right) of winter barley following *luc*, *chi*, and *fes* (one, two, and three years cropping averaged; 2007 – 2009) and spring wheat (2010). Data with different letters are significantly different (Tukey α=5%).

When comparing first subsequent crop spring wheat and second subsequent crop winter barley, greater amplitude of RP and RT and stronger response to fodder precrop-treatment were measured in spring wheat.

Despite comparing first *vs*. second subsequent crop grown in different years, dissimilar rooting depths of the subsequent crops may explain the results. The maximum rooting depth (defined as 95 % of all root length units above) of the cereals was analysed using the profile wall method (Böhm 1979). At end of June 2010, spring wheat following perennial cultivated *luc* or *chi* reached a greater maximum rooting depth (two years: 52 cm, three years: 55 cm) than spring wheat following one year cultivated fodder crops (48 cm).

In early June 2011, winter barley following two years cropped *chi* reached only slightly deeper soil layers compared with winter barley following one year cropped *fes* (148 cm *vs*. 142 cm).

Discussion

Maintenance of soil fertility by inserting forage cropping entailing perennial soil rest and increased bioporing, is an essential tool of organic farming. We investigated whether first subsequent crop spring wheat *vs*. second subsequent crop winter barley was able to profit more by perennial fodder cropping concerning water accessibility in the subsoil.

The results of the present investigation indicate that spring wheat grown under dry conditions can reach higher RP and RT after perennial cultivation of a precrop with tap root system like *luc* or *chi* when compared with annual forage production only. Studies of Gaiser *et al*. (2012) carried out in the same field trial showed that spring wheat following two year *luc* took up more water from 75 – 105 cm soil depth compared with spring wheat following one year *luc*. In this context the shown outcomes can be explained by a higher accessibility of spring wheat roots to deep soil water after perennial fodder cropping.

In contrast to that, a winter cereal like barley is considered as less affected by a dry period in early summer. We assume winter barley's maximum rooting depth enables water uptake from deep soil layer. Thus, the precrop effect may have a low impact on water accessibility when compared with spring sown cereals.

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Fatty acid composition of goat milk produced under different feeding regimens and the impact on Goat Cheese

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Key words: goats, milk, fatty acids, "feed less food"

Abstract

Ruminants and their great ability to live and produce on a diet rich in fibre have a great potential to contribute to a healthy and sustainable human nutrition (Hofmann 1989). Sadly, only in times of rising energy prices the following question is asked: How much food can we afford to feed to animals? Taking this aspect into account considerably more research is necessary on the topic "Feed no Food in ruminant nutrition". In 2009 the Thuenen-Institute of Organic Farming in Trenthorst, Germany, started the project "Feed less Food" with the dairy goats on the organic experimental station in Trenthorst, Holstein, Northern Germany.

The main questions focused on the impact of reduced concentrate use on animal welfare, milk yield and quality. In 2012, the focus was laid on lactation performance and the occurrence of fatty acids in milk essential to humans. In 2012 two feeding groups were formed and dairy goats received either an estimated 10% or 40% of the total feed intake (dry matter basis) as concentrates (KF 10 and KF 40).

Goats in group KF 40 showed a significantly higher lactation performance ($P < 0.05$) regarding milk kg, fat kg and protein kg. No significant difference between groups was found for fat and protein content. Furthermore, no significant difference occurred in fatty acid pattern of milk. Short and medium chain fatty acids turned out to be significantly increased in cheese from group KF 40. Content of long chain and polyunsaturated fatty acids as well as rumenic acid (CLA) and Ω-3 fatty acids was significantly higher in cheese from goats of group KF 10,. Ratio of Ω-6:Ω-3 proved to be significantly lower in cheese from group KF 10.

Introduction

Ruminants and their great ability to live and produce on a diet rich in fibre have a great potential to contribute to a healthy and sustainable human nutrition (Hofmann 1989). Sadly, only in times of rising energy prices the following question is asked: How much food can we afford to feed to animals? Taking this aspect into account considerably more research is necessary on the topic "Feed no Food in ruminant nutrition".

In 2009 the Thuenen-Institute of Organic Farming (TI) has started the project "Feed less Food" using dairy goats on the organic experimental station in Trenthorst, Schleswig-Holstein, Northern Germany.

The main questions focused on the impact of reduced concentrate feed on animal welfare, milk yield and quality. Similar studies have already beenconducted by Sporkmann (2011), Rahmann (2011), Muzzulini (2010) and Aschenbach (2009).

In 2012, the focus was laid on lactation performance and milk quality traits essential in human nutrition.

For this purpose dairy goats from the research station of the Thuenen-Institute were split into two treatment groups. Group KF 10 received an estimated 10% of concentrates and group KF 40 received an estimated 40% of concentrates in their ration dry matter. As most of the goat milk produced in Europe is processed into fermented products, mainly cheese (Monrad-Fehr et al. 2007), the relevant quality aspects were considered in this experiment: milk from both groups was processed individually into a six weeks aged, semi-hard cheese.

The aim of this experiment was to answer the following questions: Do fatty acid(FA) patterns of milk and cheese differ between KF 10 and KF 40 groups? This question was investigated with special regard to some essential fatty acids such as Ω-6 and Ω-3, their ratio and conjugated linoleic acids (CLA). Even though knowledge about Ω-6 and Ω-3 FAs appears to be controversial, scientist seem to agree that the ratio of Ω-6:Ω-3 FAs in consumed human food has changed within the past 10,000 years from 1.5:1 to 20:1 in modern Western societies (DeFilipps and Sperling 2006; Simopoulos 2002). These very same authors furthermore agree that the increase in intake of Ω-6 FA , and therewith the relative decrease in intake of Ω-3 FA are seen as responsible factors for an increase of various diseases, particularly cardiovascular diseases (DeFilipps

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and Sperling 2006; Psota et al 2006; Simopoulos 2002) as well as cancer and inflammatory and autoimmune diseases (Simpoulos 2002). Most studies investigating effects of Ω-3 FAintake on human health were carried out using marine sources (fish). Fewer studies dealt with Ω-3 FAs that originate from plants. Nevertheless, it is assumed that those Ω-3 fatty acids have at least a similar effect (DeFilipps 2002).

Animals, material and methods

- **Animals:** In 2012 the trial started with 58 dairy goats, all of which belonged to the BDE breed (Bunte Deutsche Edelziege, German Alpine dairy goat). The trial began with the kidding in spring 2012 and ended with the drying off in November 2012. The whole farm of the research station is certified according to the guidelines of the European Union for organic agriculture (834/2007/EC). The flock was divided into two groups (28 and 26 goats): One group received approximately 10% of the total feed intake in the form of concentrates (KF10) (dry matter basis, explored in feeding trials, in which the lactating goats did not lose any live weight). For the other group concentrate was included at a level of about 40% of the total dry matter intake (KF40). Cracked wheat was pressed into pellets and fed as concentrate. Four weeks before kidding started each goat received 50 g per day of concentrate in the milking parlour, during milking. The amount of concentrate was successively increased to 500 g per day which was handed out in two portions, for the morning and evening milking. This level was maintained until weaning. Depending on the group concentrates were either further increased by 100 g per week until 1,000 g per day were reached (KF 40), or concentrates were decreased until 100 g per day were reached (KF 10). Grazing started on April 19. Altogether, a grazing area of 13,3 ha was available. Beyond grazing season hay was offered in the morning after the milking, and after the milking in the evening. During grazing season hay was given just once after the evening milking. In order to allow the goats to make use of their selective feed intake, 50% of the offered hay was tolerated as residual. The goats were milked twice a day and milk was stored in separate tanks for each group. The milk of each group was processed into semi-soft cheese according to the same log but with or without the addition of herbs (Volkmann 2012).
- **Feed:** Beginning July 6, feedstuff samples were taken on four different days between July and October (July 6, July 13, August 31 and September 7). Hay samples were collected from the hay bale on the feed bunk. In orer to make assure the samples were representative, the hay was taken from at least five different spots of the bale. Concentrate samples were taken from the bucket in the milking parlour or the hand barrow storing it. For sampling the rangeland a frame of 1x1m in size was put on five different spots of the pasture, the dairy goats were gazing on. Crop on pasture was cut at a height of approximately five centimetres using grass scissors. The height of the remaining crop should represent the approximate pasture refusal caused by goats. The cut of each square metre was collected and weighed. The samples were put in a drier for 72 hours at 60°C. The dried material was mixed and a part of it was ground (particle size: 1 mm) in order to make further analyses possible. All feedstuff samples were taken on Fridays from batches that were expected to be fed to the dairy goats until Monday, when milk samples were taken. **Nutrient contents** (g/kg dry matter): Hay: crude protein (CP) 143, ether extract (EE) 23, crude fibre (CF) 278, crude ash (CA) 86; Pasture**:** CP 143, EE 43, CF 228, CA 88; Concentrate**:** CP 135, EE 27, CF 38, CA 31.
- **Milk quality:** In addition to the individual milk yield monitoring and sampling conducted monthly separate pooled samples from the storage tank were taken weekly. Sampling began on March 20 and latest until October 24 (Volkmann 2012). Milk was analysed for fat, protein and lactose content and the somatic cell count. As a standardised milk yield was needed for further statistical analysis,the 240-day yield performance was calculated.
- **240-day milk yield (kg)**: **KF10:** milk: 514.4, fat: 14.8, protein: 14.4; KF40: milk: 641.5, fat: 19.1, protein: 18.2. (MSE root milk: 83.9, fat: 2.6, protein: 2.2; P-values <0.001)
- **Cheese qualities:** After six weeks of ageing samples were taken. Using a drill, small pieces of cheese were taken from five different spots of the brick shaped cheese wheels. Each cheese wheel was marked with the date of manufacture and the milk it was made of (KF 10 or KF 40). They were put in a plastic bag, one bag per wheel, and frozen at the Thuenen-Institute. Six of the deep-frozen samples of each group (KF 10 and KF 40) were brought to the University of Natural Resources and Life Sciences, Vienna, Department of Food Science and Technology, and analysed via gas-phase chromatograph for their fatty acid pattern.

Statistical analysis: All statistical tests were performed using SAS 9.1. Descriptive analysis was drawn in Microsoft Excel, using the Pivot function. Treatment effects were considered significant at $P<0.05$.

- **240-day yield and milk contents:** PROCEDURE GLM (General Linear Model) (ANOVA). The model used was: $Y = \mu$ + group + number of lactations + day of drying off + ε, whereas Y is the dependent variable (kg milk, kg fat, kg protein), μ = overall mean and ε = random error.
- **Fatty acid pattern:** Differences amongst groups of fatty acids spectrum of milk and cheese were analysed using PROCEDURE GLM: $Y = \mu$ + group + day + ε, with Y = dependent variable (e.g. sum of short chain fatty acids, sum of polyunsaturated fatty acids, sum of Ω - 3 fatty acids), μ = overall means and ε = random error.

Results

Milk: Table **1** gives an overview of the content of milk regarding the most important groups of fatty acids (FA). No significant differences were observed between group KF10 and KF40.

Table 1 : Fatty acid pattern of milk (g/100g FA)

Fatty acids	KF 10	KF 40	Root MSE	P-Value
SCFA[1]	8.4	8.5	0.4	0.537
MCFA[2]	25.9	26.6	1.6	0.453
LCFA[3]	62.7	62.2	1.6	0.574
SAFA[4]	73.4	73.7	1.5	0.744
MUFA[5]	19.5	19.5	0.8	0.945
PUFA[6]	4.1	4.1	0.3	0.935
Ω-3-FA	1.1	0.9	0.2	0.225
Ω-6-FA	1.5	1.9	0.4	0.100
Rumenic acid (CLA)	1.0	0.8	0.2	0.311

[1] Short Chain Fatty Acids, sums up C4 – C8 FA, [2] Medium Chain Fatty Acids, sums up C8 – C14 FA, [3] Long Chain Fatty Acids, sums up C15 – C22 FA, [4] Saturated Fatty Acids, [5] Monounsaturated Fatty Acids, [6] Polyunsaturated Fatty Acids.

Cheese: As Table 2 points out SCFA content was significantly higher in cheese of KF40 than in cheese from goats of KF10. The same can be said for the content of MCFA. An inverse result is given for LCFA ($P<0.001$). No statistical difference was noted for SCFA and MUFA. In contrary, the level of PUFA was significantly higher in cheese from goats of KF10. The content of Ω-3- FA and CLA was significantly higher in KF 10. An inverse result is given for Ω-6-FA

Table 2 : Fatty acid pattern of cheese (g/100g FA)

Fatty acids	KF 10	KF 40	Root MSE	P - Value
SCFA[1]	8.7	9.0	0.2	0.040
MCFA[2]	26.5	28.0	0.8	0.018
LCFA[3]	64.0	62.1	0.8	0.001
SAFA[4]	75.1	75.8	0.9	0.241
MUFA[5]	20.0	19.7	0.7	0.393
PUFA[6]	4.0	3.8	0.2	0.048
Ω-3-FA	1.1	0.8	< 0.1	< 0.001
Ω-6-FA	1.4	1.8	< 0.1	< 0.001
Rumenic acid (CLA)	1.0	0.8	0.1	0.012

[1] Short Chain Fatty Acids, sums up C4 – C8 FA, [2] Medium Chain Fatty Acids, sums up C8 – C14 FA, [3] Long Chain Fatty Acids, sums up C15 – C22 FA, [4] Saturated Fatty Acids, [5] Monounsaturated Fatty Acids, [6] Polyunsaturated Fatty Acids.

Omega 3:6 ratio:. No significant difference between groups regarding the Ω-6:Ω-3 ratio was observed in milk whereas in cheese it was markedly reduced in group KF10 (Table 3).

Table 3: Ω-6:Ω-3 ratio in milk and cheese

Item	KF 10	KF 40	Root MSE	P - Value
Milk	1.4	2.1	0.8	0.200
Cheese	1.3	2.2	0.1	< 0.001

Conclusions

With regard to the above findings, it can be concluded that a reduced use of concentrates presents a possible feeding strategy in (organic) dairy goat husbandry. A significant lower milk performance has to be accepted. Therefore, the decision for a minimised inclusion of concentrates has to be made very consciously. Results are indicating that reducing the concentrate supplementation has some potential of a higher product quality. Further research is needed and should include more detailed analysis of feedstuffs,e.g. fatty acid pattern, and detailed information about feed intake.
Assuming that a reduced omega 6:3 ratio has a positive effect on human health, there is evidence that a lower concentrate intake in dairy goats kept on pasture leads to “healthier” dairy foods.

The long-term health effects of a reduced concentrate feeding strategy on goats kept on pasture remain to be explored.

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Cocoa agroforestry a bridge for sustainable organic cocoa Production

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Key words: Agroforestry, Cocoa, Full sun, Ghana, Multistage, Yield model

Abstract

Cocoa agroforestry system holds the key to sustainable future for organic cocoa production. But an important question being asked is how much of shade tree on cocoa farms can be altered in attempts to improve yields and still maintain the environmental benefits? Results showing different levels of cocoa agroforestry indicated that medium shade level uses less agrochemicals, supports biodiversity and has sustainable yield of about 500kg/Ha for over 70 years as compared to the full sun, low shade and heavy shade levels. Outreach focusing on medium shade may be the most effective way of optimizing ecological, economic, and social outcomes to build organic bridges in cocoa production.

Introduction

Cocoa naturally requires shade trees but full sun cocoa is replacing shade production in cocoa growing regions of Ghana. The full sun contribute to high rate of deforestation, unsupportive to biodiversity, high input demand, short productive life and low yield over time. Cocoa agroforestry holds the key to sustainable future outputs in organic cocoa production. The study evaluated the impact shade levels have on the yield of cocoa under the different cocoa agroforestry systems (full sun, low shade, medium shade and heavy shade) that exist in Ghana (UNDP, 2011).

Material and methods

Data were collected from 200 cocoa farmers in the Sefwi Wiawso district, Ghana, by means of multistage sampling technique through household structured interviews and focus group discussions. Respondents were stratified into the four cocoa agroforestry systems as found in Ghana. The stratification was based on the number of shade trees per hectare and the degree of canopy cover.

Table 1 Characteristics of cocoa agroforestry systems

Characteristics	Full sun	Low shade	Medium shade	Heavy shade
Number of shade trees/Ha	0	1-9	10-15	> 15
Canopy cover (%)	< 36	36-65	66-85	> 85

Data obtained from the respondents were analysed using the descriptive statistics and inferential analysis. The yield curve model (Ryan et al., 2007) was also adopted to determine the impact shade levels have on yield under the various cocoa agroforestry systems.

Results

Results showed that 85 % of the respondents are males with the remaining 15 % being females. This indicates that cocoa production is a male dominated occupation. The results from the data also shows most of the cocoa famers in the study area are small scale farm holders with an average farm size of 2 hectares. This confirms a study by Obiri et al., (2007) which states that cocoa farming is mostly practice by small holder farmer with farm size ranging from 1-4 hectares.

Respondent indicated that although agricultural activities diminishes biodiversity by displacing or replacing natural environments cocoa agroforestry systems can harbor high levels of biodiversity often comparable to native forest. Shade management on cocoa farm is strongly related to the degree of agrochemical usage.

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Table 2: Levels of Agrochemical usage

Agrochemicals/Ha	Full sun	Low shade	Medium shade	Heavy shade
Weedicide (Litres)	2.28	1.95	1.95	0.72
Fertilizer (Kg)	215.25	160	144	126.5
Fungicide (G)	213	176.75	171.75	90.75
Insectice (Litres)	2.35	2.36	2.22	2.10

Source: Field Survey, 2012

The results from table 2 shows that, quantity of agrochemical use decreases with increasing number of shade trees on the cocoa farm. This indicates that full sun cocoa system requires more agrochemical as compared to the low, medium and heavy shade shade systems. Similar studies by Schroth et al., (2000) indicated that in the case of cocoa agroforestry systems pests and disease incidence could be modified compared with full sun specific plantations. This gradual shift of reducing shade levels and approaching the full sun cocoa farming is becoming very expensive to practice and putting the livelihood of many cocoa depending households in danger since they can't afford the needed agrochemicals to maintain sustainable yield. A study by Leiter and Harding (2004) showed that cocoa grown under agroforestry system uses little to no chemical inputs, while those under full sun requires these inputs but farmers are not always able to afford them. Farmers indicated that competitive weeds have been found to be on the increase in cocoa farms under full sun system with this weeds serving as pool for pests and diseases.

Out of the sample 87.5 % grows the hybrid varieties whiles the reaming 12.5% grows the local varieties. Further results from respondents on shade levels on cocoa farms indicated that 25 % practice full sun, 37.5 % low shade, 22.5 % medium shade and 15 % heavy shade. Respondents acknowledged that shade trees on cocoa farms maintains soil moisture, improving soil fertility, suppresses weed growth and improves biodiversity. It is therefore recommended that 10 to15 trees per hectare be maintained within the cocoa plantation to avoid some of the danger of disease and pest incidence associated with heavy shade system (Padi and Owusu 2003).

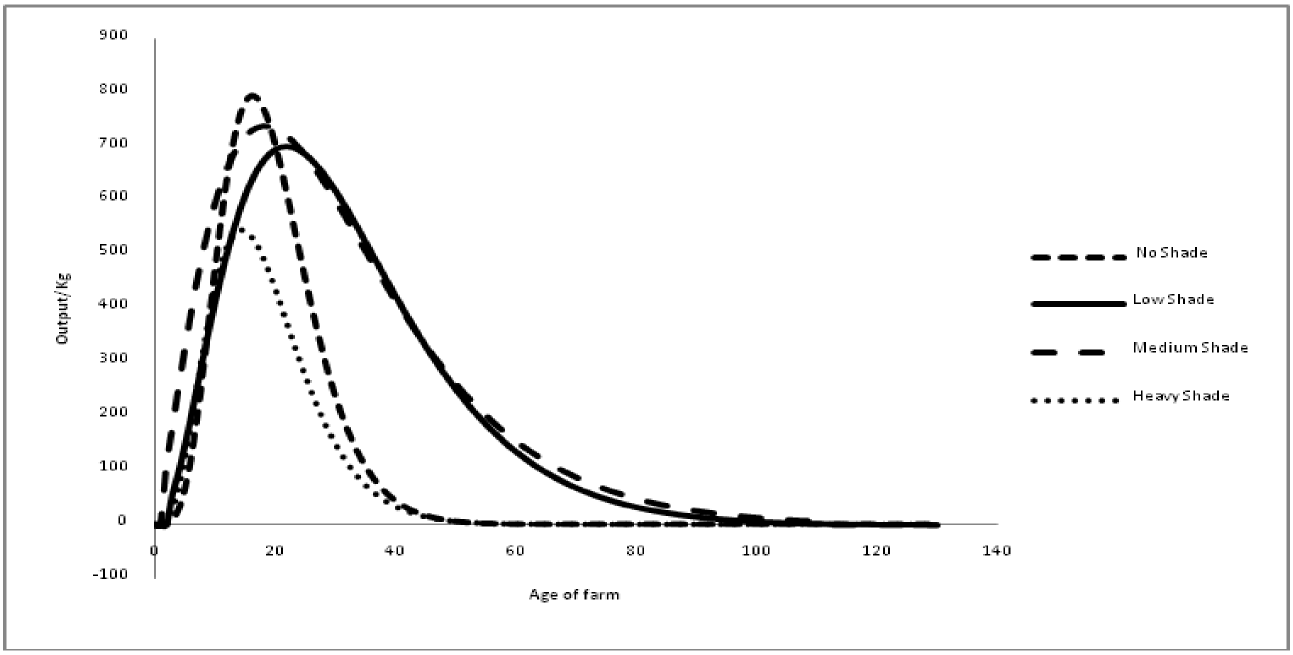

Figure 1: Cocoa yield under different cocoa agroforestry systems

The average yield per hectare of the full sun, low shade, medium shade and heavy shade were 794kg/Ha, 696kg/Ha, 735kg/Ha and 546kg/Ha respectively. The yield curve under the full sun system shows a sharp rise in the yield and followed by a very sharp fall in the yield after age 16. The medium shade has a gradual yield till it peaks at age 19 followed by a gradual fall in yield till age 80. The results confirms a study by Ruf and Zadi (1998) who noted that cocoa with less than optimum shade has a shorter life cycle. It may last for only 20 years without shade whiles shaded cocoa may yield for 60-100 years. Shade cocoa may provide fewer economic benefits in the short term but it will continue producing into the future without the need for chemical inputs. Medium shade cocoa agroforestry system maintains an average number of shade trees (10-15trees/Ha) which ensures biodiversity coupled with low agrochemical input demands making it organically and environmentally friendly and sustainable.

Discussion

Despite their higher yield potential in early years, full sun cocoa grown without fertilizer and more agrochemical application experiences rapid yield declines with time. Cocoa agroforestry system provides cool and thriving environment for biodiversity and less agrochemical use making the system supportive in organic cocoa production. Fair-trade practices, access to pre-harvest credit, carbon sequestration credits, avitourism, and environmental funds based on taxing agrochemical inputs are some incentive to promote organic cocoa production. More so outreach focusing on medium shade cocoa agroforestry system may be the most effective way of optimizing ecological, economic, and social outcomes to build organic bridges in cocoa production.

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Sustainable cultivation of olive trees by reusing olive mill wastes after effective co-composting treatment processes

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Key words: olive mill wastes, co-composting, soil conditioner

Abstract

Olive oil production is associated with extremely polluting byproducts causing serious environmental problems in most Mediterranean countries. These highly polluting residues are currently disposed of in the soil, rivers or lakes or where treatment methods have been applied, they were proven insufficient or non-feasible under the Greek situation. On the other hand strict EU environmental legislation could force the olive oil mills to close unless a viable and environmentally sound solution is adopted. This paper reports on an integrated viable solution to the olive mill waste problem. The method involves the olive oil removal from wastewater, their detoxification by Fenton oxidation reactions and following their utilization by biological treatment methods (anaerobic digestion and co-composting).

Introduction

All olives' treatment processes (olives, olive oil, olive wooden residue) produce liquid and solid wastes which are considered toxic. The treatment of these wastes by using conventional technologies (aerobic/anaerobic biological treatment, incineration, gasification etc) proved to be neither technically nor cost effective (McNamara et al. 2008, Zagklis et al. 2013). This fact threats the olive oil production by complete cease due to the serious environmental problems caused. The main problems in the treatment of Olive mill wastewater (OMWW) are the following:

- OMWW toxicity mainly due to the high phenolic compounds content (16g/L)
- OMWW high organic load (120g/L COD)
- The seasonal operation of olive mills (3 months/year)
- The olive mills capacity (small, family run companies) (Goula and Adamopoulos 2013, Justino et al. 2012, Pierantozzi et al. 2012).

In the problems mentioned before, the very tight options for environmental strategy of waste management due to economical reasons should be added. Consequently, conventional technologies even if they were technologically effective, have proved to be economically ineffective.

Material and methods

The proposed technology (Figure 1) includes the olive oil removal from wastewater, their detoxification by Fenton oxidation reactions (Vlyssides et al. 2004) and following their utilization by biological treatment methods. The latter is achieved by the implementation of anaerobic digestion process on the oxidized wastewater and the consequent methane production and by co-composting the oxidized or/and anaerobic digested wastewater with solid wastes (olive mill wooden residue, leaves, branches etc), leading to the production of a high quality soil conditioner. The biogas produced could be utilized for in situ thermal and electrical energy production. The two biological processes used (anaerobic digestion and composting) are ideally combined, since the anaerobic digested wastewater is fully used in the composting process, while the excess thermal energy produced by biogas utilization can accelerate the aerobic biological processes resulting in a high quality biological fertilizer (Vlyssides et al. 2009).

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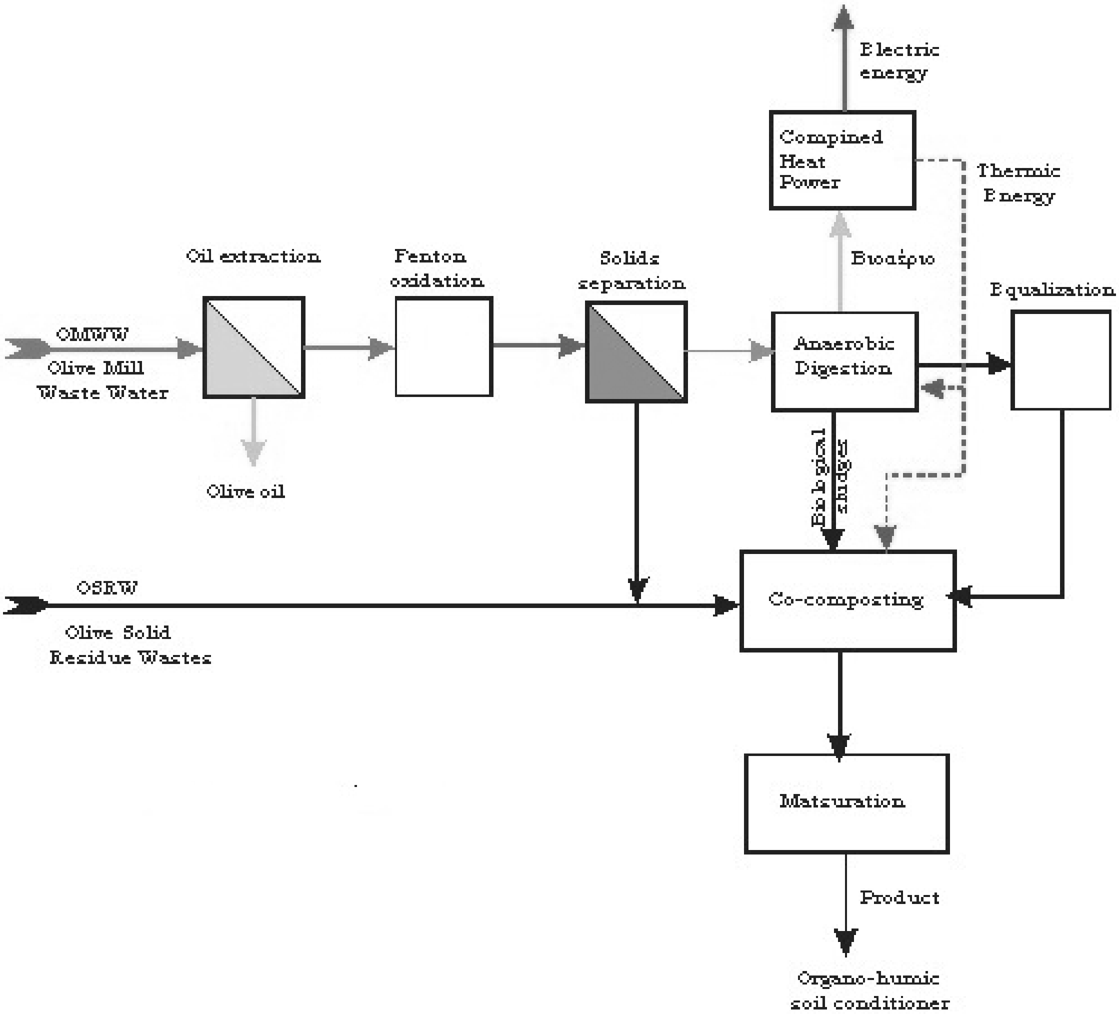

Figure 1. Recent development of the innovation

Results

Olive oil removal from wastewater is a stage of crucial importance. The produced oil could be used as raw material for biodiesel. Up to 2020, 20% of transportation fuels should be replaced by biofuels. Oils for biodiesel production are not available in Greece. In 2020, the need for oils would be up to 60000 tons per year. If there is no action in this direction, this amount should be imported. If the proposed innovation is used as a national solution, the potential oil production could be averagely 60000 tons per year, which means that Greece could meet the biofuel need without any import. Apart from this, oil removal helps essentially the co-composting process, because grease and oil are inhibitory factors in the composting ecosystem development.

By the application of the proposed technique all the nutrients (K, P, N), which have been removed from the cultivation soil, could be recycled by using the produced biological fertilizer (Vlyssides et al. 2012). This way, the sustainability of olive trees cultivation and of olive oil production is rendered feasible and the whole proposed technique could be effective. The soil conditioner is produced exclusively from plants, and it has been proved to be ideal for the biological cultivation of many products such as citrus, vineyards, aromatic herbals, asparagus etc.

The proposed technology is effective and simple to be implemented. Wastewater that has derived either from two or three phase olive mill could be treated. This technology can be implemented either in one olive mill scale or in centralized wastewater treatment plants. The proposed technology can not only effectively face the serious environmental problems caused by olive mill wastewater disposal, but it poses new perspectives in olive trees cultivation and olive oil and its by-products market.

Discussion

According to the European commission, in 2013 the financial aid of olive oil production will cease and after 2012 the olive trees cultivation and olive oil production could not proceed if the environmental problems are not addressed. In this context, the proposed technology could give the necessary development prospective in olive oil producing countries, given that it can face all the problems both environmental and economical. This innovation is environmentally integrated, since all wastes derive from olive oil production are treated effectively. The wastewater is co-composted with solid wastes (pulp, olive stone residue, olive trees leaves and branches) producing an organo-humic soil conditioner, a marketable product. If this product is used in olive trees cultivation, there is no need for additional chemical fertilizers use. By this way, the sustainable olive trees cultivation is promoted and the olive oil production becomes a "clean" technology. Additionally, the produced olives and olive oil could be considered biological products and consequently their price is elevated and the need for external finance is eliminated. It can be concluded that this innovation could promote green development in Greece, where the olive trees cultivation dating 5000 years ago. The whole innovation is feasible, because it is simple in its application with standard good results. Its economical effectiveness could be insured by the producers themselves.

This technology has already been implemented in 5 olive mills in Greece with very promising results and can be a promising alternative either for all the olive mill owners or for olive trees and generally biological products cultivators.

Suggestions to tackle with the future challenges of organic animal husbandry

Organic farming is based on the idea of sustainability, environmentally friendly and nature-orientated farming. The definition for organic farming and the converting of organic products is based on a closed loop recycling management that should ensure the sustainability. High biodiversity in fields and meadows, minimized losses of nitrogen and CO_2-fixation through increase of humus are becoming necessary efforts in times of climate change. Their importance in the modern society is associated with the demand for organic products. Thus, the sustainable olive trees cultivation and olive oil production could be set as an example for organic farming.

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Incorporation of residues of the medicinal plant *Echinacea purpurea* for the weed management in organic sunflower

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Key words: *Echinacea purpurea*, medicinal plant, residues, allelopathy, weed control

Abstract

Eastern purple coneflower [Echinacea purpurea (L.) Moench.] is globally recognized as one of the most popular medicinal herbs. In the present study, the effects of incorporation of the plant residues on weed flora and early growth of a sunflower crop were investigated. A field experiment was conducted under organic conditions at the Agricultural University of Athens. The results showed that there was a significant effect of plant residues on weed flora and biomass, especially during the first crucial growth stages of sunflower. Particularly, the incorporation of E. purpurea residues resulted to a lower number of different weed species (low richness) and an intense effect on most weed species. In a pot experiment it was revealed that sunflower seed germination was not affected by the incorporation of E. purpurea residues. However, the activity of the specific residues was inadequately selective (and needs to be further evaluated), since there was a negative effect on sunflower growth.

Introduction

Incorporation of plant residues can be a useful tool for integrated weed management since their biomass is produced at high levels and it affects weeds, especially during the early stages of crop growth (Mohler and Teasdale 1993). *Echinacea spp.* includes species famous for their medicinal properties (Hart and Dey 2009). *Echinacea purpurea* L. is a species of American origin which is lately extensively studied because of its noteworthy chemical and pharmacological properties. Many aromatic, medicinal and other plants were found to release toxic substances in the environment, through either root exudation or decay of their plant residues (Chon and Kim 2004). Although numerous studies have examined the effect of plant residues on weed suppression, however there is no information on residue effects of *E. purpurea* on weed density and biomass and sunflower response at the early growth stages and this was the objective of the present study.

Material and methods

One field and one pot experiment were conducted under organic management in the experimental field of Agricultural University of Athens (37^o 59′01.83″ N, 23^o 42′07.37″ E). The soil was a clay loam, whose physicochemical characteristics (0- to 15-cm depth increment) were clay 35.2 %, silt 45.7 %, sand 19.1 %, pH (1:2 H_2O) 7.36, $CaCO_3$ 12 g kg^{-1} and organic matter content of 24.4 g kg^{-1}. Sowing of a sunflower hybrid (Sanay MR) occurred on 3 May of 2012. This is a commonly used hybrid in Greece, and it was sown in rows (70 and 20 cm distances between and within rows). The field experiment was arranged in a randomized complete block design with three replicates and two treatments: a) incorporation of *E. purpurea* residues (246 g m^{-2}) and b) Untreated (without any incorporation). Plot size was 4.3 by 5 m. Irrigation and other common cultural practices were conducted as needed during the growing season, while the residues of the medicinal plant came from organically cultivated plants in Greece (provided by KORRES S.A. Co.). The number and dry weight of the dominant weeds were assessed. A wooden square quadrat (40 × 40 cm) was placed at random three times in each plot. Weeds in the 40 × 40 cm area were counted for each species present, and fresh and dry matter were determined (dry weight was determined after drying for 48 h at 70^{o}C). Weed assessments were made at 51, 63, 77, 94 and 115 days after sowing (DAS). Weed density per unit area (no. m^{-2}) was also recorded and furthermore the species diversity of weeds was characterized by means of the Shannon-Weiner and Simpson indices. For calculation of these indices, the software Bio DAP was used. A pot experiment was also conducted arranged in a randomized complete block design with eight replicates (pots of 15 L) for each of the two treatments (as in the field experiment). Measurements on seed germination and seedling emergence of sunflower were taken while plant height was also recorded. Statistical analysis of the results was performed using one-way ANOVA, while mean comparison was

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performed using Fisher's least signification difference (LSD) test at P < 0.05 by means of Statsoft package (1996).

Results

In some cases, the fresh and dry biomass of the weeds was significantly reduced after *E. purpurea* incorporation. In particular, this effect was significant for the fresh weight especially until 94 DAS, while later no differences were revealed. This is a clearly interesting finding, since weed control is crucial especially at the first growth stages of the crop, however in some cases these differences were not reflected on dry weight values (Table 1).

Table 1: Total fresh and dry matter of weeds sampled in the field experiment. Different letters between plots after incorporation of *E. purpurea* and untreated ones denote significant differences (LSD test, P < 0.05) within each sampling date.

Sampling date	Fresh weight (g)			Dry weight (g)	
	E. purpurea	Untreated		*E. purpurea*	Untreated
51 DAS	915.08 b	1406.29 a		173.28 b	249.31 a
63 DAS	783.17 a	708.16 a		157.23 a	157.56 a
77 DAS	1204.99 b	1537.48 a		280.4 a	294.87 a
94 DAS	772.01 b	848.76 a		242.76 b	286.95 a
115 DAS	678.75 a	628.47 a		305.37 a	307.61 a

Concerning the values of the Shannon-Weiner (H) index, in many cases there were significant differences between the two treatments, with incorporation of *E. purpurea* residues resulting to higher values (Table 2). During the early growth stages, no significant differences were noted, however, weed flora progressively had high species evenness in plots with *E. purpurea* incorporation. According to Booth *et al*. (2003) this index is increased because of emergence of additional species and that was the case in our experiment, with *E. purpurea* controlling several serious weed species (e.g. *Echinochloa crus-galli, Amaranthus retroflexus*) and thus other less competitive weeds finding the vital place to emerge (e.g. *Sonchus oleraceous*). Our results also revealed significant differences regarding Simpson index values. It could be said that the progressive decomposition of *E. purpurea* residues did not allow several noxious weed species to disperse and dominate (resulting to a lower Simpson index compared to the untreated plots), thus a balanced weed flora arised.

Table 2. Shannon-Weiner and Simpson indices for the weed community of the field experiment. Different letters between plots after incorporation of *E. purpurea* and untreated ones denote significant differences (LSD test, P < 0.05) within each sampling date.

Sampling date	Shannon-Weiner index			Simpson index	
	E. purpurea	Untreated		*E. purpurea*	Untreated
51 DAS	1.31 a	1.22 a		0.33 a	0.44 a
63 DAS	1.67 a	1.49 a		0.24 a	0.28 a
77 DAS	1.43 a	1.11 b		0.28 b	0.40 a
94 DAS	1.14 a	0.74 b		0.42 b	0.57 a
115 DAS	1.38 a	1.11 b		0.27 b	0.38 a

The results of our preliminary pot experiment revealed that the incorporation of *E. purpurea* residues in the soil had a negative effect on sunflower growth, although seed germination and seedling emergence of sunflower was rather unaffected (data not shown). However, it is noteworthy that sunflower plants after *E. purpurea* incorporation had the same height with the untreated plants at 63 DAS, so any differences seem to progressively decrease, without any permanent fitness cost for the crop.

Table 3. Time course of sunflower height during the experimental period (pot experiment). Different letters between plots after incorporation of *E. purpurea* and untreated ones denote significant differences (LSD test, P < 0.05) within each sampling date.

Treatment	Plant height (cm)					
	Days after sowing (DAS)					
	8	15	25	35	47	63
E. purpurea	1.94 b	5.50 b	11.50 b	19.34 b	42.25 b	72.94 a
Untreated	6.25 a	13.19 a	26.25 a	39.06 a	63.75 a	72.69 a

Discussion

The phytotoxicity action of residues used in this research can be plausibly attributed to the presence of several allelochemicals as previously shown in other studies (Viles and Reese 1995, Piechowski et al. 2006). There were noticeable differences among several weeds regarding their response to phytotoxical effects of *E. purpurea*, however, the number of different weed species was rather favored. Moreover, there were some negative effects on sunflower crop at early growth stages, however this reduction progressively dissapeared. Taking all the above into account and under the view of organic agriculture, integrated weed management and development of more environmentally feasible methods of weed control, the indicated allelopathic activity of plants like *E. purpurea* could be further exploited and complemented with future studies focusing on the identification and isolation of the responsive allelochemicals and additional field experiments.

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The role of mulching with residues of two medicinal plants on weed diversity in maize

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Key words: medicinal plants, residues, allelopathy, weed control

Abstract

The effects of mulch with the residues of two aromatic and medicinal plants (Sideritis scardica Griseb and Echinacea purpurea) were evaluated on weed flora and first growth of a maize crop. A field experiment was conducted under organic conditions, while a pot experiment was also conducted at Agricultural University of Athens. Our results showed that there was a significant effect of plant residues on weed flora. The incorporation of Sideritis sp. residues resulted to a lower number of different weed species (low richness) and adequate weed control. During the early growth stages of maize there was a satisfactory control of the broadleaf weeds after the incorporation of S. scardica, resulting to a significantly lower biomass. However, this effect progressively disappeared, with E. purpurea mulch progressively showing a higher phytotoxic activity. The pot experiment revealed that there was not any negative effect of mulching on maize seed germination, emergence and early growth.

Introduction

Lately, medicinal and aromatic plants cultivation has been spreading across Mediterranean countries. Among them, mountain tea (*Sideritis scardica* Griseb.) is a widely known species, while other plants such as eastern purple coneflower (*Echinacea purpurea* L.) are lately extensively studied (Laasonen et al. 2002). Towards a more environment friendly and low input agriculture, several cultural practices have been proposed. Mulching or incorporation of plant residues can reduce the amount of water needed for the main crop, provide valuable nutrients back into the soil and control some weeds (Buhler et al. 1996, Teasdale 1996). The objective of the present study was to evaluate the effects of the mulch of two important medicinal plants (*S. scardica* and *E. purpurea*) on weed flora and maize response at the first growth stages.

Material and methods

One field and one pot experiment were conducted in the experimental field of Agricultural University of Athens (37° 59′01.83″ N, 23° 42′07.37″ E). The soil was a clay loam, whose physicochemical characteristics (0- to 15-cm depth increment) were clay 35.2 %, silt 45.7 %, sand 19.1 %, pH (1:2 H_2O) 7.36, $CaCO_3$ 12 g kg^{-1} and organic matter content of 24.4 g kg^{-1}. Sowing of maize occurred after mulch incorporation in some of the plots. The experiment was conducted under organic management and arranged in a randomized complete block design with three replicates and three treatments: a) incorporation of *S. scardica* residues (5.41 kg per plot), b) incorporation of *E. purpurea* residues (5.28 kg per plot) and c) untreated (without any incorporation). The residues of both medicinal plants came from organically cultivated crops in Greece (provided by KORRES S.A. Co.). Plot size was 4.3 by 5 m. Irrigation and other common cultural practices were conducted as needed during the growing season, while the residues of the medicinal plant came from organically cultivated plants in Greece. The number and dry weight of the dominant weeds were assessed. A wooden square quadrat (40 × 40 cm) was placed at random three times in each plot. Weeds in the 40 × 40 cm area were counted for each species present, and fresh and dry biomass was determined. Five weed assessments regarding the density and the biomass were made at 51, 63, 77, 94 and 117 days after sowing (DAS). The species diversity of weeds was characterized using the Shannon-Weiner index (H) (Booth *et* al. 2003), while Simpson index was also used. For calculation of these indices, the software Bio DAP was used.

A pot experiment was also conducted near the experimental field at Agricultural University of Athens. The experiment was also arranged in a randomized complete block design with eight replicates (pots of 15 L) for each of the three treatments (as in the field experiment). Measurements on seed germination and seedling emergence of maize were taken, while plant height was also recorded. Statistical analysis of the results was performed using one-way ANOVA, while mean comparison was performed using Fisher's least signification different (LSD) test at $P < 0.05$ by means of Statsoft package (1996).

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Results

In Table 1, the fresh weights of the broadleaf and grass weeds for each treatment are shown. It has to be noted that at the very early stages (1st assessment) there was a very satisfactory control of the broadleaf weeds after the incorporation of *S. scardica*, resulting to a significantly lower biomass. However, this effect progressively disappeared, while it seems that at 77 DAS *E. purpurea* mulch had a significant effect on the several broadleaf weeds (Table 1). A similar trend was also observed for grass weeds.

Table 1. Total fresh matter of broadleaf and grass weeds sampled in the field experiment (S: *S. scardica* mulch, E: *E. purpurea* mulch and U: untreated). Different letters in each row denote significant differences (LSD test, P < 0.05) within each sampling date.

Assessment	Broadleaf weeds		
	S	E	U
1st	531.84 b	706.4 a	628.4 ab
3rd	3292.24 a	937.28 b	3627.24 a
	Grass weeds		
	S	E	U
2nd	68.8 b	102.4 a	110.32 a
5th	206.6 a	52 c	131.72 b

Concerning the values of the Shannon-Weiner (H) index, in some cases there were significant differences between the treatments as shown in Table 2. The highest values were recorded in plots with *S. scardica* incorporation, whereas weed flora had high species evenness. According to Booth et al. (2003) this index is increased because of emergence of additional unique species and that was the case in our experiment, with late emergence of many broadleaf weeds (as shown in Table 1). Moreover, it has to be noted the progressively reducing trend during the experimental period for Shannon-Weiner index in the plots of *S. scardica* and *E. purpurea*, providing evidence for a reducing richness. This can be attributed to the fact that the mulches progressively controlled and eliminated several weed species, however specific weeds such as were rather favoured and finally dominated (resulting to a slightly rising high Simpson index).

Table 2. Shannon-Weiner and Simpson indices for the weed community in the field experiment (S: *S. scardica* mulch, E: *E. purpurea* mulch and U: untreated). Different letters in each row denote significant differences (LSD test, P < 0.05) within each sampling date.

Assessment	Shannon-Weiner index				Simpson index		
	S	**E**	**U**		**S**	**E**	**U**
1st	1.83 a	1.36 b	1.72 a		0.18 a	0.25 a	0.26 a
2nd	1.67 b	1.68 b	1.99 a		0.94 a	0.23 b	0.15 b
3rd	1.60 a	1.09 b	1.55 a		0.22 b	0.45 a	0.20 b
4th	1.66 a	0.82 c	1.07 b		0.19 b	0.47 a	0.37 a
5th	1.43 a	1.05 b	0.89 b		0.26 b	0.35 ab	0.47 a

The results of our pot experiments revealed that the mulch incorporation of *S. scardica* or *E. purpurea* residues in the soil did not cause any negative impact on seed germination and seedling emergence of maize. Moreover, the first growth of maize plants was not significantly different from that of the control, while in some cases and after *S. scardica* or *E. purpurea* incorporation sunflower plants were slightly higher than the untreated ones, probably because of a potential enhancing effect of the residues.

Discussion

The results of the present study showed that *S. scardica* and *E. purpurea* mulch had a clear phytotoxic activity against several common and noxious weed species. Previous studies have shown that *Sideritis* and *Echinacea* species contain several allelochemicals with various effects (Rios et al. 1992, Viles and Reese 1995) and this noteworthy phytotoxic action shown by our studies can be plausibly attributed to the some of these allelochemicals.At a field level, mountain tea residues seem adequate for an effective weed control at early maize stages, while coneflower's mulch provides a long-term weed management. Moreover, the absence of negative effects on maize is clearly desirable and need to be further evaluated in a wider range of crops, soils and climatic conditions. Organic agriculture needs to be relied on environmentally friendly and effective methods of weed control, and under than concept the indicated allelopathic activity of plants like *S. scardica* and *E. purpurea* should be exploited and accomplished with future studies.

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Description and typology of dairy goat farms in Greece

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Key words: dairy goats, farming systems, breeding, diversity

Abstract

The national flock of dairy goats in Greece comprises genetically diverse populations that take advantage of semi-mountainous or mountainous regions, where they are traditionally fed on natural pastures and scrublands under varied climatic conditions. The dominant system is the semi-extensive and milk production is the key objective. Considering their role in rural development of Greece, goats represent an appropriate model of low input farming systems.

Introduction

Dairy goat farming is one of the earliest agricultural activities dating back to ancient Greece. It has played a vital role in maintaining rural tradition and self-sufficiency of population in poor rural areas. The latter explains the stability of the goat national flock in Greece which is ranked first with 39.8% of the total EU goat census. The indigenous Greek goats comprise genetically diverse populations and in 2011, the national flock reached 5 million heads spread over 120,000 farms. The latter are mainly mixed flocks with dairy sheep whereas only 65,031 farms raise exclusively dairy goats (see Table 1). The overall annual goat milk production is about 420,000 tons, representing about 22% of the total milk production in Greece. The traditional goat farming system is the semi-extensive where the kidding season coincides with the emergence of grazing resources and goats as fed on natural pastures and scrublands under varied climatic conditions. The latter is the dominant system in semi-mountainous or mountainous regions that have low income indices and relatively low population density engaged mainly in agriculture. The common production objective of goat farming is milk, but the extended geographical distribution of flocks as well as the diversity of the management strategies contributed to the lack of knowledge about the typology and the characteristics of those systems (Gaspar et al. 2011). Hence, the description and typology of a random sample of farms was set as our first objective within the SOLID project, considering the importance of goat farming for the future of rural development in Greece.

Material and methods

The available database of registered sheep and goat farms in Greece (Hellenic Ministry of Rural Development and Food, 2011) was initially assessed to get information about the status of dairy sheep and goat farming in Greece. A total of 103 dairy goat farms from all over Greece were randomly selected and assessed using the designated questionnaire. The questionnaire was designed for in depth interviews of farmers and farm assessment. The survey was conducted over the last two years and data were collected by the same veterinarians during extended on-farm visits (3-5 hours). The questions were selected to obtain a general description of farm characteristics and overall management practices and included information about: a) farm location and land use b) flock size and structure, c) facilities and equipment, d) feeding management, e) reproduction and breeding strategies, f) labour force and g) milk production. The variables used for statistical analysis were: i) livestock units, ii) average milk yield, iii) cultivated land per livestock unit, iv) average grazing speed, v) concentrates per livestock unit, vi) roughages per livestock unit, vii) livestock units per labour unit, viii) total facilities score, and ix) yearlings:goats ratio (as indicator of the goats replacement rate). Data analysis was performed using the SPSS 21® software. The ideal number of clusters was decided using the hierarchical cluster analysis based on Ward's method. In this analysis Euclidean distance was used as a clustering measure. Thereafter, K-means clustering was used as the most appropriate partitioning method of farms in the 3 predefined clusters. Finally, the existence of statistically significant differences between those groups was tested with ANOVA and Least Significant Difference test was used as a post hoc test.

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Results

We used data from the 2011 census to classify the national flock of dairy goats in Greece according to flock size and farm numbers. The results are presented in Table 1. As shown in Table 1, the majority of flocks (63%) have less than 400 animal and only 13% of flocks are large flocks. It is also important that 22% of flocks have less than 100 animals. Figure 1, illustrates the arrangement of the clusters produced by hierarchical clustering. The minimum cutting height was 3 because that was the point at which the total number of clusters decreased dramatically and hence the most suitable number of valid clusters appeared to be 3.

Table 1: Description of dairy goat farms in Greece

Flock size	Number of Flocks	Goat numbers
>1000	58	73.156
901-1000	38	37.337
801-900	59	50.633
701-800	110	82.408
601-700	250	162.061
501-600	479	262.498
401-500	1.008	452.836
301-400	2.416	746.694
201-300	3.924	967.273
101-200	7.278	1.062.095
81-100	2.122	193.394
61-80	2.841	199.865
41-60	4.301	214.403
21-40	8.803	253.415
11-20	10.727	162.904
0-10	20.617	103.974
Total	**65.031**	**5.024.946**

Table 2: Means ± SE of variables selected for the characterization of goat farms in 3 clusters and comparisons between them

		Cluster 1 (n=27)		Cluster 2 (n=10)		Cluster 3 (n=66)	
	Characteristic	Mean	SE	Mean	SE	Mean	SE
Staff	Owner's age	45	2.2	44	3.4	48	1.4
	Years on goat breeding	21	2.6	17	2.8	26	1.6
	Labour units	2.9	0.22	2.8	0.47	2.9	0.15
Animals	Livestock units	64	12.5	53	14.3	70	5.6
	Livestock units / labour unit	20	2.3	18	3.4	24	1.4
	Adult goats, n	341	67.5	282	81.4	386	30.9
	Milking goats, n	312	66.0	262	77.9	328	26.3
	Bucks, n	21	3.5	20	5.2	29	2.9
	Yearlings, n	75	13.7	57	12.1	76	7.8
	Goats:bucks ratio	17	1.5	14	2.0	17	0.9
	Goats replacement rate	0.15^{a}	0.010	0.16^{a}	0.014	0.13^{b}	0.027
	Bucks replacement rate	0.30^{a}	0.013	0.31^{a}	0.035	0.25^{b}	0.010
	Yearlings:goats ratio	0.3	0.06	0.3	0.06	0.2	0.03
	Age at first mating, mo	9.3	0.70	9.8	0.75	9.0	0.52
Productivity	Milk production / goat, kg	270^{a}	8.6	478^{b}	22.9	141^{c}	5.3
	Prolificacy	1.7^{a}	0.04	1.8^{a}	0.07	1.5^{b}	0.03
Land use	Cultivated surface, ha	39	17.3	27	11.8	23	7.3
	Irrigated surface, ha	1	2.9	6	10.3	2	6.2
	Non irrigated surface, ha	37	17.2	22	12.0	21	7.1
	Cultivated pasture surface, ha	16	7.8	6	3.5	11	5.4
	Cultivated land / livestock unit	0.5	0.15	0.6	0.34	0.3	0.06
Nutrition and manageme nt	Concentrates / livestock unit	1.4^{a}	0.14	3.1^{b}	0.95	0.9^{a}	0.07
	Roughages / livestock unit	1.2^{a}	0.23	2.2^{b}	0.71	0.5^{c}	0.07
	Average daily grazing time, h	$7.4^{a, b}$	0.56	5.9^{a}	1.20	8.5^{b}	0.27
	Average daily grazing distance, km	$6.0^{a, b}$	0.98	3.6^{a}	0.71	7.7^{b}	0.52
Score	Total facilities score	6^{a}	0.4	7^{a}	0.7	4^{b}	0.2

$^{a, b, c}$ Means within a row with different superscripts differ (*P*< 0.05).

Discussion

Based on existing information (Escareño et al. 2012, Gelasakis et al. 2012) and knowledge of dairy sheep and goat production it seems that the typology of flocks generated in the present study is representative of dairy goat sector in Greece. The latter is supported by the results shown in Table 2, which confirms the typology in statistical terms. However, as shown in Table 2, there were not any significant differences in some of the variables (i.e. regarding staff and livestock), which although are distinctive of some flocks in the clusters, they are not suitable to differentiate them. A key difference between clusters was the total facilities score. The latter was the lowest in Cluster 3 that accounted for 64% of the flocks and is indicative of the traditional low input system. Cluster 1, comprises 26.2% of the farms and represents those farms that are in the stage of transforming from the traditional semi-extensive system to semi-intensive system of production. Cluster 2 accounts for 9.7% of the farms and typologically is composed of middle size farms with a complementary agricultural activity. As mentioned above, Cluster 3, is the most representative of the traditional semi-extensive commercial system of dairy goat farming in Greece. The variables used in the current study are those that in our view best fit the reality of existing goat production systems in Greece and at the same time show low variability over time. In conclusion the present study is the first step for the overall assessment the goat sector in Greece and provides the basis to explore its strengths and weaknesses.

Suggestions to tackle with the future challenges of organic animal husbandry

The obtained typology enable an objective description of organic and low input dairy goat farms in Greece and indentifies their strengths and weakness. The data can be used as indicators to analyze the diversity of dairy goat farming practices. Moreover the obtained information can be used for future profitability analysis among different clusters.

Acknowledgement

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Genetic polymorphism of the *CSN1S1* gene in the Greek-indigenous Skopelos goat

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Key words: *CSN1S1*, goat milk, genetic polymorphism, PCR-RFLP

Abstract

Goat milk has been an invaluable asset for Mediterranean countries. Milk yield and composition is greatly affected by polymorphisms in the CSN1S1 *gene which encodes for the* a_{s1} *casein fraction of milk. Currently, about 18 alleles have been described which are associated with four levels of* a_{s1} *casein. In the present work, we investigated the genetic structure of* CSN1S1 *alleles in a population of Greek-autochthonous Skopelos goats. The high-protein yield A* (A, G, I, H) and B* (B1, B2, B3, B4 and C) alleles were detected at higher frequencies (0.56 and 0.59, respectively) compared to the low-protein alleles (F, 0.06 and E, 0.07). The presence of the null N allele was detected at a frequency of 0.26. Genotyping of the Skopelos goat population did not show carriers of the 01 allele. The assessment of the* CSN1S1 *genetic variability could be useful for the genetic improvement of the Skopelos goat, a breed that is well-adapted to low-input farming conditions.*

Introduction

In Greece as well as in many countries around the Mediterranean, goat milk is primarily used for cheese production. Therefore, the economic revenue of goat milk production depends greatly not only on milk yield but also on protein and fat content (Park and Haenlein, 2007). Extensive polymorphisms of the caprine gene that encodes the a_{s1} casein (CN) fraction (*CSN1S1*) have been reported to be associated with milk yield and milk composition in many goat breeds. At least 18 different alleles have been identified so far (Devold et al., 2010) that are classified in 4 groups: strong alleles (A, B1, B2, B3, B4, B', C, H, L, M) are associated with increased levels of a_{S1}-CN in milk (3.6 of g/L), intermediate alleles (E, I) with 1.6 g/L, weak alleles (F, G) with 0.6 g/L, and null alleles (01, 02, N) which are characterized by absence of a_{s1}-CN in milk.

The Skopelos breed is an important autochthonous dairy goat that is reared mainly in the Sporades islands and in the mainland of central Greece. It represents a highly homogenous population comprised of about 11,000 animals. The breed is well adapted to dry, low-input systems, which are characterized by sparse vegetation and poor scrublands. The purpose of this study was to evaluate the genetic variability of the α_{s1}-casein locus in the Skopelos breed.

Material and methods

Blood samples were collected from 238 Skopelos breed goats. The animals were grouped in 2 herds that were located in the Sporades islands of Greece. Both herds were reared using traditional low-input farming. DNA was extracted from 200µL of blood using the GeneJET Whole Blood Genomic DNA Purification Mini Kit (Thermo Scientific Inc.).

Genotyping at the *CSN1S1* locus was performed using allele-specific PCR and PCR-RFLP protocols. For identifying the *CSN1S1* A* (including A, G, I, H), B* (including B1, B2, B3, B4 and C), F and N alleles the PCR-RFLP method described by Ramunno et al. (2000, 2005) was followed. The identification of E and 01 alleles was performed using allele-specific PCR (AS_PCR) according to Torres-Vázquez et al. (2008) and Cosenza et al. (2003), respectively.

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Results

Polymorphisms at the *CSN1S1* locus have been extensively characterized in several economically important breeds as well as in indigenous breeds from different countries. However, to date, casein variability at the genomic level in the indigenous Greek goat breeds has not been assessed.

The region of the caprine *CSN1S1* gene between nucleotides 202 and 420 that includes part of the eighth intron, the ninth exon and part of the ninth intron, was amplified and subsequently digested with the restriction endonuclease *Xmn*I. Observed genotypes are presented in Figure 1.

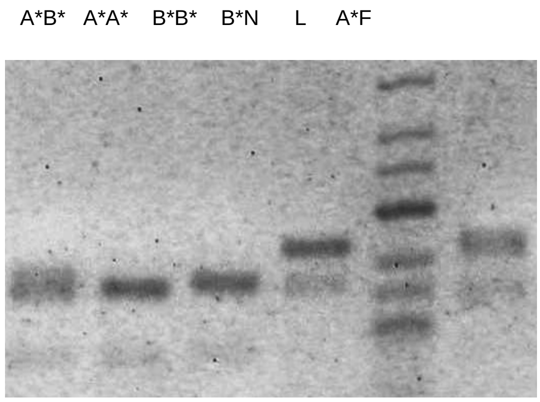

Figure 1. PCR-RFLP analysis of A*, B*, F, and N alleles of *CSN1S1* in representative Skopelos goat individuals. Amplified fragments were digested with *Xmn*I for 5 hours and then electrophoresed in 2.5% agarose-TAE gel. The molecular size marker (L) used was GeneRuler Low Range DNA Ladder (Thermo Scientific Inc.).

The most common genotype was A*B* (0.24) followed by B*B* (0.22) and A*A* (0.21). These genotypes are associated with production of milk with high protein content and more favourable cheese-making properties in many European goat breeds. The most frequent alleles observed in the Skopelos goat population were A* (0.56) and B* (0.59). *CSN1S1* E and F alleles were identified at a very low frequency (0.07 and 0.06, respectively). However, the N null allele was detected at a frequency of 0.26, a frequency similar to the Neapolitan goat and goats of French origin. The 01 null allele was not identified in any of the tested animals (Figure 2).

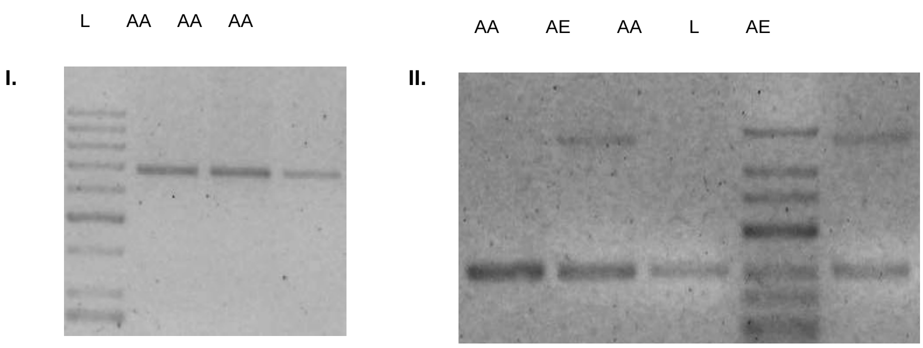

Figure 2. I. AS-PCR analysis of *CSN1S1* 01 allele. 01 allele was not identified in the Skopelos population tested. A depicts all non-01 alleles. II. AS-PCR analysis of *CSN1S1* E allele. A depicts all non-E alleles. Amplified fragments of the *CSN1S1* gene were electrophoresed in 2% agarose-TAE gel. The molecular size marker (L) used was GeneRuler 50 bp DNA Ladder (Thermo Scientific Inc.).

Discussion

The high frequency of the strong alleles A* and B* in Skopelos goats indicate that this breed possesses an allelic combination associated with high milk protein yield. Studies on the effect of *CSN1S1* polymorphism on milk yield and composition are currently under way by our group. The *CSN1S1* genotype information will be valuable to use in selection strategies in order to breed animals for higher milk yield and protein content. On the other hand, information on the null (N) allele will be useful in creating animal niches that produce milk for specialized applications (e.g. milk with low allergenic potential). Analysing the molecular diversity of local Greek breeds that are reared using traditional low-input farming systems will establish a new horizon for the conservation and sustainability of the indigenous goat population.

Suggestions to tackle with the future challenges of organic animal husbandry

Breeds of dairy goats, well-adapted to harsh environments, play a key role to sustainable milk production under low-input and organic farming systems in less favoured areas. Under these systems, genetic selection based on milk quality traits may favour the more efficient utilization of restricted resources in order to produce high-quality products.

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Soil arthropod diversity in organic, integrated and conventional olive orchards in Crete

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Key words: Olive orchards, management, arthropods, functional, agrobiodiversity

Abstract

Soil fauna biodiversity and its functional counterpart were monitored in olive orchards under conventional, organic and integrated management, for a year in Messara valley, Crete, Greece. Counter groups of functional taxa were defined, with respect to services of biological pest control and of nutrient cycling in the olive agroecosystem. Comparison of the different management systems in terms of abundance and diversity of soil arthropods and functional groups was performed. Formicidae, Coleopteran family of Tenebrionidae, Araneae, Colembola and Opiliones were the most abundant taxa found. A trend of higher total abundance and richness was found in the organic olive orchards, however not statistically significant. Functional arthropod abundance followed a similar trend. Diversity indices did not show a constant pattern in terms of management system comparison; however a trend of higher diversity appeared in the less-intensified organic orchards.

Introduction

Olive production is often a conventional agricultural protocol with applications of mineral fertiliser and chemosynthetic pesticides that can be high in intensive modern olive orchards. Such production often faces ecological problems (Kabourakis, 1999). Biodiversity is particularly affected by intensive farming practices, forcing agroecosystems to impoverishment (Biaggini, 2007).

Soil biodiversity is especially regarded as offering stability against disturbance and stress (Brussaard, 2007). The elements of agricultural biodiversity providing desired services has been be regarded as “functional” with several definitions emerged, depending on stakeholder’s objectives and priorities (Moonen and Bàrberi, 2008; Bàrberi, 2013).

The diversity of soil arthropod fauna in twenty four olive orchards in southern Crete was monitored for one year using a standard sampling method. Soil arthropod diversity was related to orchard management and the agroecological zone of the location of the orchards. This investigation was designed to optimise the efficiency of soil arthropod diversity management in olive orchards under different organic, integrated and conventional management systems.

Material and methods

Study location and surveyed orchards

The survey was done in twenty four pilot orchards located in eight different sites in Messara valley, a representative olive producing region of southern Crete. Orchards were selected following discussions with stakeholders and based on previous research carried out in the area (Kabourakis, 1999). Each study site included three neighbouring orchards (organic, integrated and conventional). The sampling period included 5 weekly measurements in each season, starting in autumn 2011 to summer 2012 (in total 20 weeks/year).

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Soil arthropod fauna monitoring

Soil arthropods were collected using pitfall traps. Each trap was left in site for 7 days. The arthropods were identified down to order level of taxonomy and to the level of class for Chilopoda and Diplopoda. Coleoptera were further taxonomized for the families of Scarabeidae, Carabidae, Staphylinidae and Tenebrionidae due to their functionality. Family Formicidae was counted independently from order Hymenoptera due to its abundance.

Data analysis

Comparison of different management systems was performed in terms of number of arthropods collected (total abundance). Richness and other indices of diversity were calculated, including the Shannon, reverse Simpson's and Pielou's Index. In addition, catches of functional fauna were grouped regarding the important and prioritized agroecosystem services of biological pest control and soil nutrient cycling they deliver. Statistical analyses were carried out using SPSS 20.0 for MS Windows.

Results

Total arthropods capture during the whole sampling period amounted to 115,364 individuals, of which 44,283 were trapped in the organic, 36,715 in the conventional and 34,367 in the integrated orchards. The arthropods were classified into 16 taxa, represented in all management systems (Table 1). Differences in total abundance were not statistically significant. Nevertheless, higher number of catches appeared in the organic orchards for all measurements, except winter. In similar studies, lower abundance of arthropods was found in conventional olive orchards (Ruano et al., 2004) and greater abundance in organic olive orchards (Cotes et al., 2010).

Table 1. Soil arthropod fauna abundance of taxa, functional groups and, and values of richness and biodiversity indices for organic (Org), conventional (Conv) and integrated (Int) management systems.

Season	Autumn			Winter			Spring			Summer			Whole period		
Management system	Org	Conv	Int	Org	Conv	Int	Org	Conv	Int	Org	Conv	Int	Org	Conv	Int
Taxa															
Acarina	68	35	97	43	21	40	1732	526	441	915	840	188	2758*	1422	766
Araneae	551	604	617	574	456	655	1234	912	1039	1407	1111	1239	3766	3083	3550
Coleoptera	921	778	798	280	296	287	12132	9638	10116	3003	4344	2963	16336	15055	14165
scarabeidae	168	84	53	6	7	9	824	170	136	6	4	9	1003	265	206
carabidae	229	200	213	43	38	43	428	331	257	24	41	43	724	611	556
staphylinidae	204	147	136	101	165	114	649	562	688	8	8	17	961	882	955
Tenebrionidae	30	17	29	32	6	16	6982	5876	5942	987	1226	681	8032	7126	6669
other	291	330	367	98	79	106	3250	2698	3093	1978	3064	2214	5616	6172	5779
Collembola	517	520	533	495	495	509	627	292	727	381	664	393	2020	1970	2162
Dictyoptera	1	3	0	13	0	13	36	25	35	1437	987	1314	1487	1014	1362
Formicidae	905	460	686	64	81	69	4555	3560	4079	6943	5129	5028	12467	9230	9862
Hemipt./Heteropt.	7	5	10	0	2	0	84	97	61	51	484	140	141	588	210
Hemipt./Homopt.	18	19	42	47	64	61	328	269	387	108	69	127	502	421	617
Hymenoptera	39	34	42	11	4	9	111	33	81	246	198	177	407	270	309
Isopoda	163	120	229	24	15	23	503	677	702	327	300	271	1018	1113	1225
Opiliones	816	432	437	476	299	531	1207	820	987	4	0	3	2503	1551	1958
Orthoptera	33	15	28	15	7	12	68	105	81	127	207	267	243	333	388
Thysanura	3	35	13	3	7	13	45	19	23	30	16	9	80	78	58
	Other taxa counted: Chilopoda, dermaptera, diplopoda (<1%)														
Total	4074	3090	3556	2097	1801	2238	22740	17092	18863	15914	14418	12151	44825	36402	36808
Mean/trap	16,98	12,87	14,82	8,74	7,51	9,32	94,75	71,22	78,60	66,31	60,08	50,63	46,69	37,92	38,34
functional taxa	3653	2653	3043	1860	1591	2021	18785	13746	15021	11032	9340	7880	35330	27331	27966
BPC	2704	1843	2090	1258	1040	1411	8073	6186	7050	8385	6289	6330	20420	15358	16881
NC	949	811	954	602	551	610	10712	7561	7972	2647	3051	1551	14910	11973	11086
S	15	15	14	15	12	15	16	16	16	16	14	14	16	16	16
J	0,762	0,844	0,799	0,763	0,844	0,810	0,540	0,593	0,607	0,632	0,711	0,680	0,674	0,748	0,724
H'	1,565	1,478	1,512	1,450	1,360	1,289	1,325	1,298	1,395	1,436	1,513	1,476	1,444	1,412	1,418
1-D	0,731	0,738	0,734	0,713	0,696	0,672	0,595	0,592	0,635	0,666	0,708	0,691	0,676	0,684	0,683

In terms of specific taxa, Coleoptera was the most abundant, dominated mostly by family Tenebrionidae, and it was followed by Formicidae, Araneae and Collembola. The differences of taxa abundance between management systems were not statistically, except Acarina, being higher in the organic than the integrated olive orchards, in the whole period results ($p<0.05$)

Functional arthropods captured throughout the whole sampling periods numbered 90,630 individuals, representing 76,7% of total arthropod catches. In the organic orchards 35,331 functional individuals were counted, in the conventional 27,331 and 27,967 in the integrated orchards.

Differences of functional taxa abundance between management systems were not statistically significant. However, a trend of higher total catches appeared in the whole period results for the organic orchards, followed by the integrated and conventional. The seasonal measurements presented the same pattern, except in the summer where the conventional ranked second, and in winter, where the integrated ranked first (Table 1). The above, not surprisingly, resemble to the results of total arthropod abundance, since the functional part accounts for a large part of the total catches.

Differences of all biodiversity indices between management systems were not statistically significant. Nevertheless, values of the Shannon index appeared higher in organic, followed by the integrated and conventional orchards in the whole period results. In the seasonal measurements, the indices values did not present a constant pattern.

Discussion

Less-intensively managed orchards appeared to support higher soil arthropod abundance and diversity of soil arthropods. Differences between management systems were not statistically significant; however a trend of higher total and functional taxa abundance in less the less intensive management systems was rather obvious. The composition of soil arthropod fauna was similar to that of previous surveys. Breakdown of the total abundance to functional groups with regards to prioritised agroecosystem services, proved to be a helpful approach for our biodiversity survey.

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Hungarian on-farm research program for varroa control in organic beekeeping

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Key words: organic beekeeping, on-farm research, varroa control

Abstract

Varroatosis as the current bane of the beekeepers is causing the biggest economic damage in the apicultural sector. Consistent control of varroatosis should be provided without harmful effects such as the occurrence of toxic residues in the hive products. In the technology of organic beekeeping only natural materials are allowed to be used such as essential oils and organic acids. In 2013 within the beekeeping on-farm research program, ÖMKi was collaborating with beekeepers throughout Hungary in comparative trials for testing the efficacy of different types of varroa control treatments and management. The trials were set up in market operations. One essential task of the program was to monitor the infestation level systematically with different mite-counting techniques.

Introduction

Varroa mites have a vector role, distributing viruses and weakening bees that become more susceptible to other pathogens as well. Disorientation, robbing, and frame exchanging may transport mites from one colony to another (Oliver, 2011). There are no colonies without mites in Hungary. The infestation level increases over time in colonies that are untreated or not managed regularly. The continuous builtup of mite population causes slower build-up, less honey production, a viral epidemic, poor wintering, or at worst, colony collapse. The infestation level should be kept as low as possible for a sustainable production. Any intervention in the colony against mite may cause disturbance and expense where the relevance of the timing and the type of method should be considered. The degree of varroa infestation must be measured in a timely manner in order to determine what efforts are needed to be making to keep the mite population below a threshold level that would cause economic injury to the colony. Oxalic acid (OA) is one of the most common natural acaricides used against varroa throughout Europe. Its activity is well known since the middle 1980s at least, due to experiments performed mainly in Eastern-Europe and Asia on the spraying and sublimation administration techniques (Nanetti, 2003). Formic acid (FA) is a natural product found in honey (Liu 1991). Several field and laboratory tests (Hoppe et al. 1989, Bracey & Fischer 1989, Fries 1991, Ritter & Ruttner 1980, Feldlaufer et al. 1997) have shown formic acid to have acaricidal properties in varroa. In the on-farm research program throughout the season the different treatments and managements were chosen that were matching with colonies' biological state and environmental conditions such as brood period, temperature, etc. Most of the treatments affect only the foretic mites. Therefore during the season some operations - where it is possible - they generate capped brood less state for treatments. The major part of the mite control is good timing of the closing treatment in the end of the beekeeping season in the brood less period.

Material and methods

Experimental setup

The Research Institute for Organic Agriculture (ÖMKi), 17 beekeepers where participating creating "participatory" research team in the on-farm program. True 'on-farm' research involves producers in experiment design, often in collaboration with scientists or extension educators. Farmers either conduct or help conduct the experiment, providing a real-life setting in which to test their theories. I this case a comparative study of commercial products for organic beekeepers in combination of bee management methods were set up. In the beginning of the beekeeping season each beekeeper selected 12 hives from their operation and made 3 groups of (3*4) or (2*2)+(2*4) colonies per apiary. The beekeepers were chosen from different location for better representative geographical data, see figure 1. The timing of treatment periods and the method of bee management

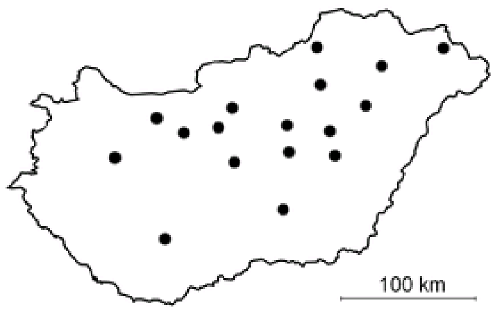

Figure 1. The geographical locations of the participating operations.

method were depending on the honey flow seasons and the type of beekeepers' equipment.

Monitoring mite levels

In practice instead of calculating the total colony infestation rate the recommended seasonal threshold levels were adapted to the local conditions which must be under the economic injury level (Amsler et al. 2009). The adapted threshold levels were at half measure as the colony density very high in Hungary compare to other European countries, which redounds rapid infestations from neighbouring colonies. The types of threshold levels where the natural 24-hr mite drop count and the rate of phoretic mites on sampled adult bees. For counting the natural drop of phoretic mites from the bees the sticky board under a screen method were used (Martin, 1998). The average natural 24-hr mite drop count was calculated from one week periods. For the rate of phoretic mites the bees were sampled from the nest, and in brood period the nursery bees where usually most of mite are present. The sample sizes were at least 300 bees. The samples where processed following the methods described by AIB* (2007).

Treatment

Because of the treatment timing setup, one monitoring period carried out right before a treatment was in some cases the backup of the previous treatment as well. The active ingredient materials of the treatments where organic acids, formic, and oxalic as "natural" treatments in the hive, as they are all naturally found in honey. All treatment where using commercial product and instruments. In each treatment period the actual active ingredient materials were the same but different brand or processed by different instrument. The backup monitoring was following a week after the treatments, to avoid counting mites fallen directly due to the treatments. The first summer treatment period was in June with one or two repetitions of dribbling OA products. 4-5 days were spaced between the repetitions. The second summer treatment period was in July with a three time sublimating oxalic acid. Until autumn groups of untreated colonies were kept as control samples for monitoring natural mite population development. In the first autumn treatment period in September two type of FA evaporating devices were compared: barred cages with evaporator plate standing and gel packs. From this time the groups of former untreated colonies were divided in two for the comparative trials. In the second autumn treatment period the OA dribbling products were applied in one or two repetitions. For the final treatment OA sublimation was applied only once in the winter in the broodless period.

Results

As the result are shown in table 1., the numbers for the degree of varroa infestation were the average numbers of all participating apiaries. All participating colonies were beginning with low infestation levels. The untreated control hives' infestation was starting to exceed our prescribed threshold levels in August and was rising eight times higher than the treated colonies until the first treatment in September. After starting to treat the former untreated colonies in September their infestation levels stopped rising but stayed higher than the threshold levels until the end of the year. The infestation level of the treated colonies stayed under the threshold level throughout the year.

Summer treatments with OA

In June the dribbling treated colonies were significantly less infested than the untreated control hives and no significant difference were perceived between product A and B. Until the next treatment period the infestation levels rise again. In practice sublimation technique of OA in August was carried out with less physical effort and disturbance compare to the dribbling treatments. The infestation levels dropped after the sublimation and stayed under the threshold levels.

Autumn treatment with FA

The infestation levels in both case of September AF evaporating treatments stayed under the threshold levels and in terms if infestation levels no significant difference were perceived between the two treatment types. However the bees showed difference in the tolerance for FA. The bees treated with the gel packs left the frame betweens right below the gel packs. The former untreated colonies showed dramatic decrease in varroa infestation into a quarter levels in two weeks treatment.

Autumn and winter treatment with OA

Glance the direct mite drops caused by the treatment were surprisingly high. No bees sampling were made from this point therefore no result were perceived of the rate of phoretic mites. October sublimation and November dribbling methods result an infestation level dropping to the quarter level of former levels. No significant difference was perceived between the OA dribbling products. After the December sublimation no mite drops were perceived.

Table 1: The timing and methods with the results

period	activity	methods for groups of (3*4) or (2*2)+(2*4) colonies/apiary and the degree of varroa infestation in average measurement				threshold levels
1st week of June	natural mite drop count	1,6				4
1st week of June	adult bee sampling	0,2%				0,5%
2nd-3rd week June	treatment	Untreated control		dribbling oxalic acid product A	dribbling oxalic acid product B	
1st week of July	natural mite drop count	3,9		3	3,1	5
1st week of July	adult bee sampling	1,0%		0,6%	0,7%	1,0%
2nd week of August	natural mite drop count	6,1		4	4	6
2nd week of August	adult bee sampling	1,7%		1%	1%	1,3%
3rd-4th week of August	treatment	Untreated control		sublimating oxalic acid		
2nd week of September	natural mite drop count	16		2	2,1	4
2nd week of September	adult bee sampling	3%		0,4%	0,4%	0,5%
3rd week of September	treatment	evaporating formic acid product E	evaporating formic acid product D	evaporating formic acid product E	evaporating formic acid product D	
1st week of October	natural mite drop count	4	4,6	1,5	1,8	2
1st week of October	adult bee sampling	-	-	-	-	0,3%
2nd-3rd week of Oct.	treatment	sublimating oxalic acid				
1st week of November	natural mite drop count	1	1,2	0,3	0,3	0,5
November	treatment	dribbling oxalic acid product A	dribbling oxalic acid product B	dribbling oxalic acid product A	dribbling oxalic acid product B	
1st week of December	natural mite drop count	0,3	0,3	0,1	0,1	0,3
December	treatment	sublimating oxalic acid				
1st week of January	natural mite drop count	0	0	0	0	0,1

Discussion

When there is brood in the hive 65% of the mite population (55% in worker and 10% in drone) are in the sealed brood at any time (Martin, 1998). Generally in Hungary once the conditions are appropriate for rearing brood in the end of the winter it will last until the beginning of the next winter. In 2013 after a short mild end of winter a very long cold spring period caused a break period in brood rearing in most of the colonies. The general low infestation levels in the first monitoring result verify that in this interval a major proportion of the varroa population may have been perished as well with the brood that caught cold. Most of the treatment materials what were used are only affecting the phoretic mites and does not harm mites in the brood. It follows that these treatments work best on colonies that are broodless at the time of treatment. Therefore due to season, we were planning to shaking swarms, or making mating nucs for making broodless stages for the period of treatment during the brood season. However the environmental conditions were not optimal in 2013 weather. The timing of the untreated colonies exceeding the threshold levels in August indicated that at least at this time treatment was already too late to keep off economic injury. By the time the untreated colonies exceeded the threshold levels in principle at this time of the year the main honey flows are harvested already and in the rest of the season winterising is being done. The difference between the bees' tolerance for FA devices may have been caused of the evaporation intensity, what is confirmed by the feedback from the beekeepers that the gel pack had allot stronger scathing smell. However the losses of frame betweens were about the same because the barred cage devices were fixed in combles empty frames. The fall treatments period was overlapping the period of the natural brood shrinking when more bees are emerging than brood being capped. This probably caused a bigger ratio of phoretic mites of the total mite population in the colony, what was verified by the direct mite drops caused by the treatments. The end of 2013 December and 2014 January was so mild, that most colonies were having capped brood in January monitoring. This may let one suggest that the zero mite drops does not mean the disappearance of varroa population in the colony since the winter survivor were hiding brood already. Hungarian on-farm research program for varroa control in organic beekeeping is still continuing in 2014 where monitoring count will be made more frequent including direct mite drops. Other OA sublimating instruments and FA evaporating instruments will be tested.

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Alternative Development on the Organic Sector Horizon Community Supported Agriculture in Hungary

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Key words: Community Supported Agriculture, alternative food network, direct marketing, Hungary, organic, rural enterprise

Abstract

In this paper we first introduce Community Supported Agriculture (CSA) as an emerging international movement and special form of direct marketing. We then describe the major characteristics of the farm enterprises following CSA practices in Hungary, define two different emerging models, and provide qualitative and quantitative analysis using descriptive statistics. In the 'Share' model, members pay in advance, commit for several months or the entire season and payment is not for the actual produce but considered as membership fee. In the 'Vegetable box' model where there is no signed commitment between producer and consumer, or any verbally agreed on membership. Using interviews, participant observation and data from stakeholder meetings, the paper evaluates Hungarian CSA farms as successful, small-scale mixed horticultural enterprises following organic production practices with innovative communication channels. The CSA segment is very new in the country. Time is needed for the ongoing enterprises to develop routines and for new CSA farms to emerge in order to conduct further investigation providing a more robust country description.

Introduction

Community Supported Agriculture (CSA) gained increasing attention and experienced rapid growth in the US and Western Europe over the past 25 years as a special form of direct marketing where producers and consumers form a connection based on mutual trust, openness, shared risk and shared rewards. This arrangement can be good for the producers as they develop a direct and long-term relationship with their consumers, and can possibly concentrate their efforts on growing high-quality produce. CSA can be good for consumers who may become members of the farm as they can be sure of where their food is coming from and can get to know more about how it has been produced. CSA can also be good for the environment, because when producers and consumers of food get together they realize that food security is assured when farming methods are environmentally sound (Vadovics and Hayes 2010).

Material and methods

Literature review, analysis of secondary data and policy documents provided the foundation for the research. The field component of the study employed participant observations and in-depth interviews with all the farmers managing farmer-led Hungarian CSA farms in the year we collected our data. In 2012 we found 10 CSA operations in Hungary, so our study extended to all stakeholders of the segment. Because of the very small sample size we did not use statistical methods for our analyses.

Results and Discussion

Basic characteristics of CSA farms

All of the Hungarian operations are new in terms of their CSA trade. The "oldest," started in 2010 and three farms just began in 2013, so all have started in the last few years. These CSAs have been operating for 2.5 years on average. Three of the ten operations started using CSA practices from inception. Two experienced organic farmers had long-term experience in "CSA-like" programs prior to the start of their current enterprises. Each studied farm employs ecological production practices and seven of the ten (70%) are organically certified. The area of cropland under production for the farms ranges from 0.2 ha at the smallest to 10 ha for the largest. In the share-model systems where production is only distributed to shareholders, most of the farmland is used for vegetable production. The average current membership/number of box deliveries was 38 (N=10) as of March 2013 and ranges from five to 80. For all of the initiatives having at least

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one year of history, most of members/frequent customers have continued and most operations show an increase in membership.

Typology

From the CSAs in Table 1. five are producer-led (50%), there are three producer-community partnerships (30%) and two are managed by non-governmental organizations (an association and a non-profit company). In these latter cases neither the growers nor the members play an active role in the design, implementation and management of the scheme, the major duties are done by the management of the organization. Five of the ten (50%) initiatives described follow the 'Share model', three (30%) follow the 'Vegetable box scheme model' and two initiatives are too new to provide data on marketing practices. The five initiatives in the first category obtain their farm income either solely or primarily from CSA.

In the Hungarian implementation of the '*Share model',* members pay in advance (prior months, half season or season), payment is not for the produce but considered as membership fee, there is mutually signed contract, which presumes a season or half-season long commitment. For the 'Share model' farms, CSA is the only product outlet and the weekly boxes are standardized with no or minimal option to fulfil individual desires through customization. In the '*Vegetable box model',* there is no signed commitment between producer and consumer, nor any ratified or verbally agreed on membership. The boxes may or may not be standardized, individual orders may be met and the operation has other market outlets (farmers' market, home delivery service, etc.)

Operation/ Initiative Name	Start Year	Type	Initiator & Management	Crop-land (ha)	Pick Up Points Location	Trans-portation distance of shares (km)	share no.
Évkerék Ökotanya	2011	Share Model	Producer	7	Szeged, Budapest deliveries discontinued	38	50
Biokert	2011	Share Model	Producer	5	Göd, Pomáz, Budapest	19	60
Szeles Kert	2011	Box scheme	community-producer partnership	7	Miskolc	47	26
Három Kaptár	2011	Share Model	Producer	1,5	Vác, Szentendre Budapest	16	80
Naspolya Farm	2012	Box scheme	community-producer partnership	4	Budapest	53	25-30
Öko-társulás	2010	Share Model	Non-profit	10	Budapest	100	60
Privát Lecsó	2012	Share Model	Non-profit	1,5	Budapest	75	25-35
Organikus Ökosziget	2013	?	Producer	1,25	Budapest	40	20
Czina-Payr Farm	2013	?	Producer	0,2	Mosonma-gyaróvár	12	5
Birs Közösség	2013	Box scheme	community-producer partnership	3	Budapest	116	23

Table 1. Basic data on CSA operations identified as of Spring 2013

Distinctive characteristics of CSA farmers

We compared and analysed the management practices of Hungarian CSAs based on typical success factors following literature on small farm success (Gilbert et al. 2003; Oberholtzer 2004). According to our analysis, CSA practices in Hungary include a number of strategies that create small farm success. All Hungarian CSAs produce mainly or solely a high diversity of high value specialty crops which they market entirely at the local or regional level. They all adapted to local conditions in terms of their marketing and engagement approach to their customer. The farmers have an open and inclusive attitude and tend to be enthusiastic and active in experimentation and building relationships with other stakeholders of their local or regional food web. All of them are committed to farming and consider it a lifestyle they highly appreciate. Hungarian CSA farmers are innovative when implementing CSA models in the country, use novel communication channels and develop communication methods which were not used before among Hungarian producers to reach out to their consumer base.

Conclusions

The demand for locally grown organic produce in urban areas reveals concerns for local, small scale organic agriculture, farmland preservation, and open space (Jarosz 2000), and can fuel the already started transformation of the food system in Hungary. All studied CSA operations have increasing numbers of customers or members, and since the demand for locally produced food is new and anticipated to increase as more sustainable consumption routines emerge, expansion of the CSA sector seems likely in the country. Although the Hungarian CSA sector is small in size, it proves to be a notable agency to popularize alternative food networks. The result of the study confirmed that CSA can be identified as a successful rural business strategy for innovative organic farmers and has transformative potential for food-system localization, providing decent livelihood, good care of natural resources and strengthening, and social cohesion within the rural-urban interfaces.

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Comparison of species-rich cover crops mixtures in Hungarian vineyards

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Key words: cover crop, grapevine, erosion, species-rich, steep slope vineyard

Abstract

Cultivation in steep slope vineyards can endanger the soil. Moreover, because the climate change we can anticipate extreme weather conditions, like heavy rainstorms. In the past few decades, vine growers and botanical experts have renewed efforts to improve floor management of the inter-row and under vine floors. In the Hungarian vineyards, the threat of the low annual precipitation combined with potential and actual periodic heavy rains is a great concern. Commercially available seed mixtures for covering threatened soils are criticized for their non-native species content, foreign sourcing of some seed, and height of the vegetation. The goal of on-farm trials started in 2012 was to investigate three cover crop seed mixtures (Biocont-Ecovin mixture, mixture of legumes, mixture of grasses and herbs) in vineyards of the Tokaj and Szekszárd wine regions of Hungary. Each mixture was sown on three consecutive inter-rows at 10 experimental sites. Besides botanical measurements, yield, must quality, and pruning weight was studied for each seed mixture at each site. Prevalence of weed species was much lower in the sown inter-rows than in the control inter-rows regardless of seed mixture used. Total plant coverage in the sown inter-rows exceeded 80% for two trials in 2012. Experimental sites where control blocks had the weed flora mown in every inter-row showed increased, but not significant, yield than was measured in some blocks using cover crops. However, in cases where every second inter-row of the control blocks were mechanical cultivated and inter-rows mown, higher yields were measured, but again the difference was not significant. The much higher total plant cover for the seeded inter-rows than observed in the control blocks is promising for erosion control, but in a drier climate and with unirrigated vineyards, sowing every second inter-row appears more optimal provided erosion control is not required.

Introduction

Sustainable floor management has played an important role in viticulture recently. Intensive agricultural practices of past decades - like mechanical cultivation on steep slope vineyards - endanger the vineyards. Suboptimal inter-row and undervine floor management, especially coupled with extreme weather conditions can lead to heavy soil degradation. In addition, because of climate change we anticipate heavier rainstorms, which can accelerate degradation of the soil. In Hungarian viticulture, preservation of soil moisture is extremely important because of the low amount of annual precipitation (sometimes less than 500 mm per year) and evapotranspiration from June to August is typically higher than precipitation (Bauer et al., 2004). Therefore, the use of cover crops in the inter-row can be beneficial, particularly on steep slopes and in case of organic farming to provide environmentally friendly soil management. One of the most often used soil management methods in the vineyards of Hungary is mechanical cultivation. But when this is used too often or inadequately, several negative effects can be observed: dry soil caused by increased evapotranspiration, deteriorating soil structure, increased erosion and nutrient losses (Bauer et al., 2004; Aljibury and Christensen, 1972; Dijck et al., 2002). Continuous mechanical soil management can also lead to topsoil and subsoil compaction from long-term traffic (Ferrero et al., 2005; Zanathy, 2006). For soil covering, several materials (e.g. straw, reed, sedge) or cover crops can be used. The species-rich cover crop mixture helps to not only to prevent erosion and provide easier of cultivation, but has a positive effect on soil structure, soil fertility and ecosystem functioning. The growth of the roots is influenced by soil structure, so the growth of the grapevine is also influenced by compaction and soil moisture (Wheaton et al., 2008). Requirements for a suitable cover crop species are as follows: it should save the soil from erosion and compaction caused by the movement of workers and machines and it should not compete significantly with the grapevines. In addition of these parameters, the optimal mixture contains local species from local provenance.

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Material and methods

In the spring of 2012 we began to develop and test several species-rich cover crop mixtures. The experiment was set up in the Tokaj and Szekszárd (Northeast, and Southwest-Hungary) wine regions. Botanical surveys were performed in the years 2012 and 2013. The investigated varieties of vines were 'Furmint', and 'Hárslevelű' (Tokaj wine region) and 'Kékfrankos' (Szekszárd wine region). During the experiments, three species-rich cover crop mixtures (Biocont-Ecovin mixture, Legume mixture, Grass-herb mixture) were compared in the vineyards. Each mixture was sown in three inter-rows (adjacent to each other) at each place of the experiment. We investigated five blocks per treatment (five vines in one block). Besides botanical measurements, grape yield, must quality, and pruning weight was studied in every treatment. The experimenets were located in slope areas where prevention of erosion is especially important. Another aim was to study which kind of native plants are optimal to cover the inter-rows instead of mechanical cultivation for our climate.

Results

The results showed that out of the sown species *Centaurea cyanus*, *Lotus corniculatus*, *Medicago lupulina*, *Onobrychiis viciifolia*, *Plantago lanceolata*, *Trifolium pretense*, *Trifolium repens* and *Vicia sativa* established during the two years long period in the inter-rows, coverage of weed species was much lower in the sown inter-rows regardless of sown seed mixture than in the control inter-rows (Table 1).

Table 1. The coverage (%) of the weed species in the years of 2012 and 2013

	Biocont-Ecowin		Legume mixture		Grass-herb mixture		Control	
	2012	2013	2012	2013	2012	2013	2012	2013
Gróf Degenfeld	55,6	63,5	84,1	35,2	48,2	16,9	105,9	96,7
Illyés Kúria	7,5	18,7	19,9	13,5	16,7	9,9	74,0	76,9
Tokaj-Oremus / Budaházi	2,6	0,6	49,1	1,7	19,8	0,1	100,2	94,7
Tringa Borpince	25,3	27,8	53,1	2,5	56,0	9,5	87,0	110,4

Total plant coverage in the sown inter-rows exceeded just over 80% in two trials already in 2012 (Table 2). The much higher total plant cover than seen in the control for the sown inter-rows is promising for erosion control.

Table 2. Total plant coverage (%) of the inter-rows in the years of 2012 and 2013

	Biocont-Ecowin		Legume mixture		Grass-herb mixture		Control	
	2012	2013	2012	2013	2012	2013	2012	2013
Gróf Degenfeld	69,0	88,6	69,0	96,6	80,6	94,0	44,4	77,0
Illyés Kúria	49,4	85,4	63,0	90,6	86,0	88,0	14,0	68,0
Tokaj-Oremus / Budaházi	37,0	86,0	39,6	87,0	58,6	62,0	11,0	46,0
Tringa Borpince	30,0	96,6	46,0	97,6	46,0	95,6	42,0	73,4

Experimental sites where controll blocks in every inter-row had the weed flora mown, higher yield – but not significantly – was seen in some blocks using cover crops (Figure 3). However, Figure 4. shows higher yield of the experiment sites in cases where every second inter-row of the conroll blocks was mechanical cultivated, combined with mown inter-rows. The difference was not significant. In our drier climate, and in unirrigated vineyards, sowing every second inter-row appears more optimal provided erosion control is not required. Abnormal circumstances in the soil, for example lack of water, may cause stress to the plants, which negatively influences both growth and yield (Fardossi, 2002).

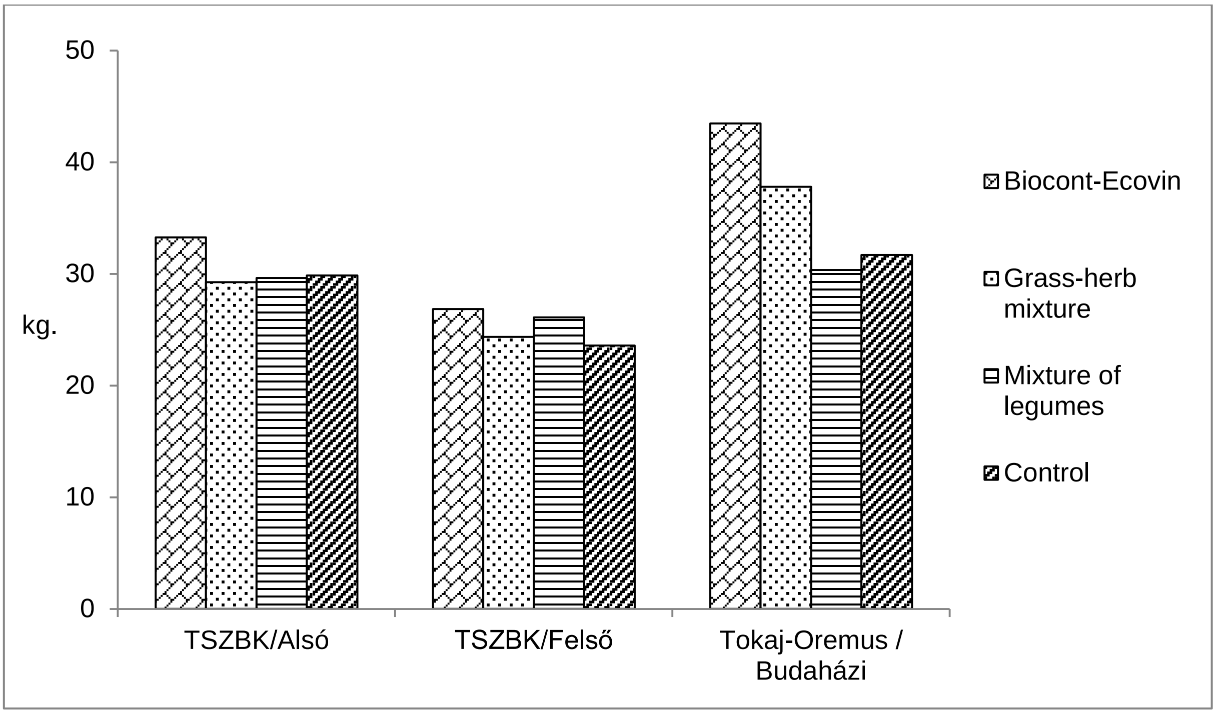

Figure 3. Yield of 25 grapevines in case of every treatment in the year of 2012

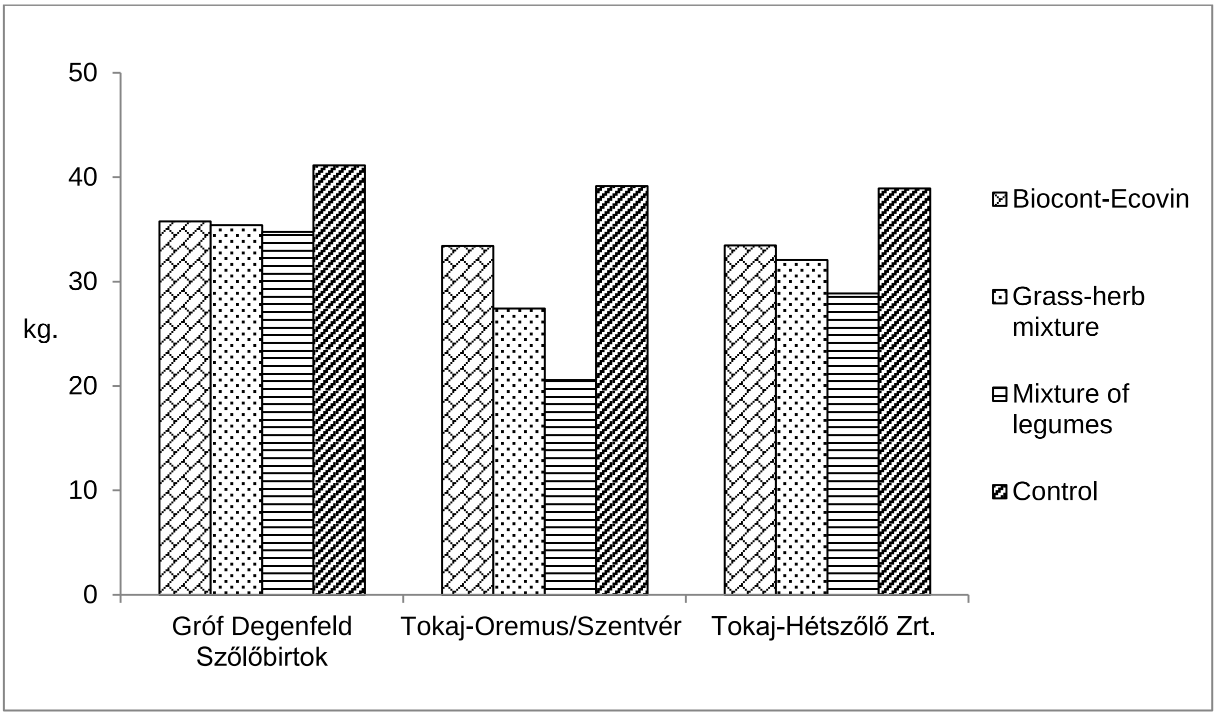

Figure 4. Yield of 25 grapevines in case of every treatment in the year of 2012

Discussion

Vine growers showed high interest in the importance of this practice, thus we involved other wine regions of Hungary in the experiment in 2013. A lack of water leads to a decrease in photosynthetic activity, which causes less vigorous vegetative growth, lower yield and lower grape quality (Azevedo et al., 2008; Escalona et al., 2003). That is why we have to compose optimal mixtures and explore management technology, to avoid water stress, but also to save the soil from degradation. The results of our experience can help the Hungarian vine growers to choose optimal cover crop mixtures in their vineyards, depending on the age of the grapevines, and in consideration of edafic and climate conditions.

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Rapid treatment monitoring by field spectroscopy

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Key words: field spectroscopy, foliar fertilization, remote sensing, rapid diagnostics

Abstract

Remote sensing has been widely used for farming applications. Historically satellites dominate this technique. Terrestrial platforms can carry spectral sensors as well enabling real-time estimations for crop yield, pest and disease occurrence and much more. Field spectroscopy is a technique that can provide biochemical measurements without wet chemistry using the solar spectrum and the reflectance spectrum of an object. An imaging spectrometer can provide physiological information with a ground pixel size of a few centimeters. This tool can help organic farming researchers and farmers better understand the biochemical components of their fields without any destructive analysis. The availability of such field techniques and the growing interest in food quality and field monitoring have speeded up the technology transfer process. This paper gives a short overview of techniques and presents an ongoing research for the rapid monitoring of organic foliar fertilizer treatments.

Introduction

This paper presents an ongoing research and technological perspective on applying high- and low-resolution field spectroscopy for the rapid monitoring of grain quality (protein) of fertilized organic spelt. We used two field spectrometers, the Minolta SPAD 502 Chlorophyll Meter that is a small hand-held spectrometer which measures light at 650 and 940 nm absorbed by single leaves and gives a non-destructive estimate of plant Chl and Nitrogen (N) status and the FieldSpec® 4 Wide-Res spectrometer (ASD/Panalytical) with a spectral resolution of 3 nm and 30 nm between 400 and 2500 nm (2151 spectral channels).

The wavelengths of SPAD Meter (650 nm, 940 nm) were selected to calculate vegetation indices that were reported to be suitable for grain protein estimation. We followed a hybrid model because the SPAD measurements were made on in-season canopy leaves and the FieldSpec measurements on grains in laboratory. The grain protein content was compared to SPAD and FieldSpec measurements in case of four foliar fertilizers for two different farms in Hungary.

Material and methods

Vegetation indices are significant indicators for agriculture activities. The NDVI (Normalized Difference Vegetation Index) has been successfully used in the last four decades (Rouse at el. 1973).Traditional vegetation indices are calculated from two relatively broad (100 nm) spectral bands. Imaging systems offered new perspectives and methodological approaches for precision farming in Hungary (Fekete et al. 2004, Baranyai and Firtha 1997, Láng et al. 2000,Felföldi et al. 2001, Tamás 2001, Németh et al. 2004, Jung et al. 2006). We calculated the following vegetation indices: Normalized Difference Vegetation Index (NDVI, Rouse et al. 1973), Ratio Vegetation Index (RVI, Jordan 1969) and Difference Vegetation Index (DVI, Tucker 1979)

In 2013 on-farm field experiments have been started on different organic fields in Hungary to evaluate the effect of natural foliar fertilizer applications on spelt crop quality and yield. Four combinations of foliar applications and a control field were compared in order to monitor the efficacy of the treatments. Products used in the experiments are all substances intended to increase grain yields and quality and are available in trade. The following parameters were analyzed: grain quality (protein-, gluten-, moisture content and falling number), and foliar SPAD chlorophyll content of treated and control plants. Chlorophyll concentration correlates with foliar N concentration which is often a limitation factor of crop productivity (Evans 1989, Yoder and Pettigrew-Crosby 1995). The aim of the SPAD measurements was to see if the leaf total chlorophyll content can be related to the grain quality, using the four foliar fertilization treatments. In some cases leaf greenness was influenced by the foliar fertilizer applications, but in most cases the treatments did not

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enhanced the postharvest quality of the crop. A direct connection between SPAD results and grain quality measurements could not be detected.

Field spectroscopy was conducted on one of the field trials, in order to test spectral information for crop quality differences between the four foliar treatments. The test measurement also allowed a comparison of the field remote sensing technique with the point measurements of SPAD.

Results

For statistical evaluation R.2.14.0 was applied. For measuring differences between group means and their associated procedures Anova and Tukey HSD post-test were applied. There was no significant difference between the grain quality of the treatments. Similarly, SPAD measurements of the treatments did not show significant difference. Moreover, correlation could not be detected between SPAD data and grain protein content.

Based on the concept that the field spectrometer can provide the same wavelengths that the SPAD meter uses, two wavelengths (650 nm, 940 nm) were selected to calculate vegetation indices. The results of Apan et al. (2006) say that the most significant spectral bands for grain protein prediction (measured in in-season canopy), in descending order are: 710-754nm, 890-960nm, 1020-1055nm, 662-680nm, 545-580nm, and few wavelengths in the SWIR (over 1000 nm).

We followed a hybrid model because the SPAD measurements were made in in-season canopy as well and the region of 662-680nm and 890-960nm fit best to the spectral sensibility of SPAD. Comparing the values of vegetation indices and protein contents it can be observed that the three indices do not show common tendencies with the protein measurements.

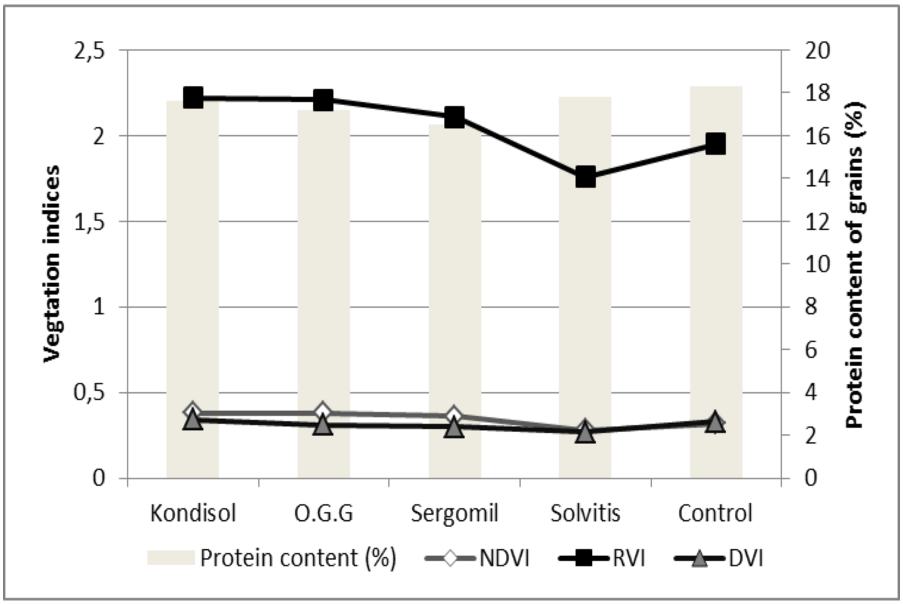

Fig.1. Comparison of the vegetation indices with the average protein content of grains in Csárdaszállás, Hungary.

Conclusions

Based on present statistical data there is no reason to assume that significant grain quality differences occurred between foliar fertilizer treatments. Further measurements are needed to verify preliminary data. Spectral nutrient analyses need to be compared to wet chemistry results. The preliminary results presented here suggest that field spectroscopy might have a good potential for the rapid analysis of crop quality. However, it is necessary to test both point and image spectrometry further. Using proximal sensing, we will continue to compare the spectral information of red-edge parameters with SPAD measurement and grain quality measures in order to detect plant Chl content and forecast crop quality in real-time under organic farming conditions. For developing sound models of organic foliar fertilizers' effects on organic spelt quality we need more SPAD- and grain quality measurements. Our aim is to proceed with the trials in order to introduce remote sensing techniques into the forecasting of organic crop quality.

Acknowledgements

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Effect of different ecological environments on organic cultivated SoyBean (*Glycine max (L.) Merril*.)

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Key words: soy bean, ecological factors, organic, yield elements

Abstract

Organic soy production-particularly for feedstock in organic animal husbandry is needed in Hungary as well as the rest of the EU. The crop area in Hungary devoted to soybeans has increased to almost 40.000 hectares. In 2012 organic cultivatation accounted for 491 hectares. For this research, we analysed the effects of ecological environment on yield potential factors. The greatest difference was seen in plant height and the number of pods per plant in the area receiving the lowest rainfall during the growth period. The nodes numbers were also impacted. Little difference was seen between varieties in droughty conditions while at the test site experiencing the highest precipitation, significant differences were observed. There was a strong positive correlation between the times of the flowering and the plant height and between the plant height and the number of pods.

Introduction

In recent years different protein sources have gained importance. Crop cultivation plays an important role in meeting the demand for many of these. In order to improve the quantity and the quality of yields; we must acquire a complex ecological attitude and exercise a more rational use of natural resources. To succeed requires favourable material, technical and social circumstances. The exploitation of genetic capability – as a form of renewable resource – is a fundamental method for increasing yields. To do this we must harmonize the biological needs of the given variety, its ecological attributes, with the circumstances of its cultivation.

Today, the soybean is one of the most important plant sources of protein and vegetable fats (Balikó et al. 2005). In the past decade the crop area in Hungary devoted to soybeans has increased to almost 40,000 hectares. In 2012 organic cultivatation accounted for 491 hectares. Organic soy production for feedstock in organic animal husbandry is needed in Hungary as well as the rest of the EU. Current production in Hungary is just 10 % of the market demand. In Hungary the 2-2.2 t/ha average yield appears to be static for the time being (Kurnik and Szabó 1987). According to Delate et al. 2008, over nine years of comparison, there was no significant difference in corn or soybean yields in the organic and conventional systems. The main reason for this appears to be related to variable weather conditions, most Hungarian soy production occurs under rained conditions. Unpredictable weather tests the genetic makeup of different varieties showing high amounts of variation under stressed conditions.

Soy is an excellent preparatory crop. It improves soil structure and leaves considerable nitrogen in the soil from residues for the following crop (Walter and Samuel 1980, Marcus-Wyner and Rain1983, Márton et al. 1990, Németh 1995). Soy is also a reliable crop, tolerant of temporary water excess and slightly tolerant to cold post establishment, but the symbiotic bacterium (Bradyrhizobium japonicum) need sufficient soil temperature to colonize root nodules (Zimmer et al. 2012).

Soy is demanding crop that responds well to physical and chemical soil improvement. The grain of present-day varieties contains on average 40-43% protein and 21% oil in by dry matter weight. For this research, we analysed the effects of ecological environment on yield potential factors of soybeans planted in Hungary.

Material and methods

In my work, I oversaw and summarized the research conducted at ÖMKI on-farm research sites in 2013. The objective of the research was to determine, via the examination of trials in different areas, the biotic and abiotic stress-factors that effect organic soybean yields with special attention to the traditional production regions and determine the specific varieties of soybean which favour these areas.

During the trial period, we recorded weather conditions, the time of flowering, the average number the pods per plant, the average number of seed per pod, the average number of branches per plant, the average plant heights, and relying on these we can state that there were significant differences. In the vegetation period of growth I surveyed the standing crop and compared the collected data on yield influencing characteristics

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using a statistical functions in Excel. I further explored their relationships to predicted norms for the trial sites. These data collected during the growth period will be combined with harvested yield data to determine the potential of varieties in specific agro ecological conditions.
The location of the research site

The observations were carried out at the 3 organic soybean farms. 2 research sites were in the west part of Hungary (Győrsövényház, Tornyiszentmiklós) and 1 research sites were located in the east (Földes). The soil of the research sites have different characteristics with relatively deep but poorly drained soils in the east and shallow soils with less water holding capacity in the west.
Beside soil conditions, profitable cultivation of soybeans depends on temperature, the amount of rainfall, and humidity during the period of flowering. In Hungary, the environmental conditions for soybeans are generally good during the vegetation period with ample time between frosty days of autumn and spring. Recently however, rainfall has been lower that the optimal 160-180 mm in summer.
In 2013, the period of this research, there was a long draught period between 15 June and 10 August. Precipitation ranged from 10-110 mm in the experiment areas, with the driest area in the northwest of Hungary, Győrsövényháza. Highest precipitation was observed in Tornyiszentmiklós, see Figure 1.

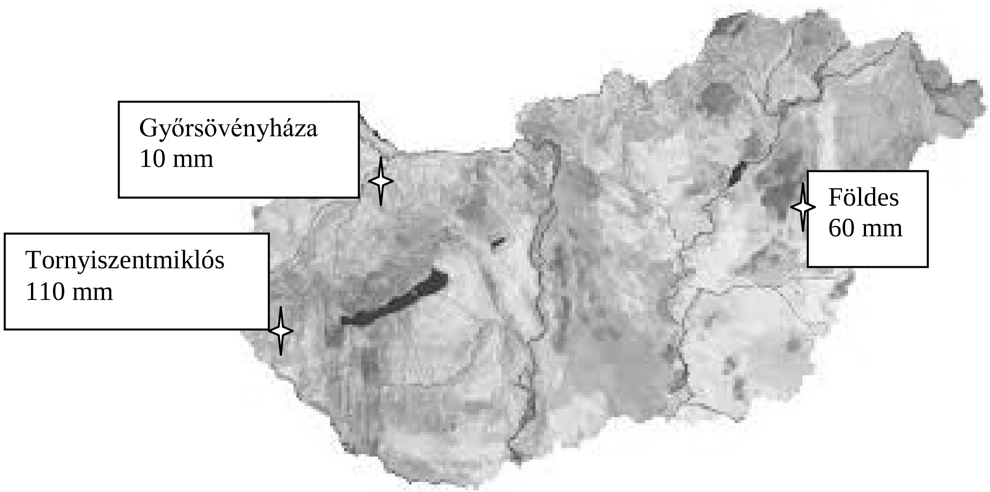

Figure 1: Precipitation in research area (15. 06 - 10. 08. 2013)

The circumstances of the research

Growing conditions varied (sowing time, sowing distance, row cultivation) at the different research sites (Table 1). On-farm research is intended to sample results from normal operation, so farmers were allowed to practice their standard production, see Table 1. In my work, I oversaw and summarized the research conducted at ÖMKI on-farm research sites in 2013. The objective of the research was to determine, via the examination of trials in different areas, the biotic and abiotic stress-factors that effect organic soybean yields with special attention to the traditional production regions and determine the specific varieties of soybean which favour these areas. During the trial period, we recorded weather conditions, the time of flowering, the average number the pods per plant, the average number of seed per pod, the average number of branches per plant, the average plant heights, and relying on these we can state that there were significant differences. In the vegetation period of growth I surveyed the standing crop and compared the collected data on yield influencing characteristics using a statistical functions in Excel –correlation with method of Pearson (Sváb 1981). I further explored their relationships to predicted norms for the trial sites. These data collected during the growth period will be combined with harvested yield data to determine the potential of varieties in specific agro ecological conditions.

Table 1: Growing system parameters in 2013

Research area	Földes	Győrsövényháza	Tornyiszentmiklós
Humus content of soil (%)	2.2	2	1.9
Previous crop	maize	buckwheat	winter wheat
Row spacing (m)	0.76	0.50	0.76

Results

Table 2: The average phenological parameters of soybean *(Glycine max (L.) Merril)* varieties (2013)

Variety	Length of flowering (days)	Plant high (cm)	Diverg. Nr.	Pods/plant Nr.	Seed/pods Nr.	Nodes/plant Nr.	1st pod h. (cm)
Győrsövényháza							
1*	34	50	0	5	2,2	7	6
2**	31	43	0.5	7	1,8	6	6
3***	31	55	1.5	6	1,6	9	9
4****	34	63	1.2	7	2,8	10	6
Mean	**33**	**52.8**	**0.8**	**6.3**	**2.1**	**8**	**8.6**
Tornyiszentmiklós							
1*	43	92	1.5	32	2,8	12	10
2**	40	75	0.5	14	2,4	13	9
3***	39	73	1.5	15	2,2	13	7
4****	48	95	1.2	26	2,8	12	11
Mean	**43**	**83.8**	**1.2**	**21.8**	**2.6**	**12.5**	**9.3**
Földes							
1*	51	100	1	35	2,9	14	8
2**	51	75	3	32	2,5	11	6.5
3***	51	85	4	32	2,3	12	8.5
4****	55	72	1	24	2,8	10	10
Mean	**52**	**83**	**2.3**	**30.8**	**2.6**	**11.8**	**8.3**

* Pannónia Kincse, ** Royalpro, *** Hipro 15, **** Isidor

The results of observations reveal that ecological factors can fundamentally influence the yield factors of soy bean as much or more than cultural factors. The greatest difference was seen in plant height (mean of 52.8 vs. 83.8 cm) and the number of pods per plant (mean of 6.3 vs. 30.8 pods per plant, see Table 2.) in the area receiving the lowest rainfall during the growth period. The nodes numbers were also impacted.

Little difference was seen between varieties in droughty conditions while at the test site experiencing the highest precipitation, significant differences were observed.

There was positive correlation (significant at $P<0.05$) between the times of the flowering and the plant height ($r=0.7506$) and between the plant height and the number of pods ($r=0.8703$, significant at *$P<0.01$)). A positive correlation was found only in Tornyiszentrmiklós between the number of pods and yield ($r=0.8332$)*.

Discussion

In 2013, the yield was highly variable (Tornyiszentrmiklós: 1800 - 3492 kg ha $^{-1}$, Foldes: 1300 -1800 kg ha $^{-1}$, Győrsövényháza not evaluable- due to the dry growing season the seeds have not been able to develop), so the effect of the studied parameters on yields requires further analysis.

The different conditions in different geographical areas may influence yields decisively: however, they influence specific varieties in a different manner: yields were of Pannónia Kincse: 1400-3492 kg ha $^{-1}$, of Hypro 15 1800-2005 kg ha $^{-1}$:

Water stress has a primary role in determining the flowering period (difference was 19 day between the areas for the mean length of flowering) and in shaping of yield-elements (pods/plants and seed/pod were reduced by drought stress effect too. Favourable soil conditions however enable soybeans to utilize the rainfall from before the vegetation period so that high yields could be achieved even with less precipitation during the vegetation period.

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On-farm examination of resistant early and maincrop potato varieties in Hungarian organic farming

ORSOLYA PAPP[1]

Key words: on-farm research, potato, organic farming, variety testing

Abstract

The Hungarian organic potato growers mainly relied on well-known conventional varieties under their organic cultivation, but these varieties are not always best suited for organic farming. Therefore, ÖMKi initiated a participatory research to test resistant potato varieties. Six Hungarian bred, disease resistant varieties were tested in 2012: Balatoni Rózsa, Démon, Hópehely, Katica, Vénusz Gold, White Lady, Desirée (as control). The best qualitative and quantitative performers, Balatoni Rózsa, Démon and Hópehely, were retested in 2013.

Overall conclusion is that the tested potato varieties are competitive and promising for Hungarian organic farming. The yield and the quality assessments showed good or acceptable results. The results and experience presented that the acceptability of potato varieties is worth to examine in on-farm research methodology: through the research practical information was given for the participants and information flow as well as cooperation were increased.

Introduction

Conditions in organic farming bring other challenges to seedstock breeders than seen in conventional farming. The different way of fertilization and reliance on contact-effect pesticides demands more disease tolerant or resistant varieties. The Hungarian organic potato grower mainly relied on well-known conventional varieties under their organic cultivation, but these varieties are not always best suited for organic farming. Therefore ÖMKi initiated a participatory-research (Baldwin 2004) to test resistant potato varieties, improve production technology, and facilitate the cooperation among the farmers and the sector's other stakeholders like advisors and breeders. This participatory research began in 2012 and continues in 2013 on three different subjects. In this paper a selection of important data is presented.

Material and methods

12 certified organic farms joined the potato on-farm experimental network in the spring of 2012. Six, Hungarian bred, disease resistant varieties were tested in 2012: *Balatoni Rózsa, Démon, Hópehely, Katica, Vénusz Gold, White Lady* along with a control variety, *Desirée*. The participating farmers planted their tubers in April, the minimum size of the test plots was 12 m² for each variety. The individual farmers determined their own cultural methods. Quantitative and qualitative assessments were done after the harvest. The yield was measured in kg/m². Samples of 50 tubers were taken from each test plot of each variety. We performed a visual inspection of the tubers' surface: we recorded infection by *Streptomyces*, *Rhizoctonia*, *Fusarium*, *Erwinia*; severe damage by animals, *Agriotes* larvae, machines; and those deformed or greened (Hooker 1981). Other problems affecting the potatoes were not included in the study data collection (nematodes, *Phytophtora*, *Helminthosporium* or interior problems).

Nine certified organic farms participated in the early potato on-farm experimental network in the spring of 2013. Based on the results of 2012, the best qualitative and quantitative performer was *Balatoni Rózsa* and was used as a control for testing additional two early varieties: *Ila* and *Pannónia*.
Unfavorable weather spring conditions delayed planting of the three early species until April. After harvest, qualitative and quantitative analysis was performed in the same manner as with the 2012 trials.
Besides the early variety trials, maincrop varieties, *Hópehely* and *Démon* are also were retested because of last year's results, but processing of 2013 data has not been completed as of the writing of this paper.

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Results

Experiment of 2012

Average yields (kg/m²) of maincrop varieties in 2012 are presented in Table 1. Because of different growing conditions (different soils, irrigation methods and plant protecion) the trends should be analyzed rather than the finer details. Based on the results, most of the examined varieties show competitive yields when compared to the control. Two redpeel varieties, *Balatoni Rózsa* and *Katica* showed the best overall results.

Table 1: Average yields in maincrop potato on-farm experiment of 2012

Variety	Balatoni Rózsa	Démon	Hópehely	Katica	Vénusz Gold	White Lady	Desirée
Yield (kg/m²)	3,03	2,89	2,82	3,08	2,16	2,45	3,01

Figure 1. summarizes the variety specific quality assessment results in 2012. Among the redpeel varieties the early type *Balatoni Rózsa* and the maincrop type Démon were shown like to be least susceptible to six variety specific quality problems. In their case, the number of affected tubers in the samples -excluding *Streptomyces* symptoms- was below 2% on average.

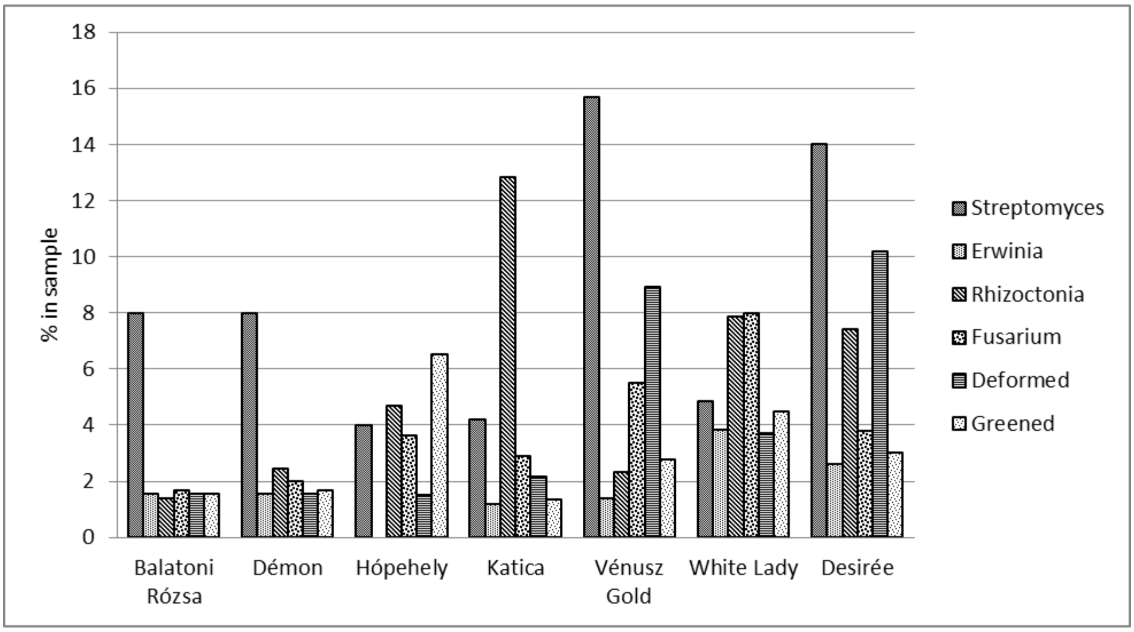

Figure 1. Variety specific results in the quality assessment; potato on-farm experiment of 2012.

At the end of growing season a survey was made among the participating farmers. Table 2. shows the overall judgement of farmers about each varieties' attributes on a scale of 1-5 (average of 9 datasheets). The farmers are most satisfied with *Balatoni Rózsa*, *Démon, Katica* and *Hópehely* varieties, but the taste of Desirée is still favorable.

Table 2: Overall judgement of farmers about tested varieties in 2012

	Cultivation and harvest attributes	Yield and tuber visual attributes	Consumption and taste attributes	Willingness to coming year's cultivation
Balatoni Rózsa	4,9	5,0	5,0	9 yes
Démon	4,3	4,4	4,2	7 yes
Hópehely	3,9	3,9	4,0	7 yes
Katica	4,4	4,0	4,2	6 yes
Vénusz Gold	3,6	2,9	3,3	5 yes
White Lady	3,9	3,2	4,0	4 yes
Desirée	3,8	2,9	4,4	3 yes

Experiment of 2013

Table 3. shows the average yield of early variety trials in 2013. Among the three varieties the *Balatoni Rózsa* showed the highest average weight.

Table 3: Average yields in early potato on-farm experiment of 2013

Variety	Balatoni Rózsa	Pannónia	Ila
Yield (kg/m²)	2,98	2,28	2,33

Figure 2. summarizes variety specific results in the early variety quality assessment for 2013. Looking at the six variety specific results, *Ila* performed the best, while control variety *Balatoni Rózsa* reached the second place. The *Streptomyces* symptom is still the most frequent problem, but in early growing conditions appear less infected tubers than in midseason growing (compared to 2012 data).

The participating farmers agree that repetition of the early variety trial is necessary in 2014 using a fleece covering. Based on field experiences, potatoes cultivated under the fleece covering redound earlier, producing larger yields with better tuber quality.

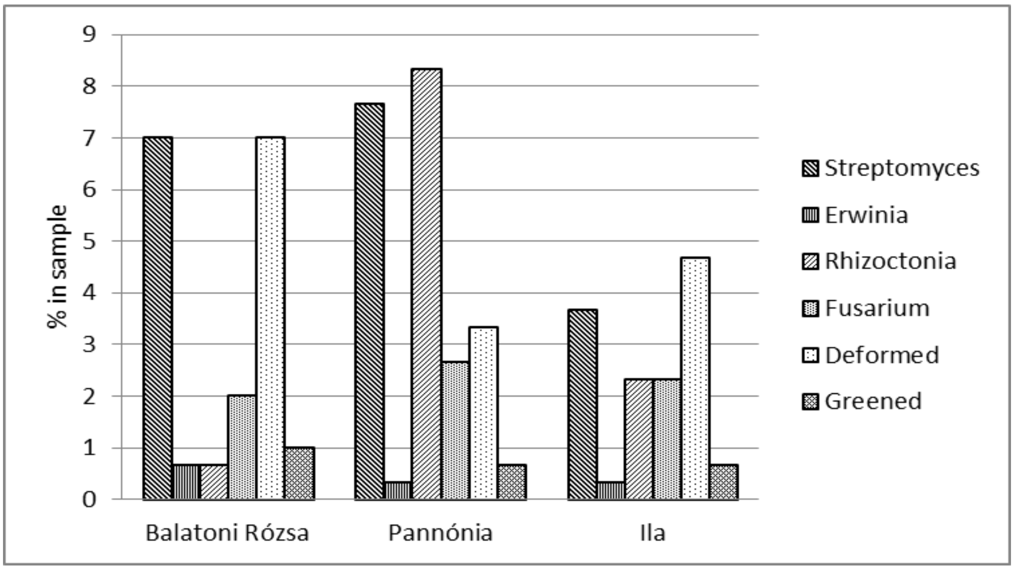

Figure 2: Early variety specific results in the quality assessment; potato on-farm experiment of 2013.

At the end of growing season same survey was made among the participating farmers as in 2012. Table 4. shows the overall judgement of farmers about each varieties' attributes on a scale of 1-5 (average of 11 datasheets). The farmers are most satisfied again with *Balatoni Rózsa*, but the yellow peeled Pannónia was also popular. In spite of good yield and taste attributes, just few of the farmers would grow Ila again because of its too many small tubers.

Table 4: Overall judgement of farmers about tested early varieties in 2013

	Cultivation and harvest attributes	Yield and tuber visual attributes	Consumption and taste attributes	Willingness to coming year's cultivation
Balatoni Rózsa	4,59	4,59	4,88	11 yes
Pannónia	4,14	4,09	4,13	9 yes
Ila	4,09	3,35	4,17	3 yes

Discussion

Overall conclusion is that the tested potato varieties are competitive compared to the control variety for Hungarian eco farming. Although hence of dry growing season the resistance against late blight could not be tested, the quality assessments showed good or acceptable results in case of variety specific quality results. The average yield was also good or acceptable in case of the most tested varieties, although the reachable maximum was mostly depending on the circumstances of each farm.

The experience proves that the acceptability of potato varieties is worth to examine in on-farm research methodology: results, received from different conditions and cultivation technologies, show the reachable characteristics of varieties in conditions of organic farming. Participants receive instant practical information through the on-farm participatory research. During the 2-years-program several meetings were organized, which have increased information flow and cooperation.

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Wild Collection and Cultivation of Native Species in Iceland

CORY WILLIAM WHITNEY[1], JENS GEBAUER[2], MOLLY ANDERSON[3]

Key words: Iceland, Ethnobotany, Cultural Importance, Conservation, *Angelica* spp.*, Betula* spp.

A full description of the following survey was published in Human Ecology in 2012 with the title *A Survey of Wild Collection and Cultivation of Indigenous Species in Iceland*.

Abstract

This paper outlines a survey of Icelanders who use native species of plants, lichen, fungi, and marine algae. It was found that some of the species (e.g. Angelica *spp. and* Betula *spp.) were very important. However, potential exists for a more diverse harvest and for sustainable management (e.g. Organic certification). It was also found that potential exists for the spreading of knowledge and the inherent associated conservation culture of native species use. The data also suggests that cultural conservation should focus on food, which appears to be paramount for increasing the cultural importance of a species.*

Introduction

Icelanders live in a fragile ecosystem still disturbed from the settlement period (*landnám*), which took place over 1,000 years ago. Icelanders have historically had a challenging relationship with their surrounding natural resources well documented in the sagas *Íslendingabókar* and *Landnámabók* (Benediktsson 1968). Forest resources were an essential part of life at *landnám*, for food and firewood to provide light, warmth, and the ability to cook and work metal. During *landnám* Vikings cut many of the forests and subsequent regeneration was largely impossible due to the rooting and grazing of livestock. This process of land-use change from forests to grazing lands has continued since *landnám* and, in many cases, has lead to serious soil degradation contributing to the spreading of basalt deserts (Arnalds *et al*. 2000). However, some conservation minded Icelanders are seeking new strategies for a healthy relationship with nature through sustainable use of native species.

Material & Methods

This work is based on surveys with this select group of Icelandic people (e.g. chefs, Organic farmers, gardeners, and herbalists) who use native species of plants, lichen, fungi and marine algae. Information was obtained through 67 in-depth interviews, participant observation (Prance et al. 1987; Kremen et al. 1998; Reyes-Garcia et al. 2006), walk-in-the-woods (Phillips and Gentry 1993a; 1993b), freelisting (Quinlan 2005), and a semi-structured questionnaire, in the summer of 2010. Key informants were sought through botanical and horticultural organizations[4]; other networks were also sought around the country[5]. The survey sought to determine the extent, composition and function of uses of plants, as well as fungi and marine algae, in the region.

The Study Area

Iceland is a mountainous, volcanic country of 103,300 square kilometers in the North Atlantic just south of the Arctic Circle. It has a sub-polar oceanic climate near the coast and tundra inland in the highlands, with a mild coastal climate. The island is of volcanic origin and makes up part of the North Atlantic basalt area, with nutrient poor, thin and easily eroded soils; three quarters of Iceland is covered by black basalt desert. This small island nation is located in the Arctic province of the Circumboreal Region within tundra in the north and boreal region in the south; it is mostly treeless with grass, sedge and moss dominating habitable areas. There are approximately 500 native species of terrestrial plants in Iceland including 69 invasives, 1500 species of fungi and 500 species of marine algae.

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Results

The survey found 109 species from 79 genera, with 91 species of terrestrial plants, (including 11 species of trees, shrubs, herbs, and forbs), 10 species of fungi, 7 species of marine algae, and 1 species of lichen. All respondents collected some wild species, and nearly half grew native species in homegardens or commercially. Some of the respondents had Organic certification, horticultural society endorsement, or were part of a collective of growers.

Quantitative Indices

The Cultural Importance index (CI) (Tardio and Pardo-de-Santayana 2008) was used to account for the number of respondents and the diversity of uses per species (Table 1). CI index[6] indicates the sum of the proportion of informants that have an active use for the species. According to this measure the 21 most culturally significant species in the entire study area include ten species of terrestrial plants (including two tree species), one species of algae (*Ascophyllum nodosum* (L.) Le Jol.), one species of fungi (*Leccinum scabrum* Bull. ex Fr.), and one species of lichen (*Cetraria islandica* (L.) Ach.).

The species *Empetrum nigrum* L., known locally as *kraekiber*, was the most frequently cited species and was used almost exclusively for food (CI *E. nigrum*=0.667). The species *B. pubescens*, known locally as *birka*, was the most versatile species (CI *B. pubescens*=0.803). The young leaves are commonly collected in spring for tea; trees are often used for privacy and shade and on farms for shelterbelts and wind protection. The species mentioned by the most informants for the greatest number of uses was *Angelica archangelica* L., known locally as *ætihvönn* (CI *A. archangelica*=1.0). The seeds of *Angelica* spp. (including *A. archangelica* and *A. sylvestris*) are commonly used as a tea, as a spice, and as a medicine for bladder control; young leaves are often used in soups and salads. Some of these species were also certified by the local Organic certifier Vottunarstofan Tún and available for sale through local producers such as the Egilsstaðir Organic Farm.

Discussion & Conclusions

The respondents identified for this survey are unique in Iceland in their use of living natural resources in a landscape with greatly diminished biodiversity. Some of these useful species are of outstanding recognition such as *Angelica* spp., *Betula* spp., which could serve as cultural keystone species to aid in conservation efforts. Increasing the use of these native plants, fungi and marine algae could also help to raise awareness of Icelandic ecology and support conservation efforts.

This survey found that edibility and nutrition are paramount for cultural significance in Iceland. It also found a conservation mentality in the culture of native plant collection and use, which was apparent throughout the interviews. Respondents who use more native species also demonstrated an appreciation for, and conservation attitude toward, Icelandic biodiversity, this manifests as action *in situ* and politically. They take action in the field to remove problematic and invasive species and to promote useful species. They are aware of the impact of the collection and adjust their use according to the habitat where they are collecting (i.e. fewer species are taken from slow growing nutrient poor hillsides while harvesting is heavier near the more abundant stream and river areas). Furthermore, the use of native species gives rise to movements in Iceland such as Organic, Slow Food, and the New Nordic Kitchen, leading to conservation efforts by chefs, farmers and food enthusiasts around the region to both conserve and utilize native species for traditional and innovative uses. These may create new opportunities for the inclusion of lessons about native plant use and conservation in Icelandic school curricula. These social efforts contrast heavily with the dominant conservation activities in Iceland, which tend to be large scale and *ex situ* based (e.g. gene banks of the Iceland Forest Service and Nordic Council of Ministers).

[6] the maximum CI index score is equal to the 11 categories of use (Whitney et. al. 2012)

Table 1: Highest Ranking Species by the Cultural Importance Index (CI)

Botanical Name	CI index
Angelica archangelica L.	1
Betula pubescens Ehrh.	0.8
Empetrum nigrum L.	0.67
Thymus praecox Opiz subsp. *arcticus* (Durand) Jalas	0.62
Vaccinium uliginosum L.	0.56
Cetraria islandica (L.) Ach.	0.52
Vaccinium myrtillus L.	0.44
Achillea millefolium L.	0.41
Taraxacum officinale F.H. Wigg	0.35
Rumex acetosa L.	0.33
Angelica sylvestris L.	0.32
Betula nana L.	0.32
Rumex longifolius DC.	0.27
Filipendula ulmaria (L.) Maxim	0.21
Leccinum scabrum Bull. ex Fr.	0.2
Trifolium repens L.	0.2
Fragaria vesca L.	0.17
Ascophyllum nodosum (L.) Le Jol.	0.15
Juniperus communis L.	0.15
Oxycoccus microcarpus Turcz. ex Rupr.	0.15
Silene acaulis L. Jacq.	0.15

More research is necessary to determine the socio-economic and influences on CI index scores as well as the exact biodiversity implications of native species uses. Through analysis of the ecological distribution of utilized species as well as time and volume of harvest, quantitative methods could provide a clearer picture of the role that Icelandic people play in the conservation of native species and the role that local food and conservation movements can play in promoting this.

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Long term effect of organic sources of nutrients on productivity and soil health in maize+soybean—wheat+gram cropping system

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Key words: Organic, soil health, nutrients, vermicompost, manures and cropping system

Abstract

Recent approach to soil fertility management in India is shifting from the chemical management to organic agriculture, because of both ecological and economic concern. Maintaining the soil health ensures sustainability in crop productivity. Hence, a long term field experiment was conducted under rainfed conditions during 2006-07 to 2012-13 at CSK Himachal Pradesh Agricultural University, Palampur, India in maize/maize+soybean—wheat+gram cropping system in randomized block design with three replications. During conversion to organic i.e. for the first three years of study (2006-2008) the yields of maize were low, however, after third year of study i.e. from 2009-2012 the yields were improved. Similarly, in wheat+gram cropping system the wheat equivalent yields were low during 2006-07 and 2007-08 but thereafter, an impressive increase was observed due to the improvement of soil health in the form of nutrients and microbial status. Combined application of composts i.e. FYM, Himcompost (HC) & Vermicopmost (VC) (FYM + HC, VC + HC and FYM + VC), being at par with each other and with HC produced higher maize and wheat equivalent yields, gross & net returns and B:C ratio.

Introduction

Organic farming has emerged as an important priority area globally in view of growing demand for safe and healthy food which provides health and environmental benefits. The long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals call for use of organic farming practices in agriculture for maintaining soil health and crop productivity. Therefore, to study the effect of different composts on the productivity of crops and soil health in terms of nutrient and microbial status in maize/maize + soybean-wheat + gram cropping system, a long term field experiment was conducted at Model Organic Farm of CSK Himachal Pradesh Agricultural University, Palampur (H.P.), India

Materials and Methods

A long term field experiment was conducted under rainfed conditions during 2006-07 to 2012-13 having maize/maize+soybean in *kharif* and wheat + gram in *rabi* seasons at CSK Himachal Pradesh Agricultural University, Palampur (H.P.), India in randomized block design with three replications and seven treatments. From 2006 to 2008 only maize was taken during *kharif* season whereas, after that soybean was included as an intercrop in maize till *kharif* 2012. The treatments consisted of Farm Yard Manure (FYM 20 t/ha), Vermicompost (VC 15 t/ha), Himcompost (HC 5 t/ha), FYM + VC (10+10 t/ha), FYM+ HC (10+2 t/ha), VC + HC (10+1 t/ha) and control (FYM 5.0 t/ha) *w.e.f*. 2006 to 2008 in maize and 2006-07 to 2008-09 in wheat+gram. Himcompost is a compost, enriched with locally available biomass, cow dung, cow urine, oil seed cake, rock phosphate, gypsum, slaked lime, bone meal, ash, egg shell *etc*. However, the doses of the composts were reduced after 3rd year of experimentation *i.e.* after the conversion period in both the seasons and the treatments were slightly modified as FYM (15 t/ha), Vermicompost (VC 10 t/ha), Himcompost (HC 5 t/ha), FYM+VC (7.5+5.0 t/ha), FYM+HC (7.5+2.5 t/ha), VC+HC (5.0+2.5 t/ha) and control. Henceforth, these treatments will be given without their doses as Farm Yard Manure (FYM), Vermicompost (VC), Himcompost (HC), FYM+VC, FYM+HC and VC+HC.

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Results

Effect on yield

Maize grain equivalent yield

During the first three years of study *i.e*. 2006-2008, FYM+VC, FYM+HC and VC +HC being at par with each other produced significantly higher yields over their individual application. However, after third year there was no significant difference in the maize equivalent yields among the compost treatments whether, applied alone or in combination due to the improvement in nutrients and microbial status of the soil to the desired level in all the treatments. Similar results have also been reported by Johnson *et. al* (1995) who observed that the crop yields were increased by using animal manures due to the corresponding improvement in soil quality.

Table 1: Effect of treatments on maize grain equivalent yield during *kharif* seasons

Treatments	Maize grain equivalent yield (MEY q/ha)						
	During conversion			After conversion			
	2006	2007	2008	2009	2010	2011	2012
FYM	17.9	16.3	12.3	30.6	27.1	35.0	36.1
VC	17.3	16.9	13.4	34.4	31.8	35.5	36.7
HC	21.1	17.4	15.9	37.6	32.9	38.8	36.3
FYM+HC	28.1	28.6	19.8	33.8	33.6	39.0	36.5
VC+HC	25.2	29.9	17.1	35.7	33.8	37.4	38.2
FYM+VC	28.2	26.8	17.1	33.8	31.0	38.0	36.1
Control	13.7	8.2	9.5	27.9	22.1	31.2	33.5
CD (P=0.05)	3.9	5.4	3.5	3.8	3.6	3.5	3.1

Wheat grain equivalent yield

In general, the yield levels during the first two years of study *i.e*. 2006-07 and 2007-08 were lower and almost similar due to the poor soil health during conversion period and after that there was a continuous increase in the yields over the years till 2011-12. However, there was no further increase in yield in the ensuring years showing that the maximum yield levels were achieved under the present situation. During the first two years of study (2006-07 & 2007-08) the combined application of composts (FYM+HC, VC+HC and FYM+VC) produced significantly higher wheat equivalent yield over the treatments when the composts were applied alone however, after 2007-08 these treatments were reduced. During 2008-09 and 2009-10 there was no significant difference in yield among the compost treatments except FYM which produced significantly lower yields. However, during the last three years of study (2010-11 to 2012-13) there was no significant difference in the wheat equivalent yield in various compost treatments whether applied alone or in combination due to the buildup of nutrients and microbial status to a desired level in all the treatments.

Table 2: Effect of treatments on wheat grain equivalent yield during *rabi* seasons

Treatments	Wheat grain equivalent yield (WEY) (q/ha)						
	During conversion			After conversion			
	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
FYM	17.9	17.2	30.7	35.8	38.8	42.2	41.3
VC	18.2	18.8	36.0	39.7	39.0	42.1	43.8
HC	19.9	19.8	37.0	39.8	40.2	43.1	42.3
FYM+HC	29.4	28.5	38.1	40.2	41.9	43.9	42.2
VC+HC	23.5	25.1	37.5	39.8	42.0	44.9	43.7
FYM+VC	22.4	23.3	39.8	39.6	42.1	44.4	43.6
Control	14.4	16.5	23.5	30.5	32.8	36.6	40.8
CD (P=0.05)	2.8	3.5	4.2	3.2	2.8	3.7	4.2

System's maize grain equivalent yield and economics

The total maize grain equivalent yield of the system was statistically similar in all the compost treatments whether applied alone or in combination except FYM which produced significantly lower yields (Table 3). The use of organic manures in farming was also observed to be effective means of improving soil structure, enhancing soil fertility and increasing crop yields by Johnson *et.al.1*995 and Simnis *et.al.*1998). FYM being at par with VC gave significantly lowest gross returns, net returns and B:C ratio over other compost treatments. VC+HC, FYM+VC, FYM+HC and HC being at par with each other produced significantly higher gross & net returns and B:C ratio over the remaining treatments calculated on the basis of system maize equivalent yield.

Table 3: Effect of treatments on maize grain equivalent yield of the system and economics after the conversion period

Treatments	System's maize grain equivalent yield	Gross return (Rs)	Net return (Rs)	B:C ratio
FYM	79.63	155108	92108	1.46
VC	83.98	163399	97099	1.46
HC	86.02	167096	106096	1.74
FYM+HC	86.19	167628	105628	1.70
VC+HC	87.40	169968	106318	1.67
FYM+VC	85.64	166777	102077	1.60
Control	70.89	138070	79670	1.36
CD (P=0.05)	4.90	9872	6278	0.24

Effect on soil health

Fertility status

In the span of six years (2006-2012) maximum OC (%) was recorded in VC+FYM and FYM alone *i.e*. 1.10 and 1.02 percent, respectively which was about 77.4 and 64.5 percent higher than the initial status. Available nitrogen increased significantly from the initial status of 188.16 kg/ha to the maximum of 278.0, 276.4 and 272.4 kg/ha in the treatments *viz*. VC+FYM, HC and HC+FYM, respectively. There was about 58.7 to 68.0 percent increase in available phosphorus in different compost treatments as compared to the initial status. In general, the plots receiving FYM alone or in combinations resulted in higher available potassium as compared to the remaining treatments (Table 4).

Table 4: Effect of treatments on Soil fertility status

Treatments (Composts t/ha)	pH	OC (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
FYM	5.82	1.02	269.4	15.6	288.4
VC	5.64	0.90	265.7	15.4	279.6
HC	5.61	0.83	276.4	14.6	275.3
FYM + HC	5.79	1.00	272.4	15.5	285.6
VC + HC	5.47	0.87	269.6	15.3	271.3
VC +FYM	5.82	1.10	278.0	15.6	294.1
Control	5.65	0.69	225.7	11.8	234.3
CD (P=0.05)	NS	0.14	12.2	1.1	10.4
Initial soil fertility status	5.40	0.62	188.16	9.50	179.08

Microbial status

Maximum microbial count was observed in treatment FYM+VC and FYM alone which was 13.31 and 12.57 log cfu/ml, respectively. In case of N fixers with emphasis on *Azotobacter* and *Rhizobium*, maximum population was obtained in FYM+VC and FYM alone *i.e.* 9.87 and 9.47 log cfu /ml, respectively.

Table 5: Effect of treatments on soil microbial status

Treatments (Composts t/ha)	Total Microbial Load (*log cfu/ml*)	*N fixers* (*log cfu/ ml*)	P. solublizers (*log cfu/ml*)	*Fungus* (*log cfu/ ml*)	*Actinomycetes* (*log cfu/ml*)
FYM	12.57	9.47	8.17	6.49	8.61
VC	12.19	8.43	8.38	5.89	7.53
HC	12.38	8.65	9.05	5.78	7.50
FYM +HC	12.11	8.43	9.28	6.62	7.99
VC +HC	12.19	8.17	9.12	5.80	8.46
FYM + VC	13.31	9.87	8.72	6.84	7.90
Control	8.06	6.84	5.99	6.01	5.18

Highest count of phosphate solubilizing bacteria (9.28 log cfu/ml) was obtained in FYM + HC treated soil. Fungal population was highest in FYM+VC *i.e.* 6.84 closely followed by FYM+HC *i.e*. 6.62. Highest *Actinomycetes* count was obtained in FYM alone followed by VC+HC *i.e.* 8.61 and 8.46 log cfu/ml, respectively.

Discussion

The long term study on the effect of organic sources of nutrients on productivity and soil health in maize+soybean—wheat+gram cropping system showed that in general, irrespective of sources of nutrients the yields of the crops both in *kharif* and *rabi* seasons during the first 2-3 years (during conversion period) was low however, there was a continuous increase in the yields after 3rd year due to the buildup of nutrients and microbial status of the soil over the years. Initially, during the conversion period application of different composts in combinations (FYM+VC, FYM+HC, VC+HC) were observed to be more effective in increasing yields however, after that the yield levels were statistically similar in all the compost treatments due to the improvement in soil health to the desired level in all the treatments. Himcompost (HC) which is an enriched compost being at par with other treatments except FYM resulted in higher system's maize grain equivalent yield, net returns and B:C ratio over FYM and control (Table 3). Hence, the conclusion is that in general, the productivity of the crops during the conversion period (2-3 years) is low and after that due to improvement in soil health (nutrients & microbial status), the productivity of the crops is also enhanced to its full potential irrespective of organic sources of nutrients.

Suggestions to tackle with the future challenges of organic farming:

To promote organic agriculture as low cost resource conserving sustainable form of agriculture, the organic policy and strategies should be such that these should give due consideration to the farming needs, potential niches as strengths for commercial development and threats of not adopting alternatives. Further, the mission must strengthen the institutional and human resource capacities of the state/country to enable it implement various components of mission.

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Sustainable Production Packages for Turmeric

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Key words: Wellgro soil, Wellgro grains, fertilizers, FYM, Yield, Quality

Abstract

Field experiment was conducted at Tamil Nadu Agricultural University to study the effect of organic sources of nutrients on growth, yield and quality parameters of turmeric. The results showed that higher Leaf area index (LAI) of 12.30 at 180 days after planting (DAP) and rhizome yield (26,076 kg ha^{-1}) was recorded with the application of 100% RDF + 40% Wellgro soil. Similarly application of Wellgro soil and chemical fertilizer registered higher curcumin, oleoresin and essential oil content (4.34, 9.38 and 3.82, respectively), which was on par with 75% RDF + 40% Wellgro pellets. Higher benefit cost ratio (2.82) was also recorded with the application of 100% RDF + 40% wellgro soil. This indicates that wellgro formulations have positive influence on yield and quality of turmeric under soil and climatic conditions of Tamil Nadu, India.

Introduction

India is called as the "Spice bowl of the world" as it produces variety of spices with quality. Though India leads in production of turmeric, but average productivity is very low due to imbalanced and suboptimal dose of chemical fertilizers, organic manure, bio-fertilizers and micronutrients (Kandiannan and Chandragiri, 2008). Since, turmeric is a nutrient responsive crop and removes large amount of nutrients from soil, sufficient quantities of nutrients have to be applied in order to obtain sustainable yield levels. Organic source of nutrients (wellgro formulations) would augment the nutrient uptake, yield and economics of turmeric. Therefore, the present investigation was carried out to test the effect of Wellgro organic formulations on growth and yield of turmeric under irrigated conditions.

Materials and Methods

A field experiment was conducted during June 2010 – March 2011 at Northern Block Farm, Agricultural Research Station (Tamil Nadu Agricultural University), Bhavanisagar, Erode district of Tamil Nadu. The soil of the experimental field was red sandy loam in texture having slightly acidic pH (6.27) with medium soluble salts (0.75 dSm-1), medium in organic carbon content (0.50%t), low in available N (205 kg ha-1), medium in available P(15.7 kg ha-1) and high in available K (376 kg ha-1). The field experiment was laid out in Randomized Block Design with three replications. Three different wellgro formulations (wellgro soil, wellgro pellets and wellgro grains) were applied in 12 different treatments at 20% and 40% of total Weight of chemical fertilizer applied. Two treatments consisted of farm yard manure (well decomposed cow dung) at the rate of 12.5 t ha-1. Recommended dose of fertilizers 150: 60: 100 kg NPK ha-1 was applied (to meet the nutrient requirement of turmeric) along with wellgro formulations as six equal splits at 0,30,60,90,120 and 150 DAP, where as full dose of P was applied as basal.

In today's cultivation many commercial organic types of manure are being used because of their application in lesser volume and also enriched with nutrients. One such commercial organic manure used in the study is *Wellgro*
(Yet to be commercialized). *Wellgro* organic manures are a product of Indian Tobacco Company (ITC) and are developed for soil application. These products are made from non-timber forest produce and rich source of nutrients and organic carbon. Across the country, its efficacy was examined in different agro climatic conditions on various crops.

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Table 1. Nutrient status of Wellgro organic manure.

Character	Wellgro soil	Wellgro pellets	Wellgro grains
Total nitrogen (%)	2.24	1.77	2.52
Total phosphorus (%)	0.52	0.35	0.43
Total potassium (%)	1.30	2.70	1.70
Organic carbon (%)	39.50	31.70	34.80

Results and discussion

The growth characters of turmeric *viz.,* plant height, leaf area index, and dry matter production were significantly influenced by application of wellgro organic manures. Among the different wellgro formulations, turmeric applied with 100% RDF + 40 % wellgro soil registered significantly higher values of LAI (12.3) at 180 DAP and it was closely followed by 100% RDF + 40% wellgro grains. The minimum values were noticed with the application of 100% RDF with the values of (8.19). Similarly, application of recommended dose of fertilizers along with 40% wellgro soil recorded higher dry matter accumulation (10316kg ha^{-1}) at 180 DAP. This was due to higher underground rhizome mass. The higher uptake of nutrients could have led to maximum dry matter accumulation. Addition of organic manure was found to improve soil health and microbiological process. Application of 100% RDF + 40% wellgro soil recorded increased organic carbon accumulation. Incorporation of organic manure resulted in increased total N content of soil and formation of stable complex with humic substances supplied through wellgro soil. It might be due to decreased soil bulk density, increased soil organic matter, total porosity, water infiltration into soil as noticed with the earlier report of Obi *et al.* (1995).The results of the present influenced by the application of wellgro formulations (Table 2).

Table 2. Influence of wellgro formulations on growth and physiological parameters of turmeric

Treatments	Days to rhizome sprouting	Plant height @ 180 DAP	LAI at 180 DAP	DMP at 180 DAP(kg/ha)
T_1 - 100 % RDF	27.03	107.19	8.19	6493
T_2-100 % RDF + 20% Wellgro Soil	25.31	120.17	10.55	8997
T_3 - 100 % RDF + 40%Wellgro Soil	18.02	131.01	12.30	10316
T_4- 75 % RDF + 20% Wellgro Soil	24.20	118.65	10.15	8251
T_5-75 % RDF + 40%Wellgro Soil	20.86	119.18	10.61	8780
T_6 - 100 % RDF + 20% Wellgro Pellets	22.25	118.43	9.15	7952
T_7 - 100 % RDF + 40%Wellgro Pellets	21.92	122.13	9.45	8570
T_8- 75 % RDF + 20% Wellgro Pellets	25.42	117.96	10.29	7730
T_9 - 75 % RDF + 40%Wellgro Pellets	20.19	120.72	10.10	9671
T_{10} - 100 % RDF + 20% Wellgro Grains	24.16	118.76	9.04	7304
T_{11} - 100 % RDF + 40%Wellgro Grains	20.62	130.41	11.17	8187
T_{12}- 75 % RDF + 20% Wellgro Grains	24.96	116.31	9.35	7825
T_{13} - 75 % RDF + 40%Wellgro Grains	21.45	118.06	10.08	7738
T_{14} - 100% RDF + FYM	21.51	122.20	10.65	7897
T_{15} - 75 % RDF + FYM	21.94	116.46	10.4	7822
SEd	0.45	3.36	0.40	218
CD (P=0.05)	0.92	6.87	0.81	448

In general, organic sources of nutrients in turmeric recorded significantly higher yield over control. among the treatments, application of 100% RDF + 40% wellgro soil recorded the maximum yield of mother rhizome (10,590 kg ha^{-1}) and finger rhizome (15,451 kg ha^{-1}), which was followed by 75 % RDF + 40% wellgro pellets

(9,347 and 14305kg ha^{-1}, respectively). Simultaneously higher economic yield of rhizome (26,076 kg ha^{-1}) was recorded by the application of 100% RDF + 40% wellgro soil over all the treatments, Lower yield of (17,257 kg ha^{-1}) was obtained due to application of 100 % RDF (Table 3). Humus substance present in organic product could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. This product would help the better availability and utilization of nutrients. This in confirmation with findings of Mato and Mendez (1970). Application of 100% RDF + 40% wellgro soil recorded higher curcumin, oleoresin and essential oil content. Organic manures produce more chelated phosphates, which are more soluble in water. This easily available form might have triggered the oleoresin content of rhizomes. The possible reason for higher essential oil content in wellgro soil is that it stimulates the nitrate reductase activity in plants. This enzyme regulates nitrogen availability to plants. Improved nitrogen metabolism particularly through nitrate reductase activity might have exerted higher essential oil content in rhizomes. Application of 100 % RDF + 40 % wellgro soil significantly increased B: C ratio which might be due to the synergistic effect of wellgro soil which in turn could have triggered the highest rhizome yield of turmeric.

Table 3. Effect of organic sources of nutrients on yield, quality and economics of turmeric

Treatment	Yield parameters and B:C ratio of turmeric				Quality of turmeric		
	Mother rhizome (kg ha^{-1})	Fingers (kg ha^{-1})	Cured rhizome yield (kg ha^{-1})	B: C ratio	Curcumin	Oleoresin	Essential oil
T_1	6806	10521	3400	1.62	3.72	8.54	3.35
T_2	8438	12014	4377	2.08	3.92	8.88	3.55
T_3	10590	15451	5960	2.82	4.34	9.38	3.82
T_4	8716	12916	4650	2.23	3.99	9.05	3.66
T_5	9035	13195	5125	2.45	4.16	9.19	3.59
T_6	7917	12882	4704	2.24	3.72	8.91	3.67
T_7	8160	12083	4476	2.12	4.09	9.23	3.54
T_8	7847	11757	4039	1.93	3.88	9.13	3.56
T_9	9347	14305	5278	2.52	4.13	9.33	3.78
T_{10}	8472	12326	4529	2.16	3.87	8.87	3.53
T_{11}	7986	13506	4260	2.02	4.10	9.12	3.60
T_{12}	8576	13160	4490	2.15	4.06	9.08	3.45
T_{13}	7708	1257	4074	1.94	4.04	8.84	3.59
T_{14}	8944	12673	4521	2.10	3.86	8.88	3.53
T_{15}	8611	12639	4308	2.02	3.91	8.80	3.53
SEd	378	486	117	-	0.07	0.073	0.05
CD(P=0.05)	774	996	239	-	0.14	0.15	0.11

Conclusion

From the field investigation, it is concluded that turmeric responded favorably to wellgro formulations. Taking into consideration of the growth and productivity of crops and economic benefits it is inferred that application of 100% RDF along with 40% wellgro soil could be a viable practice. Hence, integrated nutrient management practice of 100% recommended dose of fertilizer + 40% wellgro soil w/w of chemical fertilizer in turmeric crop has been found to be an ideal option to sustain the soil fertility, crop productivity besides higher economic benefits.

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Ecofriendly Nutrient Management Practices for Yield and Quality of Banana

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Key words: Wellgro soil, Wellgro grains, fertilizers, Farm Yard Manure, Yield, Quality

Abstract

Field investigations were carried out at Northern Block Farm of Agricultural Research Station, Bhavanisagar (TNAU) of Tamil Nadu, India during 2010-2012 to study the effect of nutrient management practices on productivity of banana. The results revealed that application of 100% recommended dose of fertilizer (RDF) along with 40% Wellgro soil recorded the maximum number of hands (10.2 and 10.3), number of fingers (136.3 and 145.2), bunch weight (23.9 and 25.3 kg/plant) and total yield (72.8 and 77.1 t/ha) during 2010-11 and 2011-12,respectively. Similarly, quality parameter was also influenced by integrated nutrient management practices during both years of study in banana. Nutrient management practices i.e. combined application of 40% Wellgro soil or Cow based Farm Yard Manure @ 10kg plant^{-1} with recommended dose of fertilizers to banana has been found to be an ideal option to improve yield parameters and quality of banana under the soil and climatic conditions of Tamil Nadu, India.

Introduction

Banana owing to its large size and rapid growth rate require relatively large amount of nutrients for higher yield and quality. Application of inorganic fertilizers though increases the yield substantially but could not able to sustain the fertility status of the soil. Considering the present situation of soil quality and environmental security, it is necessary to go for an integrated nutrient management (INM), involving various sources of organic manures. In today's cultivation many commercial organic manures are being used because of their application in lesser volume and also enriched with nutrients. One such commercial organic manure used in the study is Wellgro. Wellgro organic manure is a unique product with a blend of neem and non-timber forest produce and a rich source of nutrients. Hence, this study was under taken to find out the influence of ecofriendly nutrient management practices on yield and quality parameters of banana under irrigated conditions.

Material and methods

The experiments were laid out in sandy loam soil at Northern Block Farm, Agricultural Research Station (Tamil Nadu Agricultural University), Bhavanisagar, Erode district of Tamil Nadu. The banana cv. Grand Naine (AAA) was used as a test crop during 2010-11 and 2011-12. The experiments consisted of thirteen treatments viz., Control (100% Recommended dose of fertilizer), four treatments consisted of Wellgro soil @ 20 and 40% in combination of 100 and 75% RDF, two treatments consisted of 2% Wellgro liquid organic manure spray on bunches with 100 and 75% RDF, four treatments consisted of Wellgro grains @ 20 and 40% combined with 100 and 75% RDF and the last two treatments comprised of Cow based Farm Yard Manure (FYM) @ 10kg plant^{-1} with 100 and 75% RDF combinations. Randomized Complete Block Design was adopted for the experiments and it was replicated thrice. The net plot size for each treatment was 78 M^2, which accommodated 24 numbers of banana trees spaced at 1.8 M X 1.8 M. Wellgro organic manures are a product of Indian Tobacco Company (ITC) and developed for soil application and foliar spray. These products are made from non-timber forest produce. They have appreciable quantities of nitrogen (1.6%) phosphorus (0.41%) and potash (2.10%) and also micronutrients such as zinc, boron, copper etc. Yield attributes such as bunch weight, number of hands bunch^{-1}, total number of fingers bunch^{-1}, finger weight and yield were recorded in both the seasons. Quality parameters such as Total Soluble Solids, acidity, ascorbic acid, reducing sugars, non reducing sugars and sugar acid ratio were also recorded in banana during both the years of study.

Result

Yield parameters

Results revealed that the yield and quality parameters were conspicuously higher in organic manure combinations as compared to fertilizers alone (control). However, application of 100% RDF along with either 40% Wellgro soil or FYM @ 10kg/plant recorded the maximum bunch weight, number of hands and fingers/bunch and total yield (Table 1). During 2010-11 and 2011-12, the highest bunch weight (23.9 and 25.3kg), number of hands (10.2 and 10.3) and fingers (136.3 and 145.2/bunch), finger weight (175.0 and 184.2 g) and maximum yield (72.8 and 77.1 t ha^{-1}), respectively were obtained with application of 100% RDF along with 40% Wellgro soil. However, bunch weight was comparable with T_{12} (23.77 kg), T_9 (23.3 kg) and T_2 (23.0 kg) during 2010-11 and with T_{12} (25.3 kg) and T_9 (24.9 kg), T_2 (24.5 kg) and T_8 (23.7 kg) during 2011-12. Similarly, total yield was on par with T_{12} (72.5 t ha^{-1}), T_9 (71.0 t ha^{-1}), T_2 (70.1 t ha^{-1}) and T_8 (69.3 t ha^{-1}) during first year and T_{12} (77.1 t ha^{-1}), T_9 (75.9 t ha^{-1}), T_2 (74.7 t ha^{-1}) and T_8 (72.1 t ha^{-1}) during second year. The increment of yield due to the application of 100% RDF along with 40% Wellgro soil was 11.2 and 14.7% as compared to control. Similarly, application of 100% RDF with FYM @ 10kg/plant registered 10.8 and 14.6% higher yield over control during 2010-11 and 2011-12, respectively.

Table 1. Effect of nutrient management practices on bunch characteristics of banana

Treatments	2010-11					2011-12				
	Bunch weight (kg)	Number of hands/ bunch	Total no. of fingers/ bunch	Finger weight (g)	Yield (t/ha)	Bunch weight (kg)	Number of hands/ bunch	Total no. of fingers/ bunch	Finger weight (g)	Yield (t/ha)
T_1 - 100% RDF (Control)	21.2	8.6	125.2	167.3	64.6	21.6	9.6	131.3	173.3	65.8
T_2 - 100% RDF + 20% WS	23.0	9.5	132.0	172.7	70.0	24.5	10.3	139.0	182.3	74.7
T_3 - 100% RDF + 40% WS	23.9	10.2	136.3	175.0	72.8	25.3	10.3	145.2	184.2	77.1
T_4 - 75% RDF + 20% WS	21.0	8.6	123.3	169.3	64.0	21.6	9.5	124.1	178.0	65.7
T_5 - 75% RDF + 40% WS	22.5	9.2	126.4	171.0	68.5	22.5	10.0	128.7	180.3	68.6
T_6 - 100% RDF + WC spray	21.9	8.7	126.5	172.3	66.9	22.3	9.6	130.7	178.0	68.0
T_7 - 75% RDF + WC spray	20.5	8.5	118.6	170.0	62.5	21.0	9.1	124.0	176.3	64.1
T_8 - 100% RDF + 20% WG	22.5	9.8	130.7	173.7	69.3	23.7	10.0	136.1	181.0	72.1
T_9 - 100% RDF + 40% WG	23.3	9.5	133.4	178.7	71.0	24.9	10.2	139.8	184.7	75.9
T_{10} - 75% RDF + 20% WG	21.2	8.9	122.2	172.8	64.6	21.8	10.0	127.3	179.0	66.5
T_{11} - 75% RDF + 40% WG	21.4	9.3	123.1	171.7	65.2	21.7	9.9	129.0	178.3	66.1
T_{12} - 100% RDF + FYM	23.8	10.0	135.4	174.3	72.5	25.3	10.4	141.5	186.3	77.1
T_{13} - 75% RDF + FYM	21.3	9.7	126.3	170.4	65.0	21.9	9.6	130.9	179.0	66.9
S.Ed	0.6	0.5	3.1	5.3	2.1	0.8	0.5	3.4	5.4	2.4
CD(P=0.05)	1.2	1.0	6.3	10.1	4.2	1.6	1.1	7.0	11.2	5.0

Fruit quality

The various INM practices ushered in variation on TSS content of banana during the course of investigation. All the INM treated plots significantly influenced the TSS content over inorganic fertilizers alone (T_1). Among the treatments, 75% RDF + 2% liquid organic manure spray on bunches (T_7) recorded the maximum TSS (21.38°B) during 2010-11 whereas 100% RDF + 2 % liquid organic manure spray (T_6) had more pronounced effect on TSS (21.86°B) during 2011-12. The highest acidity percentage (0.33) was recorded with application of 100% RDF alone (T_1) during 2010-11, but it was on par with T_6, T_3, T_{12}, T_5, T_9, T_8, T_4 and T_7 whereas, the minimum percentage of acidity (0.22) was recorded in T_{10} and T_{11}. Similar results were obtained during 2011-12 also. Application of 75% RDF along with 40% *Wellgro soil* (T_5) recorded superior values of ascorbic acid (16.35 and 15.91 mg $100g^{-1}$) than T_1 *i.e.*100% RDF alone (12.60 and 11.61 mg $100g^{-1}$) during 2010-11 and 2011-12 respectively. The INM practices did not have any marked influence on the total sugar contents during both the years of study. However, numerically the highest value of total sugar content (14.13%) was noted in T_5 (75% RDF + 40% *WG organic soil*) during 2010-11 and in T_7 (15.35%) during 2011-12. The sugar acid ratio of fruits showed highly significant differences due to adoption of various INM treatments during both the years. During 2010-11, the treatment T_{10} (75% RDF + 20% *Wellgro grains*) recorded the maximum sugar: acid ratio of 66.33 and was statistically on par with T_{11} (55.24). During the second year, application of 75% RDF + 2% liquid organic manure spray on bunches (T_7) registered the maximum sugar acid ratio (109.64) and it was comparable with T_{13}.

Table 2. Effect of nutrient management practices on fruit quality parameters during 2010-11

Treatments	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100g)	Reducing sugars (%)	Non reducing sugars (%)	Sugar: acid ratio
T_1 - 100% RDF (Control)	18.57	0.33	12.60	10.28	1.55	36.18
T_2 - 100% RDF + 20% WS	20.13	0.26	14.27	11.63	1.43	50.99
T_3 - 100% RDF + 40% WS	20.36	0.31	14.29	11.58	1.25	42.36
T_4 - 75% RDF + 20% WS	20.56	0.28	15.61	10.66	1.48	42.99
T_5 - 75% RDF + 40% WS	21.09	0.29	16.35	11.82	2.32	48.73
T_6 - 100% RDF + WC spray	21.25	0.31	12.70	11.81	1.55	43.36
T_7 - 75% RDF + WC spray	21.38	0.27	12.57	11.13	2.09	48.85
T_8 - 100% RDF + 20% WG	20.33	0.28	14.16	10.40	1.82	44.83
T_9 - 100% RDF + 40% WG	20.48	0.28	14.23	10.04	2.13	43.91
T_{10} - 75% RDF + 20% WG	20.52	0.22	15.32	12.42	2.31	66.63
T_{11} - 75% RDF + 40% WG	19.95	0.22	14.02	10.41	1.67	55.24
T_{12} - 100% RDF + FYM	20.93	0.30	12.63	9.25	2.30	39.67
T_{13} - 75% RDF + FYM	21.22	0.26	12.49	10.58	1.49	45.87
S.Ed	0.64	0.03	1.18	1.14	1.15	6.10
CD(P=0.05)	1.32	0.06	2.43	NS	0.35	12.59

Table 3. Effect of nutrient management practices on fruit quality parameters during 2011-12

Treatments	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100g)	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)	Sugar: acid ratio
T_1 - 100% RDF (Control)	19.05	0.22	11.61	12.12	1.34	13.46	61.18
T_2 - 100% RDF + 20% WS	19.15	0.17	14.85	12.19	1.67	13.86	81.53
T_3 - 100% RDF + 40% WS	18.79	0.18	14.05	10.82	1.58	12.40	68.89
T_4 - 75% RDF + 20% WS	21.03	0.16	15.23	12.66	1.45	14.11	88.19
T_5 - 75% RDF + 40% WS	21.52	0.17	15.91	13.50	1.83	15.33	90.18
T_6 - 100% RDF + WC spray	21.86	0.21	14.36	13.48	1.70	15.18	72.29
T_7 - 75% RDF + WC spray	21.59	0.14	14.85	13.54	1.81	15.35	109.64
T_8 - 100% RDF + 20% WG	19.84	0.21	14.77	13.35	1.58	14.93	71.10
T_9 - 100% RDF + 40% WG	18.18	0.19	14.25	12.08	1.66	13.74	72.32
T_{10} - 75% RDF + 20% WG	20.86	0.16	15.02	12.74	1.55	14.29	89.31
T_{11} - 75% RDF + 40% WG	21.12	0.18	13.65	13.27	1.76	15.03	83.50
T_{12} - 100% RDF + FYM	18.26	0.18	13.30	12.50	1.51	14.01	77.83
T_{13} - 75% RDF + FYM	21.29	0.14	14.21	12.83	1.43	14.26	101.86
S.Ed	0.99	0.02	1.67	0.61	0.18	0.98	8.84
CD(P=0.05)	2.05	0.03	3.46	1.26	NS	NS	18.24

Discussion

Effect of INM on yield of banana

Higher yield response owing to application of organics ascribed to improved physical, chemical and biological properties of soil resulting in better supply of plant nutrients, which in turn led to good crop growth and yield. Humus substance present in organic product could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. These products would help the better availability and utilization of nutrients. All these positive effect might have facilitated quick mobilization and availability of nutrients that would aid in increased plant height, number of leaves, leaf area, leaf area index and photosynthetic rate. This in turn would have assisted for the increased yield of banana. This is in confirmation with the findings of Patel *et al.* (2010) and Aba *et al.* (2011).

Effect of INM on quality of fruits

The fruit quality in banana is mainly assessed by the parameters like TSS, starch, total sugar, ascorbic acid and acidity in the pulp. Fruit quality was superior in plants treated with organic and inorganic manures as compared to inorganic alone. It might be due to application of adequate amount of nutrients through organic and inorganic fertilizers. A high total soluble solid was recorded either with 100 or 75% RDF along with 2% liquid organic manure spray on bunches. This might be due to rapid transformation of complex carbohydrates into soluble sugars and also quick mobilization of metabolites from source to sink under the influence of growth substances contained in the liquid organic manure. Athani and Hulamani (2000) also reported that the increased fruit quality parameters were due to the addition of different organic manures to the soil and in turn to plants, which enhanced the biosynthesis and translocation of carbohydrates to fruits. Further, the availability of macro and micronutrients from different organic manures might have increased the leaf area with higher synthesis of assimilates, which is due to translocation of photosynthetic products from leaves to developing fruits and thereby increasing total sugars. These results are in agreement with those obtained by Naby (2000).

Suggestions to tackle with the future challenges of organic banana production

From the two years of experiments, it can be concluded that combined application of either 40% Wellgro soil or Cow based Farm Yard Manure @ 10kg plant^{-1} along with recommended dose of fertilisers is found to be an ideal option to improve yield and quality parameters of banana under the soil and climatic conditions of Western zone of Tamil Nadu, India.

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Incidence of white fly (Bemisia tabaci Genn.) and their sustainable management by using biopesticides

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Key words: Ladysfinger, microbial pesticides, plant extracts, IPM, organic farming

Abstract

Ladysfinger (Abelmoschus esculentus L.) is susceptible to various pests of which white fly (Bemisia tabaci Genn.) causes heavy damage. The pest was active throughout the growing period with a peak population (3.98 white fly /leaf) and (4.33 /leaf) during 20rd SMW (middle of May) in the pre-kharif and during 42nd -43rd SMW (middle of October) in the post kharif crop respectively. Sudden fall of population was found during July because of heavy rains. White fly showed insignificant positive correlation (p=0.05) with maximum temperature, minimum relative humidity(RH) whereas insignificant negative correlation with maximum RH and significant negative correlation with weekly total rainfall. This study evaluated the efficacy of extracts from plants, microbial insecticides against B. tabaci infesting ladysfinger. Imidacloprid was the most effective treatment followed by the microbial insecticide spinosad. Satisfactory white fly control (> 50 % population suppression) was achieved with extract of Polygonum plants (5 % concentration) and spinosad. The Polygonum extract was very effective against the white fly, achieving more than 60 % mortality at 3 and 7 days after spraying. Plant extracts and microbial insecticides of biological origin (biopesticides) have less or no hazardous effects on health and the environment, therefore they can be incorporated in IPM programmes and organic farming.

Introduction

In the sub-Himalayan region of north east India ladysfinger (*Abelmoschus esculentus* L.), an annual vegetable crop is cultivated at a commercial scale but insect and mite pest damage constitutes a limiting factor in successful production. One of the most important pests of this crop is the white fly, *Bemisia tabaci* Genn. As observed by Watson et al*.* (2003) low rainfall caused significant outbreaks and dense population developed only where humidity low and temperatures high. Higher temperature and low rainfall were found to favour rapid multiplication of the pest (Threhan, 1944). The use of synthetic insecticides is problematic because the toxic residues in the fruits could pose a health hazard. *Polygonum* is a well known weed in the terai agro-climatic region of West Bengal, India. Acharya et al. (2002) reported that abamectin was safer to use in the presence of coccinellid predators. Information on seasonal activity of white fly pests helps to take up effective management strategies. The objective of this study was to determine the efficacy of the biopesticides against *B. tabaci*.

Material and methods

Studies were conducted in the Instructional Farm of UBKV (Agri. University), West Bengal, India for two years (2010-11). The experimental area is situated in the sub-Himalayan region of north-east India. This so called terai zone is situated between 25^{0}57' and 27^0 N latitude and 88^{0}25' and 89^{0}54' E longitude.

The ladysfinger variety 'Nirmal-101' was grown round the year which excludes winter during 2010-2011 in both years under recommended fertilizer levels (120:60:60 kg NPK/ha) and cultural practices in 4.8 m x 4.5m plots at a spacing of 75 cm x 35 cm. The treatments were replicated five times in a Randomized Block Design (RBD). The total white fly population per leaf from five randomly selected plants per replication was recorded at seven days (Standard Meteorological Week) interval. Data obtained over two years were presented graphically with important weather parameters viz. temperature, relative humidity. Correlation co-efficient (r) was worked out between incidence of white fly and important weather parameters during the period to find out influence of weather on population fluctuation.
The ladysfinger variety 'Nirmal-101' was grown during the post-kharif (early September) season in both years under recommended fertilizer levels and cultural practices. The treatments were replicated three times in a Randomized Block Design. Two microbial insecticides, *Saccharopolyspora spinosa* (Spinosad 45 SC) @ 1.0 ml/ 3 L and *Beauveria bassiana* (Bals.) Vuillemin (Biorin 10^7 conidia /ml) @ 1.0 ml/L, and two botanical extracts, *Pongamia pinnata* leaf extract @ 1.0 % and 5.0 % and *Polygonum hydropiper* flower extract @ 1.0 % and 5.0 %, were evaluated and compared with the ability of imidacloprid (Confidor 17.8 SL) @ 1ml/5 L)

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to control *B. tabaci*. The *Pongamia* leaves and *Polygonum* floral parts were extracted in methanol as follows. After washing with water, the plant parts were powdered in a grinder. The powder (50 g) samples of each tested plant were transferred separately to a conical flask (500 ml) and dipped in 250 ml methanol. The material was allowed to stand for 72 hours at room temperature with occasional stirring. After 72 hours the extract was filtered through Whatman 42 filter paper.

Four sprays at 12 day intervals were made, starting with the initiation of infestation. White fly population densities were recorded 3, 7, and 11 days after each spraying by counting white fly on each leaf of five apical leaves from five randomly selected plants per replication. Percent reduction of pest population over control was calculated by the following formula (Abbott, 1925):

$$Pt = \frac{Po - Pc}{100 - Pc} \times 100$$

Where, Pt = Corrected mortality, Po = Observed mortality and Pc = Control mortality. Data were analyzed by using INDO-STAT- software for analysis of variance following randomized block design (RBD) treatment means were separated by applying CD Test (critical difference) at 5 % level of significance.

The fruits were harvested at frequent intervals when they reached marketable size. The yield of marketable produce was converted to tons per hectare.

Results

The pest was active throughout the growing period except 9-11 SMW i.e., last week of February to first week of March (Fig 1). However, population appeared during middle of March and remained very low up to middle of April and thereafter increased gradually with the rise of temperature. Pest population reached high (3.98 white fly/leaf) during 20th SMW (mid of May) in the pre-kharif crop and thereafter started decline with the onset of monsoon and heavy rainfall, and this tendency was continued up to 33 SMW (2nd week of August). After rainy season, again pest population increased and reached highest population (4.33/leaf) on the 42nd – 43rd SMW (mid of October) in the post kharif crop when the average temperature, average relative humidity and weekly total rainfall ranged 27.12-28.65 ^{0}c, 78.63-79.88 % and 6.20-23.80 mm. respectively. However, white fly was most active during May i.e., 17-21 SMW and October i.e., 40-45 SMW. There was a sudden fall of population was found with the heavy rains (weekly total 175.05 mm) during monsoon in 30th SMW (last week of July).

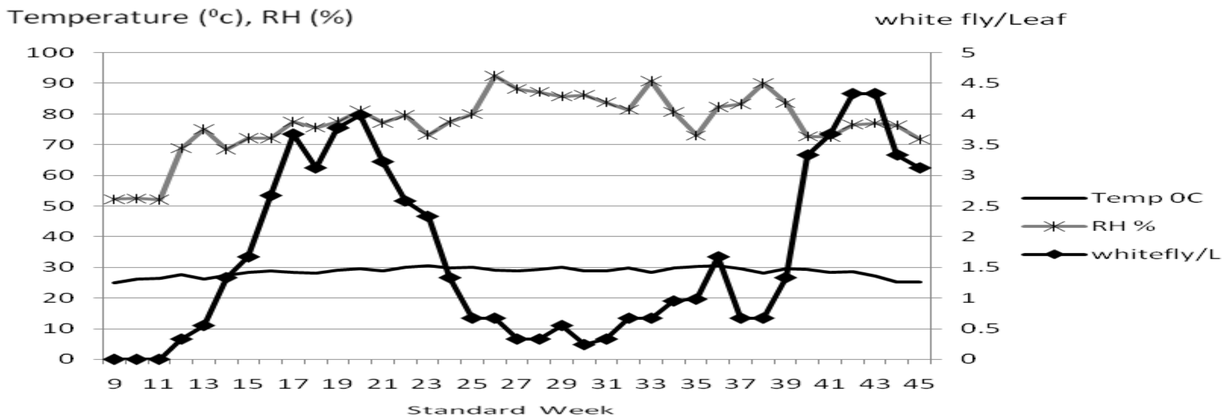

Figure 1. Incidence of white fly as influence by temperature and RH

Correlation between white fly infestations with important weather parameters (table 1) showed non-significant positive correlation (p=0.05) with maximum temperature, minimum relative humidity whereas non-significant negative correlation with maximum relative humidity and significant negative correlation with weekly total rainfall.

Table 1:Correlation co-efficient (r) of white fly with environmental parameters

pest	Temperature				Relative Humidity			Weekly total rainfall (mm)
	Max.	Min.	Difference	Average	Max.	Min.	Average	
White fly	0.149	(-) 0.063	0.130	(-) 0.004	(-) 0.008	0.221	0.133	(-) 0.429**

* significant at P< 0.05 and ** significant at P< 0.01

Among the seven treatments (Table 2), imidacloprid provided the best suppression of populations (77.00 %), followed by microbial toxin *Saccharopolyspora spinosa* (69.80 %). Among the biopesticides, *Saccharopolyspora spinosa* was the most effective followed by the *Polygonum* flower extract at 5.0 % concentration (54.31% suppression). Three days after spraying, imidacloprid was the most effective (85.95 % suppression) against the white fly, followed by *Saccharopolyspora spinosa* (80.19 % suppression). *Polygonum* flower extract at 5.0 % concentration provide better results against white fly (62.44 % suppression). Likewise, the ability of imidacloprid to suppress white fly populations extended to seven and 11 days after spraying. At seven and eleven days after spraying, among the biopesticides, *Saccharopolyspora spinosa* was found very effective against the white fly (70.50 % and 58.71 % suppression respectively) followed by the *Polygonum* flower extract at 5.0% concentration (60.07% and 40.41 % suppression respectively).
The highest yield was obtained from plots treated with imidacloprid (41.17 q/ha), followed by *Saccharopolyspora spinosa* (40.20q/ha) (Table 2). There was no significant difference in yield between these two treatments. The *Polygonum* flower extract at 5.0 % concentration was very effective against *Bemisia tabaci* (62.44 % mortality at 3 days after application).

Discussion

Low rainfall coupled with high temperature and low RH causes outbreak of white fly population. These findings indicated that post kharif crop as well as pre-kharif crop is
most susceptible to white fly infestation. The population of white fly had a tendency to

Table 2: Overall efficacy of plant extracts and microbial insecticides against *Bemisia tabaci* , and the fruit yield of Ladysfinger

Treatments	Dose ml./litre (%)	Pre treatment observation of w.fly/Leaf	Overall efficacy (% reduction) Days after treatment				Fruit Yield (q/ha)
			3	7	11	Mean	
S. *sponisa* (Spinosad 45 SC)(T_1)	1 ml/3 L	0.83	80.19 (63.62)	70.50 (57.13)	58.71 (50.03)	69.80 (56.92)	40.20
Imidacloprid (Confidor 17.8 S.L.)(T_2)	1 ml/5 L	0.72	85.95 (68.28)	73.36 (58.95)	71.69 (57.89)	77.00 (61.70)	41.17
Pongamia (1.0 %) (T_3)	10.00 (1.0 %)	0.69	43.34 (41.16)	38.48 (38.29)	25.81 (30.50)	35.76 (36.58)	32.90
Pongamia (5.0 %) (T_4)	50.00 (5.0 %)	0.77	54.28 (47.47)	48.36 (44.05)	34.48 (35.93)	45.70 (42.48)	36.13
Polygonum (1.0 %) (T_5)	10.00 (1.0 %)	0.63	49.94 (44.96)	47.39 (43.67)	30.23 (33.50)	42.50 (40.59)	31.49
Polygonum (5.0 %) (T_6)	50.00 (5.0 %)	0.77	62.44 (52.16)	60.07 (50.34)	40.41 (39.46)	54.31 (47.47)	36.53
B.bassiana (Biorin 10^7 conidia/ml) (T_7)	1 ml/L	0.75	46.80 (43.16)	42.30 (40.56)	29.60 (32.85)	39.56 (38.85)	32.51
Untreated Control (T_8)	-	0.83	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	27.08
SE m (±)	-	-	2.14	2.81	1.75	-	1.14
CD at 5 %	-	NS	6.36	8.35	5.21	-	3.87

Figures in parentheses are angular transformed values, NS = Not significant increase with the decrease of relative humidity and rainfall and with increase of maximum temperature. This observation was supported by Watson et al. (1993) and Threhan (1944).The flower extract of *Polygonum* and the microbial toxin *Saccharopolyspora spinosa* gave satisfactory white fly suppression. Based on their moderate to high efficacy levels, as well as low toxicity to natural enemies and human health, we conclude that biopesticides can be incorporated in future IPM programme and organic farming in vegetable cultivation.

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Studies on Soil fertility, Cow urine and Panchagavya levels on Growth and Yield of Maize

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Key words: Organic farming, soil fertility, panchagavya, maize, cow urine and pressmud

Abstract

A field experiment on organic farming was conducted to study the influence of different levels of cow urine, panchagavya and fertility on maize. The grain and stover yield of maize varied significantly under different levels of fertility, panchagavya spray and cow urine levels. Maximum grain yield of 18.6 q per ha and 17.6 q per ha were recorded with application of cow urine and panchagavya and minimum was recorded in the plots without application of them. However, no significant difference was observed in stover yield but, higher stover yield of 42.7 q per ha and 39.6 q per ha were recorded in the plots with application of panchagavya and cow urine. Among different fertility levels, maximum grain yield of 20.9 q per ha and stover yield of 47.5 q per ha were recorded in the plots supplied with press mud equivalent to recommended 300 per cent N. Height, number of leaves per plant at harvest in maize crop varied significantly due to application of different cow urine and fertility levels.

Introduction

Traditional Agriculture has been generally considered everywhere as a joint effort of man and cattle. In recent past, a great deal of importance has been given to individual animal product and formulation. Among the formulations, the most widely mentioned and discussed is *Panchagavya*, which literally means a mixture of five products originating from cow. Panchagavya is the formulation mentioned in Ayurveda, prepared using five components derived from cow *viz.* milk, curd, ghee, urine and dung (Mathivanan *et al*., 2006). The liquid organic manures such as panchagavya and cow urine are commonly used in organic farming to provide balanced nutrition to the crop. Devakumar *et al.,* (2008) observed the presence of naturally occurring beneficial microorganisms, predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi in organic liquid manures. Another important product that is being extensively used in traditional agriculture is cow's urine or *go-mutra* (Sanskrit), which has been known to be used by various sectors of people in India from Vedic period for medicinal and agricultural purposes. The traditional knowledge also recognizes the importance of cow urine in agriculture and is being sprayed on plants to control fungal/bacterial diseases. It helps in the management of pests (25%) of sweet corn at tasseling and cob formation stages. Maize is the third most important cereal grown in India after wheat and rice. With this in view, an attempt was made to study the effect of soil fertility and cow urine levels with panchagavya spray to study growth and yield of maize.

Materials and methods

A field study was conducted at Organic Farming Research Centre, (OFRC), University of Agricultural Sciences Bangalore, India. The soils are sandy loam with low organic carbon content of 0.38 per cent. The experiment consisted of cow urine levels (2) with and without panchagavya (2) and three fertility levels (100%, 200% and 300% of recommended N equivalent). Experiment was laid out on Factorial Randomized Block Design with 12 treatment combinations and three replications. The treatment combinations are: $P_1C_1F_1$, $P_1C_1F_2$, $P_1C_1F_3$, $P_1C_2F_1$, P1C2F2, $P_1C_2F_3$, $P_2C_1F_1$, $P_2C_1F_2$, $P_1C_2F_3$, $P_2C_2F_1$, $P_2C_2F_2$ and $P_2C_2F_3$. Panchagavya was prepared by following the standard procedure and filtered. Three litres of filtrate was taken and diluted to 100 litres using water and sprayed to the crop during the 30th and 60th day after sowing when the soil is moist. Cow urine was collected and applied to the crop at the rate of 5000 litres per ha during the 30th and 60th day after sowing when the soil is moist and recorded observations on plant height, number of leaves per plant, grain and stover yield at harvest.

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Results

Grain and stover yield of maize varied significantly due to different soil fertility levels, panchagavya spray and cow urine levels (Table 1). Maximum grain yield of 18.6 q per ha was recorded with plot applied with cow urine and minimum of 14.2 q per ha was recorded in the plot without the application of cow urine. Although, no significant difference was observed in stover yield, higher stover yield of 39.6 q per ha was recorded in cow urine applied plots. Among the different fertility levels, maximum grain yield of 20.9 q per ha and stover yield of 47.5 q per ha were recorded in plots applied with 300 per cent N equivalent supplied through pressmud. Minimum grain yield of 10.8 q per ha and stover yield of 31.4 q per ha was recorded in 100 per cent fertility levels. Plant height and number of leaves per plant in Maize at harvest varied significantly due to different cow urine and fertility levels. Maximum plant height (173.7 cm) and number of leaves (13.0) per plant were recorded in cow urine applied plots and higher plant of 177.7 cm and 13.3 leaves per plant in 300 per cent N equivalent supplied through pressmud. Taller plants and higher leaves per plant were recorded with application panchagavya.

Table 1: Effect of fertility, cow urine levels and Panchagavya spray on grain and stover yield (q / ha) in maize

Panchagavya Spray (P)	Grain yield (q / ha)				Stover yield(q / ha)			
	Cowurine levels (C)				Cowurine levels (C)			
	With (C_1)		Without (C_2)	Mean	With (C_1)		Without(C_2)	Mean
With Panchagavya	19.50		17.60	17.6	44.0		41.3	**42.7**
Without Panchagavya	15.7		12.80	15.2	35.2		37.4	**36.3**
Mean	**18.60**		**14.20**		**39.6**		**39.4**	-
	F-test	S.Ed±	C.D at 5 %		F-test	S.Ed±	C.D at 5 %	
C	**	0.373	0.70		NS	1.493	-	
P	**	0.773	1.45		*	1.737	3.25	
C x P	NS	1.093	-		NS			
Fertility levels (F)								
F_1 – 100 %	13.1		8.5	10.8	32.2		30.6	**31.4**
F_2 – 200 %	19.4		15.7	17.5	37.2		42.1	**39.6**
F3 – 300 %	23.2		18.6	20.9	49.6		45.4	**47.5**
Mean	**18.6**		**14.2**		**39.6**		**39.4**	
	F-test	S.Ed±	C.D at 5 %		F-test	S.Ed±	C.D at 5%	
F	**	0.946	2.307		**	2.128	5.19	
C x F	NS	1.339	-		NS	3.00	-	

Discussions

Higher grain and stover yield recorded might be due to the higher plant height (172.5 cm) and increased number of leaves (13) leading to more photosynthetic area thereby resulting in higher yield levels. These results are in confirmity with the findings of Sathyamoorthi (1997) where higher leaf area index (LAI) and nutrient uptake might have contributed for higher yield attributes in maize by application of bio-digester liquid, panchagavya and cow urine spray. These might be also due to presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi which were detected in organic liquid manures (Swaminathan, 2005 and Devakumar *et al.* 2008). Maximum grain yield of 17.6 q per ha and stover yield of 42.7 q per ha was recorded in panchagavya sprayed plots. This was due to increased in plant height and number of leaves. These results are in corroboration with the findings of Meena and Bheemavat, (2009) that cow urine combined with application of green manures and foliar application of panchagavya twice on the standing crop resulted in better growth and development of plants for increased and maximum grain yield of maize. Cob length and cob girth were significantly higher in the plots applied with bio-digester slurry followed by plots supplied with cow urine and panchagavya liquid manures. Papen *et al.,* (2002) reported that panchagavya contains macro and micro nutrients besides total reducing sugar-glucose. Chemolithotrops and autotropic nitrifiers (ammonifers and nitrifers) present in panchagavya which colonize in the leaves and increase the ammonia uptake and thereby enhancing the total N supply. The microorganisms present in the rhizosphere environment around the roots, influence the plant growth and crop yield. Because of these reasons crops applied with liquid manures are benefitted in terms of soil fertility, soil health.

Table 2: Effect of fertility, cow urine levels and panchagavya on plant height (cm) and number of leaves per plant at harvest in maize

	Plant height (cm)				**No. of leaves/plant**			
Panchagavya Sprays (P)	**Cowurine levels (C)**				**Cowurine levels (C)**			
	With (C_1)		Without(C_2)	Mean	With (C_1)		Without(C_2)	Mean
With Panchagavya	176.4		168.5	**172.5**	13.2		12.8	**13.0**
Without Panchagavya	170.9		164.3	**167.6**	12.9		12.1	**12.5**
Mean	**173.7**		**166.4**		**13.0**		**12.5**	
	F-test	S.Ed±	C.D at 5 %		F-test	S.Ed±	C.D at 5 %	
C	**	0.880	1.65		*	0.192	0.359	
P	NS	2.42	-		NS	0.293	-	
C x P	NS	3.42	-		NS	0.414	-	
Fertility levels (F)								
F_1 – 100 %	164.8		156.3	**160.5**	12.5		11.7	**12.1**
F_2 – 200 %	175.0		168.6	**171.8**	13.2		12.7	**12.9**
F3 – 300 %	181.1		174.4	**177.7**	13.5		13.1	**13.3**
Mean	**173.7**		**166.4**		**13.0**		**12.5**	
	F-test	S.Ed ±	C.D at 5 %		F-test	S.Ed±	C.D at 5%	
F	**	2.96	7.22		NS	0.359	-	
C x F	NS	4.18	-		NS	0.508	-	

The higher grain yield of 20.9 q per ha and stover yield of 47.5 q per ha were recorded in plots applied with 300 percent N equivalent supplied through pressmud. They are in confirmity with the findings of Khan *et al,.* (2008) who reported that grain yield and stover yield were significantly higher under 10 to 20 t FYM per ha and also had significant and positive effect on green cob yield than control. Pressmud supplies nitrogen, phosphorus and sulphur in available forms to the plants through biological decomposition and improves physical properties of soil such as aggregation, aeration, permeability and water holding capacity. These results are in confirmity with the findings of Masti *et al.,*(2003) where liquid cattle manure applied to soil did not affect the seed germination but resulted in a significant increase in plant height, number of green leaves and dry biomass of maize relative to control and was similar to that fertilizer treatment. Organic manures can improve soil-water-plant relations through modifying bulk density, total porosity, soil water relation and consequently, increasing plant growth and water use efficiency.

Conclusion

The present study revealed that higher grain and stover yield, plant height and number of leaves in maize with panchagavya, cow urine which were comparable to recommended fertilizer treatments at higher level (200% and 300%). It can be concluded that presence of rich plant growth substances, both major and micro nutrients, beneficial microbial population in organic liquid manures have helped to bring rapid changes in phenotypic characteristics of plants and also improvement in the growth ultimately improving in the productivity of the crops. Liquid organic manure like panchagavya could be prepared locally by farmers themselves and obtain increased yield levels. Such practices would pave way to reduce use of external inputs and increase sustainability among organic farmers in the developing countries.

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Effect of Seed treatment, Panchagavya application and Organic Farming Systems on Soil microbial population, Growth and Yield of Maize

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Key words: Panchagavya, Beejamrutha, Rhizosphere, Bacteria and organic farming system, palekar's method

Abstract

An experiment was conducted to study the effect of seed treatment, panchagavya application and organic farming systems on soil microbial population, growth and yield of maize. Grain yield of maize varied significantly due to different organic farming systems, seed treatment and panchagavya spray. Maximum grain yield of 19.3 q per ha was recorded in organic farming system II and minimum maize grain yield was recorded in systems I (17.1 q / ha). The grain yield of 19.6 q per ha and 16.90 q per ha was recorded with panchagavya (3 %) and without panchagavya application. Maximum yield of 19.90 q per ha was recorded in seed treatment with panchagavya followed by beejamrutha (17.99 q / ha) and minimum grain yield of 16.90 q per ha was recorded in control. Higher microbial population was observed in organic farming system II compared to organic farming system I. Panchagavya spray and panchagavya seed treatment showed higher rhizosphere microbial population followed by with panchagavya and beejamrutha seed treatment. Lower microbial population was observed in without panchagavya spray and without seed treatment.

Introduction

With increased awareness on organic farming among the farming community they are use of many organic formulations in crop production is increasing. During the last few years there has been increasing interest in the use of panchagavya, beejamrutha, jeevamrutha and other liquid organic formulations. Panchagavya and beejamrutha are two organic products which have received wide spread attention and acceptability among organic farming practitioners. They proved to be efficient plant growth stimulants enhances the biological efficiency of crops and the nutritional quality of the fruits and vegetables. Swaminathan (2007) and Devakumar *et al*., (2008) reported the presence of naturally occurring beneficial microorganism's predominantly lactic acid bacteria, yeast, actinomycets, photosynthetic bacteria, nitrogen fixers, phosphorus solublisers and fungi in panchagavya and beejamrutha. An attempt was made to study the effect of seed treatment, panchagavya application and organic farming systems on soil microbial population, growth and yield of maize. The objectives are to study the effect of beejamrutha and panchagavya on growth and yield of maize, and to study the effect of these on soil microbial population.

Material and Method

A field study was conducted at Organic Farming Research Center, Shivamogga, University of Agricultural Sciences, Bangalore, India. The soil type of experimental field was red sandy loam. Beejamrutha was prepared by following standard procedure given by Palekar, (2006). Panchagavya was prepared by following standard procedure given by Natrajan (2007).Panchagavya was filtered through a clean cloth and 3 liters of Panchagavya filtrate was diluted in 100 liters of water and sprayed at seedling, vegetative and tassling stages of maize crop. Grain and stover yields were recorded and studied microbial population viz; bacteria, fungi, actinomycets, N-fixers, P-solubilizers present in rhizosphere. Serial dilution and standard plate count methods were used for isolation of rhizosphere bacteria, fungi and actinomycets using nutrient agar, Martin's rose bengal agar and Kuster's agar respectively. The free living nitrogen fixers and P-solubilizers using Norri's N-free media and Pikovskaya's media respectively. Inoculated plates were incubated at 32 ± 2^0C for 5 days and the colony counts were recorded. Field experiment consists of three main factors viz; Organic Farming Systems-F_1- Organic farming system I (Palekar's method) and F_2- Organic farming system II (Non Palekar's method), Panchagavya (3%) spray-P_1-With Panchagavya and P_2–Without Panchagavya, Seed treatments-S_1- Control, S_2 – Beejamrutha and S_3 – Panchagavya (3%) and experiment was laid out on Factorial Randomized Block design with 12 treatment combinations with three replications. The treatment

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combinations were T_1: $F_1P_oS_1$, T_2: $F_1P_oS_2$, T_3: $F_1P_oS_3$, T_4: $F_1P_1S_1$, T_5: $F_1P_1S_2$, T_6: $F_1P_1S_3$, T_7: $F_2P_oS_1$, T_8: $F_2P_oS_2$, T_9: $F_2P_oS_3$, T_{10}:$F_2P_1S_1$, T_{11}: $F_2P_1S_2$ and T_{12}: $F_2P_1S_3$

Results

The results indicate that grain yield of maize varied significantly due to different organic farming systems, seed treatment and panchagavya spray (Table 1). Maximum maize grain of 19.3 q per ha and stover (30.0 q / ha) yield were recorded in organic farming system II and minimum yield of 17.1 q per ha and stover yield of 25.7 q per ha were recorded in systems I i.e., Palekar's method of cultivation.

Table 1: Effect of seed treatment, panchagavya application and organic farming systems of cultivation on grain and stover yield (q / ha) of maize

Panchagavya Sprays (P)	Grain yield (q / ha)				Stover yield(q / ha)			
	Organic Farming systems (F)				Organic Farming systems (F)			
	System I (F_1)		SystemII (F_2)	Mean	System I (F_1)		System II(F_2)	Mean
With Panchagavya spray (P_1)	17.5		21.7	**19.6**	28.1		31.4	**29.7**
Without Panchagavya spray (P_2)	16.7		17.0	**16.9**	23.3		28.0	**26.0**
Mean	**17.1**		**19.3**		**25.7**		**30.0**	
	F-test	**S.Ed±**	**C.D at 5 %**		**F-test**	**S.Ed±**	**C.D at 5 %**	
F	**	0.252	1.154		*	1.326	8.07	
P	**	0.636	11.423		*	1.197	21.50	
F x P	*	0.899	16.155		NS	1.692	-	
Seed treatments (S)								
S_1 – Control	16.3		17.6	**16.9**	24.8		30.5	**27.6**
S_2 – Beejamrutha	17.1		18.6	**17.9**	25.6		28.1	**26.8**
S3 – Panchagavya	18.0		21.8	**19.9**	26.7		31.4	**29.0**
Mean	**17.1**		**19.3**		**25.7**		**30.0**	
	F-test	**S.Ed±**	**C.D at 5 %**		**F-test**	**S.Ed±**	**C.D at 5 %**	
S	*	0.778	6.70		NS	1.466	-	
F x S	NS	1.101	-		NS	2.073	-	

The rhizosphere microbial population varied due to the levels of panchagavya, seed treatment and organic farming systems are presented in table 2. Higher microbial population was observed in organic farming system II (Non Palekar) as compared to organic farming system I(Palekar's method). Treatment T_9 with panchagavya spray and panchagavya seed treatment showed higher microbial population followed by with panchagavya and beejamrutha seed treatment. Lower microbial population was observed in T_4 without panchagavya spray and without seed treatment.

Table 2. Soil microbial populations as influenced by seed treatment, panchagavya application and organic farming systems in maize

Treatments	Bacteria (10^5)	Fungi (10^4)	Actinomycetes (10^3)	N-fixers (10^3)	P-solubilizers (10^3)
Initial	124	8	16	25	36
T_1	208	06	20	58	53
T_2	112	07	22	62	50
T_3	224	04	19	59	49
T_4	103	03	11	40	30
T_5	208	06	19	57	47
T_6	211	08	16	46	54
T_7	298	07	14	68	76
T_8	313	12	23	72	85
T_9	348	18	29	85	108
T_{10}	221	08	18	44	49
T_{11}	256	07	21	58	54
T_{12}	176	09	18	63	57

Discussion

Higher grain and stover yield of maize in non palekar method of cultivation was may be due to the better nutrients, soil-water-plant relations in these treatments due to application of pressmud. These are in confirmity with Muthuvelu (2002) and Devakumar et al., (2008) have also reported increase yields in ladies finger, field bean and finger millet. Grain yield of 19.6 q per ha and 16.90 q per ha were recorded with panchagavya (3 %) and without panchagavya spray. Maximum yield of 19.90 q per ha was recorded in seed treatment with panchagavya followed by beejamrutha (17.99 q per ha) and minimum grain yield of 16.90 q per ha was recorded in control. The interaction effects between were found to be non significant.

The organic liquid manures are eco-friendly organic preparations made from cow products and contain macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting substances like IAA, GA and beneficial microorganisms. In the present study, higher growth, yield and quality of crops are due to these factors which are in confirmation with findings of Palekar (2006) and Natarajan (2007). Application of beejamrutha resulted in significantly higher root length than jeevamrutha at vegetative and tassling the stages of crop growth. Panchagavya contains naturally occurring beneficial, effective microorganisms, lactic acid bacteria, yeast, actinomycets, photosynthetic bacteria and certain fungi have improved quality, growth and yield of crops. These results are in confirmity with the findings of Devakumar et al., (2008) reported, application of liquid manure promotes biological activity in soil and enhance nutrients availability to crops.

Application of panchagavya at regular intervals has resulted in higher microbial population over different treatments. This may be attributed to the fact that panchagavya is a rich source of beneficial micro-organisms like N-fixers and P-solubilizers. Similar observations were made by Nagaraj and Sreenivasa (2009) and Sreenivasa *et al*., (2010). Beneficial microorganisms present in beejamrutha produced IAA and GA and resulted in improvement in seed germination, seedling length and seed vigour in soybean. Sreenivasa et al., (2009) reported that beejamrutha contains not general microflora, certain beneficial biochemical groups such as free living N_2-fixers, P- solubilizers and bacteria and Jeevamrutha promotes higher microbial population in soil (Paleker 2006) and Devakumar *et al*., (2008).

Conclusion

Grain and stover yield of maize varied significantly due to different organic farming systems, seed treatment and panchagavya application. Significantly higher grain and stover yields were recorded in organic farming system II and lower was recorded in system I. Panchagavya spray and panchagavya seed treatment recorded higher rhizosphere microbial population followed by with panchagavya and beejamrutha seed treatment. Use of these formulations in organic farming would help framers to get higher yield and returns besides improvement in soil physical, chemical and biological properties. These formulations can be prepared locally by resource poor farmers and improve soil health, besides obtaining higher returns to the farmers in rural areas.

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Organic Farming on Productivity of Rice and Soil Fertility under Alfisols of Southern Transition Zone of Karnataka, India

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Key words: Organic rice production, insitu green manuring, crop productivity, soil fertility

Abstract

A field experiment was conducted during kharif 2012-13 on effect of organic farming on productivity of Rice and soil fertility under alfisol at organic farming research centre, ZAHRS, UAHS, Shimoga, Karnataka, India. Organic biomass generation is primary importance in organic production system to achieving the higher yield and fertility. The results of the study revealed that FYM applied for raising of green manures as in-situ recorded significantly higher green biomass yield. The 100 per cent recommended N(100 kg N/ha) equivalent to FYM applied at sowing of Sesbania aculeata green manure recorded 20.60 ton /ha green biomass yield followed by 100 per cent recommended N equivalent to FYM applied to soil at sowing of mixed green manures (Sesbania aculeata + Crotolaria juncea + Vigna unguilculata) recorded 16.26 ton/ha. Maximum grain (44.05 q/ha) and straw yield (82.01 kg/ha) of paddy as well as soil organic carbon, available N, P_2O_5, K_2O, S and soil microorganisms were recorded in 100 per cent N through FYM applied at sowing of Sesbania aculeata + FYM @10 t/ha at in-situ incorporation of raised green manure biomass followed by 100 per cent N through FYM applied at sowing of mixed green manures + FYM (@10 ton/ha) applied at incorporation. Higher yield and soil fertility under organic paddy production system was achieved through the application of organic manure for raising (at sowing) of green manures as in-situ as well as at incorporation of in-situ raised green manures.

Introduction

Rice (*Oryza sativa* L.) is one of the important food grain crops produced and stable food for more than two billion people in Asia and one billion people of Africa and Latin America. The declined soil fertility and productivity of majority crops in India mainly due to indiscriminate use of agrochemicals and fertilizers. The indiscriminate use not only affecting the soil and cop but also affecting the environment and health of living beings. The wide spread soil nutrient deficiencies, contaminated food and fodder are the negative impact of chemical agriculture on environment and human health has been reported and documented. In rice production system major part of agro chemicals used, to control pests and diseases and more than 50 percent of fertilizers applied to increase the production were contaminated the natural resources. Increased environmental awareness and health consciousness among the producers and consumers apart from fetching good return worldwide to think about organic agriculture as an alternate way for sustainable agriculture to protect the environment and lives health. Organic farming is one of the practices to make rice based cropping system more sustainable without adverse effects on the natural resources and the environment (Stockdale et al. 2002). In organic rice production system nutrients supply through different organic sources is prime importance. Among the organic source the nutrient through green manuring is widely acceptable and feasible technology, but higher green biomass production is difficult without addition of nutrients. The green manure biomass production is through the supply of organic sources of nutrients at the time of sowing to raise green manure crop as the in-situe and incorporate into the soil for achieving the sustainable maximum production. Therefore a study under taken to increase the green manure bimass grown as insitue and incorporate into the soil with additional quantity organic manure to enhance the rice yield and soil fertility under organic system.

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Material and methods

A field experiment was conducted during *Kharif* 2012-13 at organic farming research centre, University of Agricultural and Horticultural Sciences, Navile, Shimoga, Karnataka, India. The soil of experimental site (Initial values) was shallow depth, well drained, sandy loam in texture, low organic carbon (0.50%), low soil available P_2O_5 (15 kg/ha), medium available K_2O (135 kg/ha), low available N (< 280 kg/ha), low CEC (7.3 cmol p^+kg^{-1}), Zn (1-1.1 ppm), Mn (10-15.6 ppm), Fe (15-18.5 ppm) and Cu (1-1.25 ppm). The soil pH was 6.5 and electrical conductivity of soil was 0.45 $dS^{-1}m$. The experiment was laid out in RCBD design with three replication and eight treatments as given in table 1. The quantity of manure was applied on N equivalent basis (FYM:1.02% and neem cake : 5.6 %) as per treatments. Incorporation of green manure was done by ploughing after 8 weeks and allowed it for 15 days to facilitate decomposition then three week old paddy variety jyothi seedlings were transplanted manually with a spacing of 22.5 x 10cm @ 3 seedlings per hill in 24 m^2 area plot. One spray of econeem 50000 ppm @ 4ml per litre (65 DAT), one spray of cow urine and water (1:10) ratio (35 DAT) and two (30 DAT & 55 DAT) spray of panchagavya @ 3 percent were taken as a measure of managing pest, disease and enhance the plant growth. Representative surface soil samples were collected before initiating and after harvest of the paddy crop using core sampler. The air dried processed soil samples were used for analysis. The standard methods and procedure adopted by Piper (1966) and Jackson (1973) were used for the soil analysis. Grain and straw yield were recorded. Statistical analysis of the data was done using computer aided MSTAT.

Results

FYM @10 ton/ha applied at sowing of green manures recorded significantly higher green biomass yield as compared to without FYM. The plot receiving 100 percent N equivalent to FYM at sowing of Dhaincha recorded maximum green biomass yield (20.60 ton/ha) followed by mixed green manures (Dhaincha + Sunhemp + Cowpea) crops (16.26 ton/ha) Maximum grain (44.05 q/ha) and straw yield (82.01 q/ha) , soil available nutrients and microbial population were recorded in the treatment receiving 100 % N equivalent to FYM at sowing of Dhaincha + FYM @10 t/ha at incorporation followed by 100 % N equivalent to FYM at sowing of mixed green manures + FYM @10 ton/ha at incorporation (38.43 q/ha grain and 71.68 q/ha straw yield, respectively) (Table1).

Table 1: Green biomass yield, Rice Productivity, Microbial population and soil properties as affected by organic farming practices

Treatments		Green biomass yield (t/ha)	Grain	Straw	Microbial population (cfug^{-1})					pH	EC	OC	N	P_2O_5	K_2O	S
			Yield (Kg/ha)		B	F	A	PS	NF	1:2.5	dSm^{-1}	g/kg	Kg/ha			ppm
T_1	Without FYM at sowing of Dhaincha (Insitu) green manure + RDM (FYM@10 ton/ha) at incorporation	3.86	26.43	48.06	71	14	10	25	34	6.4	0.49	4.8	168.9	17.1	144.2	16.3
T_2	Without FYM at sowing of mixed green manures (Insitue) + RDM (FYM,10 ton/ha) at incorporation of green manure	2.96	22.73	43.12	52	13	08	21	30	6.8	0.58	4.4	158.4	17.2	146.0	15.1
T_3	T_1+ 50 % rec N through neem cake at incorporation	3.56	26.80	47.87	73	13	10	27	36	6.5	0.55	4.3	164.6	18.1	167.2	19.0
T_4	T_2 + 50 % rec N through neem cake at incorporation	3.11	23.25	43.25	64	12	08	23	33	6.3	0.51	4.1	162.3	18.3	155.9	20.3
T_5	100 % rec N through FYM at sowing of dhaincha green manure + RDM (FYM @ 10 t/ha)at incorporation	20.60	44.05	82.01	126	22	18	36	49	6.6	0.65	6.7	196.4	24.77	185.4	26.5
T_6	100 % rec N through FYM at sowing of mixed green manure + RDM (FYM @10 t/ha) at incorporation	16.26	38.48	79.68	112	20	13	32	45	6.4	0.70	5.9	187.4	22.29	179.5	24.4
T_7	50 % rec N through FYM at sowing of dhaincha green manure + 50 % rec N through (FYM + neem cake) at incorporation	9.29	36.43	71.40	97	18	10	26	35	6.5	0.56	4.8	170.2	20.4	166.7	21.3
T_8	50 % rec N through FYM at sowing of mixed green manure + 50 % rec N through (FYM +neem cake) at incorporation	8.36	34.54	69.04	86	15	10	27	32	6.3	0.59	5.0	169.6	20.17	170.3	20.6
SEm±		**0.886**	**1.97**	**4.21**	**-**	**-**	**-**	**-**	**-**	**0.12**	**0.071**	**0.06**	**5.04**	**1.01**	**9.88**	**1.07**
CD@5%		**2.551**	**5.64**	**12.02**	**-**	**-**	**-**	**-**	**-**	**0.37**	**0.210**	**0.11**	**14.6**	**3.23**	**28.99**	**3.14**
CV (%)		**17.73**	**11.82**	**12.05**	**-**	**-**	**-**	**-**	**-**	**1.12**	**7.27**	**1.79**	**1.68**	**3.21**	**3.48**	**3.05**

B – Bactria (10^5), F – Fungi (10^4), A – Actinomyctes (10^3), PS - Phosphorous solubilisers (10^3), NF - Nitrogen Fixers (10^3), OC - organic carbon
DAT: Days after Transplanting

Discussion

Natarajan (2003) reported that *Sesbania aculeata* with poultry manure resulted in higher rice yield than combination with press mud and FYM. Kenchaiah (1997) reported that application of *Sesbania rostrata* + poultry manure and FYM increased the grain and straw yield of rice. Application of green manures increased yield and yield components reported by Sudhakar (2000) Significantly higher organic carbon (6.7 g/kg), available N (196.4 kg/ha), available P_2O_5 (24.77 kg/ha), available K_2O (185.4 kg/ha) and available S (26.51 ppm) were recorded in the treatment receiving 100 percent N equivalent to FYM at sowing of dhaincha + FYM @10t/ha at insitu incorporation followed by the treatment receiving 100 percent N equivalent to FYM at sowing of mixed green manures + FYM @10 ton/ha at incorporation. The continuous application of all the organic sources to rice for three years significantly improved the soil organic carbon, N, P and K status at the end of the cropping system (Singh 2011). The higher soil nutrients and microbial properties in organically managed farms compared to chemical farms (Moola Ram *et al* 2011). The slightly increase in soil pH and electrical conductivity might be due to release of soluble salts during decomposition of green manures and FYM.

Conclusion

The research results can be concluded that the insitue green manuring with addition of organic manures increased the green manures biomass yield. In situe Green manuring with FYM at sowing and at incorporation enhanced the productivity of organically grown rice and soil fertility.

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Microbial analytical studies of traditional organic preparations beejamrutha and jeevamrutha

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Key words: Beejamrutha, Jeevamrutha, Bacteria, Fungi, N-fixers, P-solubilizers

Abstract

An experiment was conducted on liquid formulations to study microbial diversity and know the best period of its use in crop production. Higher colony forming units (CFU) were observed on the day of preparation of beejamrutha and in jeevamrutha it was between 9th to 12th days after preparation (DAP). Higher number of bacteria, different fungi and N-fixers clearly indicate that the jeevamrutha is enriched consortia of native soil microorganisms. It was found that, beejamrutha would give best result if it is used on the day of preparation and Jeevamruth between 9th to 12th days after preparation. The microbial studies revealed that higher bacterial population was recorded followed by N-fixers, P-solubilizers, fungi and actinomycetes. Due to the higher beneficial microbial load would mobilise more of plant nutrients and provide plant growth promoting substances and also other micro nutrients required by the plants.

Introduction

Organic agriculture is now finding place in the mainstream of development and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. Liquid formulations that are used in organic agriculture like panchagvya, beejamrutha and jeevamrutha are the fermented products which are used as plant growth enhancing substances prepared with material available with farmers. They are the rich sources of beneficial micro flora which support, stimulate the plant growth and help in getting better vegetative growth and also good quality yield. Formulations prepared on agricultural by- products, *viz.,* bran of grains, oil cakes, farmyard manure *etc*., which are found to support excellent growth carrier and storage media (Devakumar *et al*. 2011). During the last few years, there has been an increasing interest in the use of panchagavya, beejamrutha, jeevamrutha and other liquid organic formations in organic agriculture. Devakumar *et al*., (2008) and Srinivas et al., (2010) have reported the presence of many beneficial microorganisms viz., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in jeevamrutha and beejamrutha. With this in view, an experiment was conducted to study the microbial load and diversity in the fermented liquid formulations viz., beejamrutha and Jeevamrutha.

Material and Methods

A laboratory study was conducted at Organic Farming Research Centre (OFRC), ZARS, Navile, Shivamogga, University of Agricultural Sciences, Bangalore, India. The liquid organic formulations beejamrutha and jeevamrutha were prepared by following procedures given by Palekar (2006). Beejavamrutha was prepared by soaking 5 Kg of local cow dung in 20 litres of water and 50 g of lime in one litre water overnight. Next day morning squeeze cow dung into the lime soaked water and to this add 10 liters of local cow urine, stir thoroughly and add lime solution and mix well. Jeevamrutha is prepared by mixing 10 kg local cow dung with 10 litres cow urine, add 2 kg local jaggery, 2 kg pulse flour and handful of garden soil and the volume made upto 200 litres. Keep the drum in shade covering with wet gunny bag and stir the mixture clockwise thrice a day and incubate. Laboratory studies on microbial analysis of beejamrutha and jeevamrutha were made following serial dilution and plate count technique. Samples were drawn on daily basis up to 7 days after preparation (DAP) for beejamrutha and up to 20 days for Jeevamrutha. Samples were studied for five groups of micro organisms' *viz*., bacteria & fungi, actinomycets, N-fixers and P-solubilizers.

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Results

Maximum CFUs of bacteria, fungi, actinomycets, N-fixers and P-solubilizers were present in beejamrutha on the day of preparation and later on there was sharp decline in their number as the days elapsed (Table 1) and maximum CFUs of bacteria (623), fungi (22) actinomycets (2), N-fixers (71) and P-solublisers (52) were recorded on the day of preparation of beejamrutha and thereafter, it decreased progressively and it was minimum on 7th day after preparation.

From the table 2 it was noticed that the higher colony forming units (CFU) in Jeevamrutha were recorded between 9th to 12th days after preparation. In the preparations, higher number of bacterial CFUs *viz*., *Azatobacter* sp., *Bacillus* sp., *Beijerinckia* sp., *Chromatium* sp., *Chromobacterium* sp., *Pseudomonas* sp., *Rhodomicrobium* sp., *Serretia* sp., *Xanthomons* sp., were recorded.

Table: 1. Microbial population of Beejamrutha between 1 to 7 days after preparation

Days After Preparation	Microbial populations (CFU's*)				
	Bacteria (10^5)	Fungi (10^4)	Actinomycetes (10^3)	N-fixers (10^4)	P-solubilisers (10^4)
1	623	22	2	71	52
2	435	11	2	40	42
3	371	11	1	39	34
4	259	9	2	39	34
5	208	2	1	28	25
6	190	2	1	19	20
7	171	1	1	15	10

*Colony farming units

The different fungi observed were: *Aspergillus* sp., *Fusarium sp., Penicillium* sp., *Trichoderma* sp., isolated P-solubilisers fungi like - *Aspergillus* sp., *Penicillium* sp., Bacteria like- *Bacillus* sp., *Pseudomonas* sp., and N-fixers like Bacteria - *Azatobacter* sp., *A.chroococcum*, *Bacillus* sp., *Beijerinckia* sp., Actinomycetes - *Streptomyces* sp. It clearly indicates that the jeevamrutha is enriched consortia of native soil micro organisms. The preparation would give best results if it is used between 9th to 12th days after preparation.

Table: 2. Microbial population of Jeevamrutha between 1 and 30 days after preparation

Microbes	Microbial Population									
	Days after Preparation									
	01	02	03	04	05	06	07	08	09	10
Bacteria (10^5)	213	351	269	271	361	495	692	780	813	855
Fungi (10^4)	11	2	6	2	1	6	7	31	32	29
Actinomycetes (10^3)	1	1	1	1	1	2	1	9	12	8
N-Fixers (10^4)	34	29	16	46	23	09	20	27	63	69
P-Solubilizers (10^4)	61	60	12	48	37	53	61	48	50	80

Microbes	Microbial Population									
	Days after Preparation									
	11	12	13	14	15	16	17	18	19	20
Bacteria (10^5)	843	727	447	526	562	551	402	367	339	292
Fungi (10^4)	36	17	08	21	18	14	17	06	05	04
Actinomycetes (10^3)	11	03	03	03	06	01	02	03	02	02
N-Fixers (10^4)	67	58	49	34	40	118	90	64	43	30
P-Solubilizers (10^4)	52	79	67	32	34	131	40	47	48	35

The nutrient composition of beejamrutha, jeevamrutha and their constituents (Table 3) reveals that beejamrutha is alkaline and jeevamrutha is acidic in nature. They are good source of macro and micro nutrients.

Table: 3. Nutrient composition of beejamrutha, jeevamrutha and their constituents.

Sample	pH	N	P	K	Mg(ppm)	Cu(ppm)
Beejamrutha	8.02	2.38	0.127	0.485	16	36
Jeevamrutha	4.92	1.96	0.173	0.280	46	51
Local cowurine	8.16	1.67	0.112	2.544	6.3	20.00
Local cowdung	8.08	0.70	0.285	0.231	9.33	3.60
Pulse flour	6.70	1.47	0.622	0.910	12.6	12.40

Discussion

Beejamrutha and jeevamrutha were found to have higher number of beneficial microorganisms. Maximum microbial population was observed on the day of preparation in beejamrutha and on 10th day after preparation in jeevamrutha. The presence of beneficial microorganisms in these liquid formulation might be mainly due to their constituents such as: cow dung, cow urine, legume flour and jaggery containing both macro and essential micro nutrients, many vitamins, essential amino acids, growth promoting substances like indole acetic acid (IAA), gibberlic acid (GA) and beneficial microorganisms (Palekar, 2006; Sreenivasa *et al*., 2010; Neelima and Sreenivasa, 2011). For jeevamrutha a handful of soil is collected from the field for which these formulation is to be used is also added at the time of preparation. This would serve as a initial inoculums of bacteria, fungi, actinomycetes, N-fixers and P-solublizers. Hence, the higher beneficial microorganisms found in these organic formulations are in confirmity with Papen *et al.,* (2002), Sreenivasa et al., (2010) who have also reported the presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes and certain fungi in organic liquid manures. Hence, these formulations would serve a long way in supplementing many of the biofertilizers and biocontrol agents used in crop production in the rural areas. This is also in conformity with Devakumar *et al*., (2011) who have reported that both jeevamrutha and panchagavya have enhanced the growth of nitrogen fixers in locally available substrates such as FYM, pressmud, compost and digested biogas slurry.

Somasundaram *et al.,* (2003) have found that under higher acidity, more number of beneficial microorganisms were recorded in panchagavya. They not only enhance the microbes in the environment but also act as catalysts with a synergistic effect to promote all the useful microbes of the environment. These microorganisms secrete proteins, organic acids and antioxidants in the presence of organic matter and convert them into energy thereby the soil micro flora and fauna change a disease inducing soil to a disease suppressive soil.

Conclusion

Liquid Organic preparations contain higher number of bacteria, fungi, actenomycets, N-fixers and P-solubilizers. From the studies it is evident that beejamrutha is to be used on the day of preparation while jeevamrutha to be used between 9 to 12 days after preparation. The application of these liquid formulations would supplement the application of biofertilizers and they can be prepared easily by locally available materials by the farmers, in rural areas.

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Multiplication of bio-control agents on locally available organic media

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Key words: Organic farming, bio-control agents, panchagavya, jeevamrutha

Abstract

Crop protection in organic farming is done by using plant extracts, bio-pesticides, bio-control agents, local preparations like panchagavya, jeevamrutha etc. Bio-control agents such as Trichoderma, Verticillium, Nomuraea etc., are used in control of soil borne diseases and some insect pests. An attempt was made to multiply these micro organisms with the objective of evaluating the suitability of locally available organic materials for multiplication of micro organisms and to compare the growth in different media. It was observed that, only jeevamrutha alone, without glucose supported the growth of all the bio-control agents and their growth was better when 1 per cent glucose was used with all media substrates except panchagavya. The results indicate that these micro-organisms can be multiplied by farmers on their farm using locally available material at a very low cost.

Introduction

Crop protection in organic farming involves use of many naturally occurring plant extracts such as neem, pongamia, vitex etc., and preparations like panchagavya, jeevamrutha. Micro organisms such as *Trichoderma, Verticillium, Neumoria* etc., are important bio-control agents in controlling soil borne plant diseases and some of the insect pests. The commercial biocontrol agents available in market are expensive and are not available to farmers easily. Formulations based on the agricultural waste products, *viz.,* bran of grains, oil cakes, farmyard manure etc.., are found to support microbioal growth and storage media (Patibanda *et al. 2003).* Application of *T.harzianum* colonized on wheat bran to soils infested with *Rhizotonia solani* and *S.rolfsii* reduced the incidence of diseases in beans and mungbean (Haidar *et al.* 1979). In order to know the feasibility of these bio-inoculants using locally available organic materials by the farmers themselves on their farm, a laboratory study was conducted to evaluate the suitability of locally available organic materials for multiplication of micro organisms and also to compare the growth of micro organisms.

Material and Methods

The experiment was conducted at Organic Farming Research Centre (OFRC), Zonal Agricultural Research Station, Navile, Shivamogga, India. The nutrient materials tested were: digested bio-gas slurry, compost, press mud, jeevamrutha and panchagavya. Six micro organisms were used as bio-control agents and tested for their growth and development on locally available natural media substances. The micro-organisms tested were: *Pseudomonas florescence, Metarhizium anisopliae, Nomuraea rileyii, Verticillium lecanni, Fusarium* – 15 and *Trichoderma viride.* As a control treatment, the bacterial cultures were inoculated on nutrient agar and fungal cultures on potato dextrose agar. The experiment was conducted with and without 1 per cent glucose to know carbon source supplementation.

The test organisms were isolated locally from the organic plots of OFRC. Test materials used were: digested bio-gas slurry, compost, press mud, Jeevamrutha and panchagavya. They were mixed in 1:1 proportion with sterilized distilled water, soaked overnight and the extract was filtered. The extrantant was sterilized along with 20 g agar as a solidifying agent. About 15-20 ml of sterilized media was then transferred to each Petri plate and the bio control agents were inoculated under aseptic condition. The inoculated plates were incubated under room temperature and observations were recorded after 48 hours for bacteria and seven days for fungal inoculants. Growth observations were recorded for three days for bacteria and seven days for fungal inoculants. Growth was compared with the growth in control plates and they were scored as average (+), good (++), better (+++) and Nil(–). The treatment combinations of the experiment conducted were: T_1 -Compost extract, T_2 - Digested biogas slurry (DBS), T_3 – Panchagavya, T_4 – Jeevamrutha, T_5 -

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Press mud, T_6 Control, T_7 – Compost extract +DBS + Panchagavya + Jeevamrutha + Pressmud (1:1), T_8 – Compost extract + panchagavya (1:1), T_9 – Digested Biogas Slurry + panchagavya (1:1), T_{10} – Digested Biogas Slurry + Jeevamrutha (1:1), T_{11} – Compost extract + Jeevamrutha (1:1), T_{12} – Press mud + Panchagavya (1:1), T_{13} – Press mud + Jeevamrutha (1:1), T_{14} – Digested Biogas Slurry + compost extract (1:1) and T_{15} – Digested Biogas Slurry + press mud (1:1).

Results

The observations recorded on growth of different bio control agents on locally available natural media and their combinations with and without glucose supplementations are presented in table 1 to 4. Among the different basal materials, jeevamrutha has supported maximum growth of the bio control agents (Table 1).

Table 1: Growth of bio-control agents on locally available natural nutrient media without glucose supplementation

Organisms	T_1	T_2	T_3	T_4	T_5	T_6
Pseudomonas florescence	+	+	-	++	+	++
Metarhizium anisopliae	+	-	+	++	-	++
Nomuraea rileyii	-	+	-	++	-	++
Verticillium lecanni	-	+++	+	++	-	++
Fusarium – 15	+	++	+	++	+	++
Trichoderma viride	++	+	+	++	++	++

Performance of micro organisms did not follow a definite trend when the combinations of basal media were used without 1 per cent glucose supplementation (Table 2). Growth of *Trichoderma* was good with compost extract, digested biogas slurry and Press mud when used either with Jeevamrutha or Panchagavya. When the media was supplemented with 1 Per cent glucose as an additional carbon source, growth and development of all the bio control agents were better except in panchagavya (Table 3). Better growth may be attributed to the readily available source of carbon for growth of micro organisms. Higher growth in control plates indicated that there is a need to supplement media with initial nutrient source for multiplication of bio-control agents.

Table 2: Growth of bio-control agents as influenced by combinations of locally available natural nutrient media alone without glucose supplementation

Organisms	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}
Pseudomonas florescence	++	+	-	++	+	++	+	+	++	++
Metarhizium anisopliae	++	+	-	+	+	-	+	+	+	+
Nomuraea rileyii	++	+	+	+	+	-	+	+	++	+
Verticillium lecanni	++	+	+	++	++	+	++	-	+	-
Fusarium – 15	++	+	+	+	+	-	+	-	-	-
Trichoderma viride	++	+	++	++	++	++	+	++	++	+

Table 3: Growth of bio-control agents on locally available natural nutrient media alone with glucose supplementation

Organisms	T_1	T_2	T_3	T_4	T_5	T_6
Pseudomonas florescence	+	++	-	++	++	+++
Metarhizium anisopliae	++	++	+	++	++	+++
Nomuraea rileyii	++	++	-	++	++	+++
Verticillium lecanni	++	++	-	++	++	+++
Fusarium – 15	++	++	-	++	++	+++
Trichoderma viride	++	++	+	++	++	+++

Growth of micro-organisms was uniform and better (Table 4) when 1 Percent glucose was added to the combination of materials viz; Press mud + Panchagavya, digested biogas slurry + Press mud followed by fairly good growth in digested biogas slurry + Panchagavya (1:1) and digested biogas slurry + Compost extract (1:1). This clearly shows presence of readily available nutrients in digested bio gas slurry and uneven growth pattern observed with different combinations of materials was due to non availability of nutrients.

Table 4: Growth of bio-control agents as influenced by combinations of locally available natural nutrient media with glucose supplementation

Organisms	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}
Pseudomonas florescence	+++	++	+	++	++	+	++	+	++	++
Metarhizium anisopliae	+++	++	+	++	++	+	++	+	++	++
Nomurea rileyii	+++	+	+	++	+	+	++	+	++	++
Verticillium lecanni	+++	+	+	++	+	+	++	+	+	++
Fusarium – 15	+++	+	+	+	+	+	++	+	+	++
Trichoderma viride	+++	+	+	++	++	+	++	+	+	++

Discussion

Growth of *Trichoderma* was good in compost extract and press mud, while growth and performance of *Verticillium lecani* was better in digested biogas slurry, and performance of all bio-control agents was good in control plates. In compost extract, available nutrients might have encouraged the growth of *Trichoderma* compared to other bio-control agents. Growth of *Verticillium lecani,* was maximum in digested biogas slurry and it might be due to the fact that the digested biogas slurry contained nutrients in readily available form also in a balanced proportion. Jeevamrutha supported growth of all the bio-control agents and it might be due to the higher content of nutrients and lower pH of jeevamrutha as compared to other natural media. Jeevamrutha with a pH 4.8 to 5.2 has more beneficial micro organisms and also contains higher amounts of other metabolites for supporting growth of micro organisms (Devakumar *et al*. 2008).Similarly, application of jeevamrutha to sunflower crop increased the activity of soil microbes, solubalisation and uptake of nutrients, synchronizing with crop growth and sustained productivity of sunflower (Manjunatha *et al*. 2009). Panchagavya alone failed to support growth of micro organisms and this might be due to the presence of many fatty acids and other biochemicals present in panchagavya have intribited the growth of biocontrol agents (Selvaraj et.al. 2006). It was also observed that it contained many beneficial micro organisms. The microbial population count increased up to 21st day of its preparation. Hence, it may be also due to the presence of micro-organisms in panchagavya which might have also acted as antagonistic to the inoculated micro-organisms. Further, these results are corroborating with Natarajan (2002) and Balasubramanian *et al*. (2009) who have also obtained similar results. However, Natarajan (2002) reported that, microorganisms present in Panchagavya not only enhance the microbes in the environment but also act as catalysts with a synergistic effect to promote all the useful microbes. Thus, the soil micro flora and fauna change from a disease inducing soil to a disease suppressive soil.

Conclusions

Multiplication of micro organisms used as bio control agents is possible using locally available organic materials viz., compost extract, Jeevamrutha, Press mud, digested biogas slurry. Performance of bio control agents was better with the combination of digested biogas slurry+ Panchagavya; Press mud + Panchagavya and digested biogas slurry + Press mud. Bio-control agents can be multiplied locally with low cost by adding Jaggery solution.

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Productivity and Profitability of Cotton-based Production Systems under Organic and Conventional Management in India

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Key words: Cotton, Economic analysis, Organic agriculture, India, smallholders, cropping systems

Abstract

The debate on benefits of conventional and organic farming systems has recently gained significant interest. Results from systems comparisons in the South, however, are scarce. This study presents agronomic and economic data of a systems comparison trial in India. We observed significantly lower yields in organic systems in crop cycle 1 (2007-2008) for cotton (-29%) and wheat (-27%), whereas in crop cycle 2 (2009-2010) yields were similar in all systems. In contrast, organic soybean yields were only marginally lower (cycle 1: -1%, cycle 2: -11%). Gross margins were significantly higher in conventional systems in cycle 1 (+29%), whereas in cycle 2 they were significantly higher in organic systems (+25%) due to lower variable production costs. Soybean gross margin was significantly higher in an organic system (+11%) across the four harvest years. We suggest that organic soybean production is a viable option for smallholder farmers under semi-arid conditions in India.

Introduction

The debate on the relative benefits of conventional and organic farming systems is more topical than ever. The achievements of conventional high-input agriculture were based to a large extent on fossil fuels and largely brought about at the cost of deteriorating soil fertility. Developing more sustainable farming practices on a large scale is of utmost importance (IAASTD, 2009). However, information about the performance of farming systems under organic and conventional management in tropical and subtropical regions is sparse.

Material and methods

This study presents agronomic and economic data from the conversion phase (2007-2010) of a farming systems comparison trial on a Vertisol soil in central India. A cotton-soybean-wheat crop rotation under biodynamic, organic and conventional (with and without genetically modified (GM) Bt cotton) management was investigated (Figure 1). A detailed description of the materials and methods used in this study can be found in Forster et al. (2013)

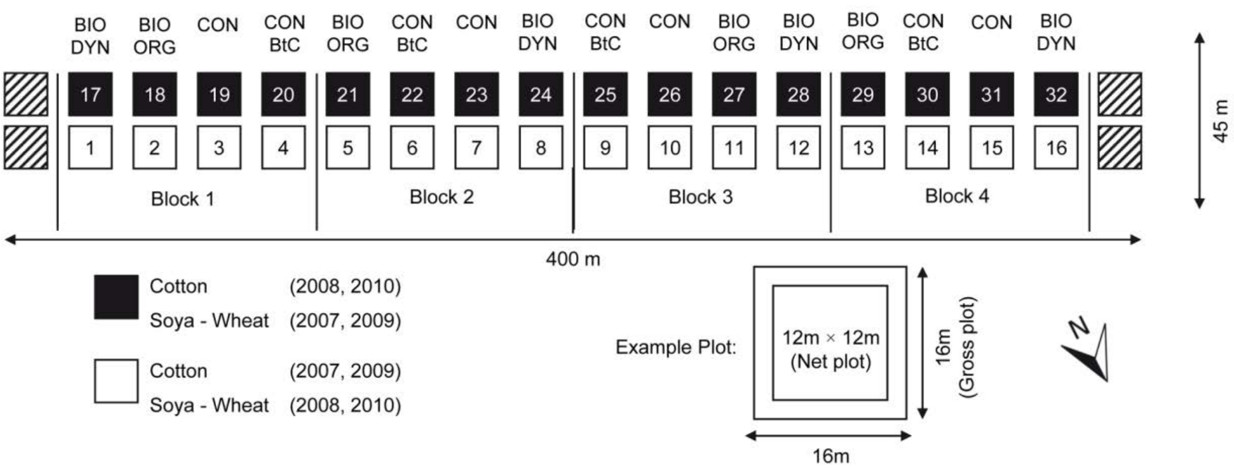

Figure 1: Experimental design of the farming systems comparison trial. Farming systems: biodynamic (BIODYN), organic (BIOORG), conventional (CON), conventional with Bt cotton (CONBtC).

Results

We observed a significant yield gap between organic and conventional farming systems in the first crop rotation (cycle 1: 2007-2008) for cotton (-29%) and wheat (-27%), whereas in the second crop rotation (cycle 2: 2009-2010) yields were similar in all farming systems (Figure 2). Lower variable production costs in organic farming systems (-32%) led to similar gross margins in all systems, averaging 104’909 Indian rupees ha^{-1} (equivalent to 2’089 US Dollars ha^{-1}) per crop rotation (Figure 3). Conventional farming systems achieved significantly higher gross margins in cycle 1 (+29%), whereas in cycle 2 gross margins in organic farming systems were significantly higher (+25%).

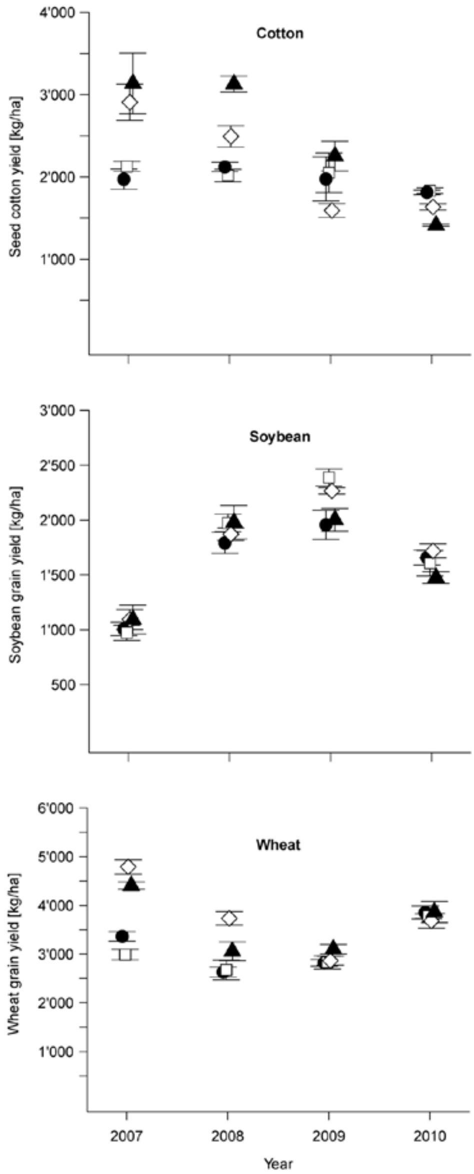

Figure 2: Yield 2007-2010 in cotton, soybean and wheat. Farming systems: ● biodynamic (BIODYN), ■ organic (BIOORG), ♦ conventional (CON), ▲ conventional with Bt cotton (CONBtC).

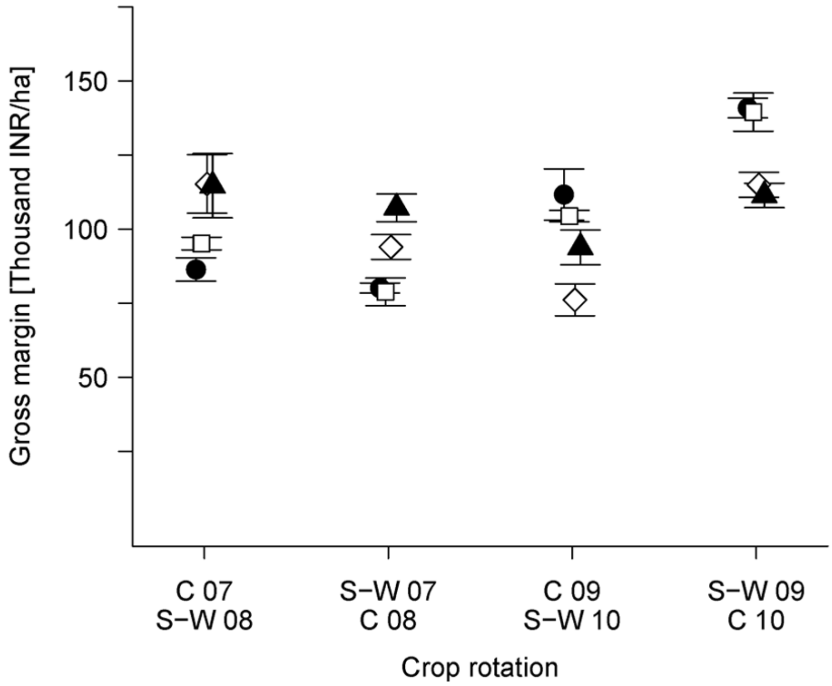

Figure 3: Gross margins of four crop rotations. C = cotton, S-W = soybean-wheat. Farming systems: ● biodynamic (BIODYN), ■ organic (BIOORG), ♦ conventional (CON), ▲ conventional with Bt cotton (CONBtC).

Discussion

Our findings show the potential benefits of organic farming systems under the premise that marginal farmers have access to knowledge, purchased inputs such as organic fertilizers, pesticides and non-GM seeds, and assuming that there is a market demand and well developed certification system (Forster et al. 2013). Future research needs to elucidate the long-term productivity and profitability, particularly of cotton and wheat, and focus on the ecological impact of the different farming systems. Furthermore, the results need to be verified in further crop cycles and on geographically spread on-farm comparisons.

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Is organic tuber production promising? Focus on implications, technologies and learning system development

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Key words: Eco-friendly farming, root crops, yield, quality, soil health, learning system

Abstract

Organic farming is an alternative for sustainable and safe food production. Tropical tuber crops, cassava, yams and aroids are ethnic starchy vegetables with good taste and nutritive value. Field experiments were conducted at Central Tuber Crops Research Institute, India, for a decade to compare the varietal response, yield, quality and soil properties under organic vs conventional system in tuber crops and to develop a learning system. The industrial and domestic varieties, the elite and local ones and the native and introduced species responded similarly.Organic management enhanced yield by 10-20%, net profit by 28%, improved the tuber quality with higher dry matter, starch, crude protein, K, Ca and Mg contents and lower anti-nutritional factors and promoted the physico-chemical properties, dehydrogenase enzyme activity and microbial count. A learning system was developed using artificial neural networks to predict the performance of organic system. Technologies are described.

Introduction

Presently world agriculture needs knowledge-intensive design to reduce the dependence on external fossil fuel inputs and enhance yield and access to food. Organic farming provides synergies between food production and ecosystem services and contributes to safe food and environment. Tropical tuber crops viz., cassava, elephant foot yam, taro and yams (*Dioscorea* spp.) are climate smart and food security crops for 500 million of the global population. These are high energy starchy vegetables with good taste and medicinal values. As these crops respond well to organic manures there is ample scope for organic production and export. The goals were to compare yield, quality, economics, soil physico-chemical and biological properties under organic vs conventional management in tuber crops by field experiments and to develop a learning system using artificial neural network to predict the yield of elephant foot yam under various organic input combinations in different locations of India.

Material and methods

Study site, experimental design, treatments and test variety

Seven separate field experiments were conducted at the Central Tuber Crops Research Institute, Thiruvananthapuram, India, over a decade (2004-2013) to compare organic farming over conventional system in cassava, elephant foot yam, taro and yams in an acid Ultisol (pH: 4.3-5.0). In cassava, the experiment was laid out in split plot design with three varieties, H-165 (industrial variety), Sree Vijaya and Vellayani Hraswa (domestic varieties) in main plots and five production systems, traditional, conventional, integrated and two types of organic in sub plots. The impact of conventional, traditional, organic and biofertilizer farming was evaluated in RBD in elephant foot yam. Comparative response of 5 varieties of elephant foot yam (Gajendra, Sree Padma, Sree Athira and 2 locals) under organic and conventional farming was also evaluated in another experiment. The three trailing genotypes of edible *Dioscorea* (white yam: *D. rotundata* (var. Sree Priya), greater yam: *D. alata* (var. Sree Keerthi) and lesser yam: *D. esculenta* (var. Sree Latha)) were evaluated under conventional, traditional and organic farming systems in split plot design. Likewise the response of three varieties of taro (Sree Kiran, Sree Rashmi and local) to the various production systems was studied. The dwarf genotype of white yam (var. Sree Dhanya) was also evaluated under conventional, traditional, organic and integrated systems in RBD. The organic farming technology developed for elephant foot yam (on station) was confirmed through on farm trials conducted at 10 sites covering 5 ha in Kerala under the project financed by National Horticulture Mission.

Chemical inputs were not used for an year prior to the start of the investigations. In "conventional plots" farmyard manure (FYM) + NPK fertilizers were applied. Farmers practice of using FYM and ash was followed in "traditional plots". In "organic farming plots", FYM, green manure, ash, neem cake and/or biofertilizers

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were applied to substitute chemical fertilizers. In “biofertilizer farming”, FYM, mycorrhiza, *Azospirillum* and phosphobacterium were applied. In “integrated farming“, FYM, chemical fertilizers and biofertilizers were

used. The NPK additions in the various treatments is given in Table 1. Organically produced planting material was used for the study. In this paper the comparison between organic and conventional treatments alone are discussed.

Plant and soil measurements and statistical analysis

Pooled analysis of yield data of 5 years was done. Proximate analyses of tubers for dry matter, starch, total sugar, reducing sugar, crude protein, oxalates and total phenols, mineral composition of corms viz., P, K, Ca, Mg, Cu, Zn, Mn and Fe contents, chemical parameters of soil viz., soil organic matter (SOM), pH, available N, P, K, Ca, Mg, Cu, Zn, Mn and Fe status, physical characters of the soil such as bulk density, particle density, water holding capacity and porosity, plate count of soil microbes viz., bacteria, fungi, actinomycetes, N fixers, P solubilizers and the activity of dehydrogenase enzyme were determined by standard procedures. Economic analysis was done. The analysis of variance of data was done using SAS (2008) by applying analysis of variance technique.

Table 1 : NPK additions in the various production systems

Crop	N: P_2O_5 : K_2O (kg ha^{-1})			
	Conventional	Traditional	Organic	Biofertilizers/Integrated
Cassava	163:75:135	74:57:177	245:83:249	110:55:128
Elephant foot yam	225:100:220	198:120:314	353:153:408	145:70:70
Yams	130:80:108	84:54:148	239:87:243	
Dwarf white yam	130:80:108	84:54:148	239:87:243	100:60:108
Taro	140:49:134	87:62:184	242:95:278	

Development of a learning system

A learning system was developed using artificial neural networks (ANN) to predict the performance of elephant foot yam production system (Frank Zee and David Bubenheim 1997, Rajasekaran and Vijayalakshmi 2009). A three layered system with one input layer, one output layer and a hidden layer was developed. There were 12, 3 and 4 neurons in the input, hidden and output layers respectively. The input layer neurons included temperature, rainfall, planting material, FYM, K, P, ash, neem cake, *Azospirillum*, phosphobacteria, mycorrhiza and green manure. The output layer neurons were total biomass, corm yield, canopy spread, plant height. Four datasets for the different years were used for training the system.

Results

Varietal response

The industrial and domestic varieties of cassava, the elite and local varieties of elephant foot yam and taro and all the three species of *Dioscorea* responded similarly to both the systems. However, the industrial variety of cassava, Gajendra variety of elephant foot yam and the trailing genotypes of *Dioscorea* yielded more under organic farming than chemical farming. The dwarf white yam produced slightly higher yield under conventional practice.

Yield and economics

Organic farming resulted in 10-20% higher yield in cassava, elephant foot yam, white yam, greater yam and lesser yam ie., 8, 20, 9, 11 and 7% respectively. In taro and dwarf white yam slight yield reduction was noticed under organic farming (2-4%) (Figure 1). The boxplot showing the distribution of yield of different crops under the organic and conventional production systems was drawn using R environment for statistical computing (R version 3.0.2, 2013) (Figure 2). Yield trend over 5 years and pooled analysis indicated the significantly superior performance of organic farming in elephant foot yam. In yams, up to third year, organic farming proved superior, thereafter it was on par or slightly lower than conventional practice. Pooled analysis indicated that organic farming was on par with conventional practice but with slightly higher yield. In taro, organic farming was on par with conventional practice, but chemical farming produced slightly higher yield. This was because taro leaf blight could not be controlled by organic measures. Cost-benefit analysis in elephant foot yam indicated that the net profit was 28% higher and additional income of Rs. 47,716 ha^{-1} was obtained due to organic farming (Suja et al. 2012).

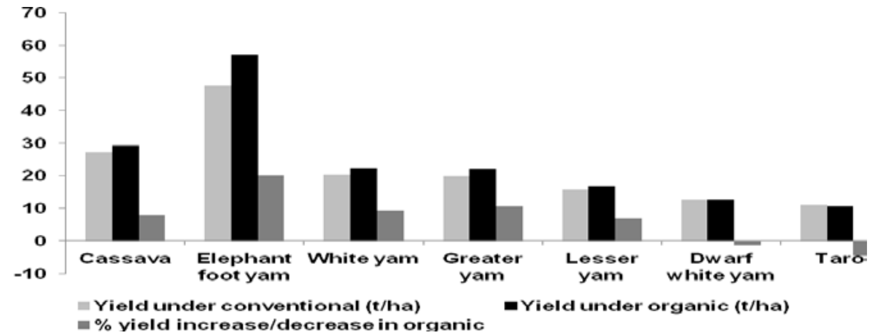

Figure 1: Organic vs conventional in tuber crops: tuber yield

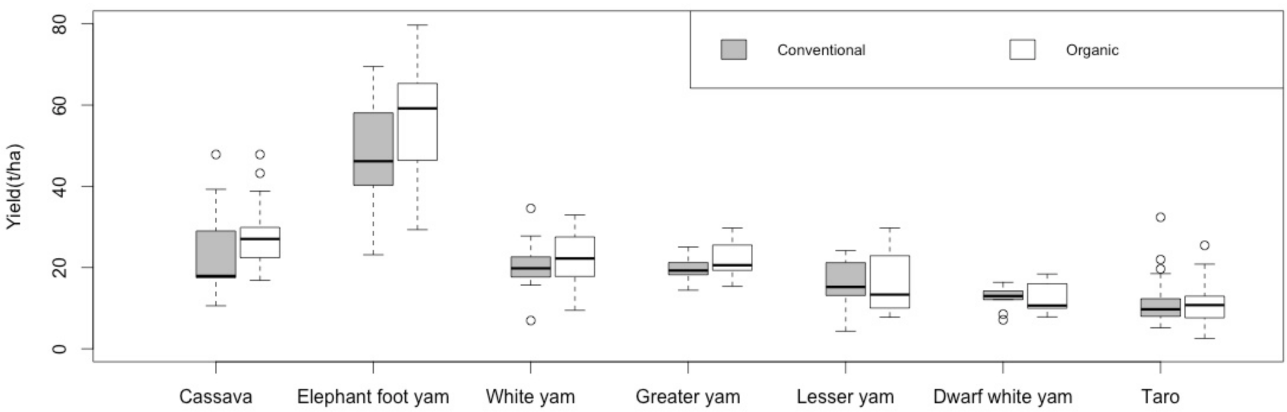

Figure 2: Distribution of yield of different crops under organic vs conventional systems

Tuber quality

The tuber quality was improved with higher dry matter, starch, crude protein, K, Ca and Mg contents under organic management. The anti-nutritional factors, oxalate content in elephant foot yam and cyanogenic glucoside content in cassava were lowered by 21 and 12.4% respectively due to organic farming.

Soil quality indicators

The water holding capacity was significantly higher under organic management (14 g cm^3) in elephant foot yam and yams over conventional practice (11-12 g cm^3). There was significant improvement in pH in organic farming (0.77, 0.46, 1.20 and 1.0 unit increase over conventional system) in elephant foot yam, yams, taro and cassava. The SOM was higher by 10-20% (Figure 3). In elephant foot yam, exchangeable Mg, available Cu, Mn and Fe contents were significantly higher in organic plots. Organic plots showed significantly higher available K (by 34%) in yams and available P in taro. The population of bacteria was higher by 41% and 23% in elephant foot yam and yams respectively. Organic farming also favoured the fungal population by 17-20%. While the N fixers showed an upper hand by 10% in organically managed soils in elephant foot yam, P solubilizers remained more conspicuous under organic management of yams (22% higher). The count of actinomycetes was favoured by 13.5% in taro. The dehydrogenase enzyme activity was higher by 23% and 14% in elephant foot yam and yams.

The Package

Use of organically produced seed materials, seed treatment in cow-dung, neem cake, bio-inoculant slurry**,** farmyard manure incubated with bio-inoculants, green manuring, use of neem cake, bio-fertilizers and ash formed the strategies for organic production. The organic farming package for elephant foot yam is included in the Package of Practices Recommendations for crops by Kerala Agricultural University (KAU, 2011).

Learning system for elephant foot yam

The learning system using ANN was designed with a learning rate and momentum coefficient of 0.6 and a tolerance value of 0.01. The output of the learning system showed about 90% agreement with the observed values. Training the ANN with more datasets can improve the predictions made by the system. The system can predict the optimum combination of organic, inorganic and environmental parameters for maximizing yield of elephant foot yam in different agroclimatic regions. Study of the environmental influence on the efficacy of organic inputs for elephant foot yam cultivation is another important application of this system.

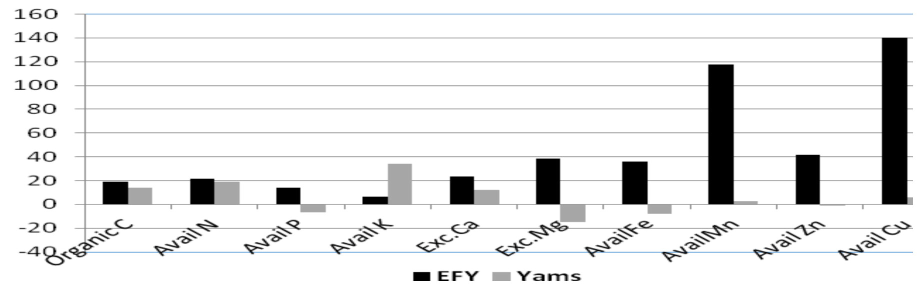

Figure 3: Percent increase or decrease in available nutrients under organic management in elephant foot yam (EFY) and yams

Discussion

Organic management enables 10-20% higher yield, quality tubers and maintenance of soil health in tuber crops. This is contrary to some of the reports that crop yields under organic management are 20–40% lower than for comparable conventional systems (de Ponti et al. 2012, Seufert et al. 2012).The higher yield in these crops may be due to the overall improvement in soil physico-chemical and biological properties under the influence of organic manures (Stockdale et al. 2001). Elimination of NH_4 fertilizers, addition of cations especially via green manure applications, decrease in the activity of exchangeable Al^{3+} ions in soil solution due to chelation by organic molecules and Ca content of the manures might have resulted in higher pH under organic management. Higher soil organic matter status of organic plots, available N, P and K under organic management was due to the direct result of inputs and constituents of various manures, especially green manure. The higher tuber quality is similar to the reports of Rembialkowska (2007) that organic crops contain more dry matter and minerals, especially Fe, Mg and P. Cost effective technologies were developed. The learning system developed will help to estimate the extent of replacement of inorganic inputs with organic manures for realizing comparable yields even without field experiments.

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Influence of nutrient sources and inclusion of mungbean on productivity, soil fertility and profitability of organic rice-wheat cropping system

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Key words: basmati rice, biofertilizers, crop residue, farm yard manure, organic farming, vermicompost

Abstract

Rice–wheat cropping system (RWCS) occupies 13.5 million hectares in the Indo-Gangetic Plains (IGP). Recent years have witnessed a slowdown in the yield growth rate of RWCS. A long-term field experiment evaluated the effect of including mungbean in RWCS with different organic nutrient management practices at Indian Agricultural Research Institute, New Delhi. Averaged across seven years, rice-wheat-mungbean cropping system (RWMCS) produced 12.5 and 8.0% higher grain yields of basmati rice and wheat crops, respectively over RWCS. Overall, the basmati RWMCS was more profitable over the traditional RWCS. On the basis of seven years of investigation we conclude that application of vermicompost + crop residue + biofertilizers (BGA + cellulolytic culture + PSB in rice, Azotobacter + cellulolytic culture + PSB in wheat, Rhizobium + PSB in mungbean) was most productive and FYM + crop residue + biofertilizers was most profitable for nutrient need of basmati rice-based cropping systems.

Introduction

The rice–wheat cropping system (RWCS) is one of the largest agricultural production systems of the world, occupying 13.5 million hectares of cultivated land in the Indo-Gangetic Plains (IGP) in South Asia and several million hectares in China (Ladha et al. 2009). Presently, the IGP contributes nearly 42% to the total food grain production in India with the rice-based cropping systems (Shibu et al. 2012). However, during recent years, a significant slowdown in the yield growth rate of RWCS has been observed. Key issues associated with the sustainability of this system include decline in soil organic matter (SOM) due to reduced inputs of bio-resources and lack of an adequate rotation (Shibu et al. 2010); negative macro and micro-nutrient balances leading to depletion of soil fertility and nutrient deficiencies (Timsina et al. 2006); overexploitation of groundwater resources leading to a decline in the groundwater table (Hira 2009); increased energy cost of pumping water, and deterioration of groundwater quality, increasing salinity (Tiwari et al. 2009); the development of herbicide resistance and a shift in weed flora and pest populations (Hobbs et al. 1997); poor management of crop residues, leading to their burning, and finally decreased total factor productivity or input-use efficiency, increased cost of cultivation and reduced profit margins (Hobbs and Morris 1996). Overcoming these interacting abiotic constraints requires adoption of more integrated farming systems that build-up and maintain SOM, need less water and improve nutrient use efficiency (Prasad 2005). Furthermore, the demand of rice and wheat crops for nutrients, especially nitrogen, is very high. One option is to include a dual purpose summer legume in the rotation and supply nutrients through organic sources to sustain the cropping system.

Adoption of organic farming practices in basmati rice and wheat crops would also enhance income to the farmers as organic products fetch higher prices than conventional ones. During year 2010-11 the share of organic basmati rice was 7.51% to the total volume of organic products' export from India. Thus research on organic farming opens new vistas in Indian Agriculture. Organic farming often has to deal with a scarcity of readily available nutrients in contrast to conventional farming which rely mostly on chemical fertilizers. The aim of nutrient management in organic systems is to optimize the use of on–farm resources and minimize losses. This study evaluated the effect of including mungbean (*Vigna radiata* L.) in rice-wheat cropping system on productivity and profitability of basmati rice and wheat crops. Further aim of the study was to find out the most promising nutrient management practices for better yields, returns and improved soil fertility.

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Material and methods

A long-term field experiment on organic farming of basmati rice-based cropping systems was started in year 2003 and is on-going. The initial three years were considered as transitional (2003-2005) period and a truly organic experiment started since year 2006 onwards. This experiment is located on the research farm of Indian Agricultural Research Institute, New Delhi, India (28.4°N latitude, 77.1°E longitude, and elevation of 228.6 metres above the msl). The soil of the experimental field is classified as a typical Ustochrept (sandy clay loam texture). Soil had 52.06% sand, 22.54% silt and 25.40% clay at the beginning of the experiment. It had medium levels of organic carbon (5.1 mg kg^{-1} soil), low levels of available nitrogen (73.1 mg kg^{-1} soil) and medium levels of available phosphorus (8.42 mg kg^{-1} soil) and available potassium (108.87 mg kg^{-1} soil) and had a pH 8.16 at the start of experiment. The experiment was laid out in a strip plot design with three replications. Treatments consisted of 2 rice-based cropping systems (basmati rice-wheat and basmati rice-wheat- mungbean) in columns, six combinations of different organic materials and biofertilizers [farmyard manure equivalent to 60 kg N ha^{-1} (FYM), vermicompost equivalent to 60 kg N ha^{-1} (VC), FYM + crop residue of preceding crop @ 3 t ha^{-1} for each rice, wheat and mungbean (CR), VC + CR, FYM + CR + biofertilizers and VC + CR + biofertilizers] and control (no fertilizer applied) in rows. These treatments were applied to both rice and wheat, whereas, mungbean in rice-wheat-mungbean cropping system was grown on residual fertility. For biofertilizers, blue green algae (BGA), phosphate solubilizing bacteria (PSB) and cellulolytic culture used in rice, Azotobacter, PSB and cellulolytic culture in wheat and Rhizobium + PSB in mungbean.

Results

Averaged across seven years, rice-wheat- mungbean cropping system (RWMCS) produced 12.5 and 8.0% higher grain yields of basmati rice and wheat crops, respectively over RWCS (Table 1). Furthermore, RWMCS also gave 0.88 t ha^{-1} additional seed yield of mungbean besides a significant improvement in soil fertility over RWCS. With respect to profitability, the basmati RWMCS was more profitable over the traditional RWCS (Figure 1). Hence, inclusion of mungbean, a legume, in RWCS enhanced the yield, profits and soil fertility. All the nutrient management practices increased the grain yield of rice and wheat crops significantly over the control. The increase was most when biofertilizers and crop residues were combined either with farmyard manure (FYM) or vermicompost (VC). Furthermore, application of vermicompost + crop residue + biofertilizers (BGA + cellulolytic culture + PSB in rice, *Azotobactor* + cellulolytic culture + PSB in wheat, *Rhizobium* + PSB in mungbean) was most productive and FYM + crop residue + biofertilizers was most profitable (Figure 1) for nutrient need of basmati rice-based cropping systems. Both these combinations also resulted in a significant improvement in soil chemical and biological properties.

Table 1. Mean grain yield of basmati rice, wheat and mungbean crops in organic rice-wheat and rice-wheat-mungbean cropping systems

Year	Rice-Wheat (yield in t/ha)				Rice-Wheat-Mungbean (yield in t/ha)				
	Rice	Wheat	Total	Mean	Rice	Wheat	Total	Mean	Mungbean
2006-07	4.26	3.57	7.83	3.92	4.55	3.82	8.37	4.19	0.86
2007-08	4.51	4.47	8.98	4.49	4.91	4.83	9.74	4.87	0.90
2008-09	4.30	3.71	8.01	4.01	4.60	3.80	8.40	4.20	0.98
2009-10	3.94	3.81	7.75	3.88	5.10	4.04	9.14	4.57	0.81
2010-11	4.49	3.38	7.87	3.94	5.18	3.78	8.96	4.48	0.95
2011-12	3.71	3.52	7.23	3.62	4.08	3.97	8.05	4.03	0.83
2012-13	3.88	3.61	7.49	3.75	4.33	3.87	8.20	4.10	0.87
Mean	4.16	3.72	7.88	3.94	4.68	4.02	8.69	4.35	0.88

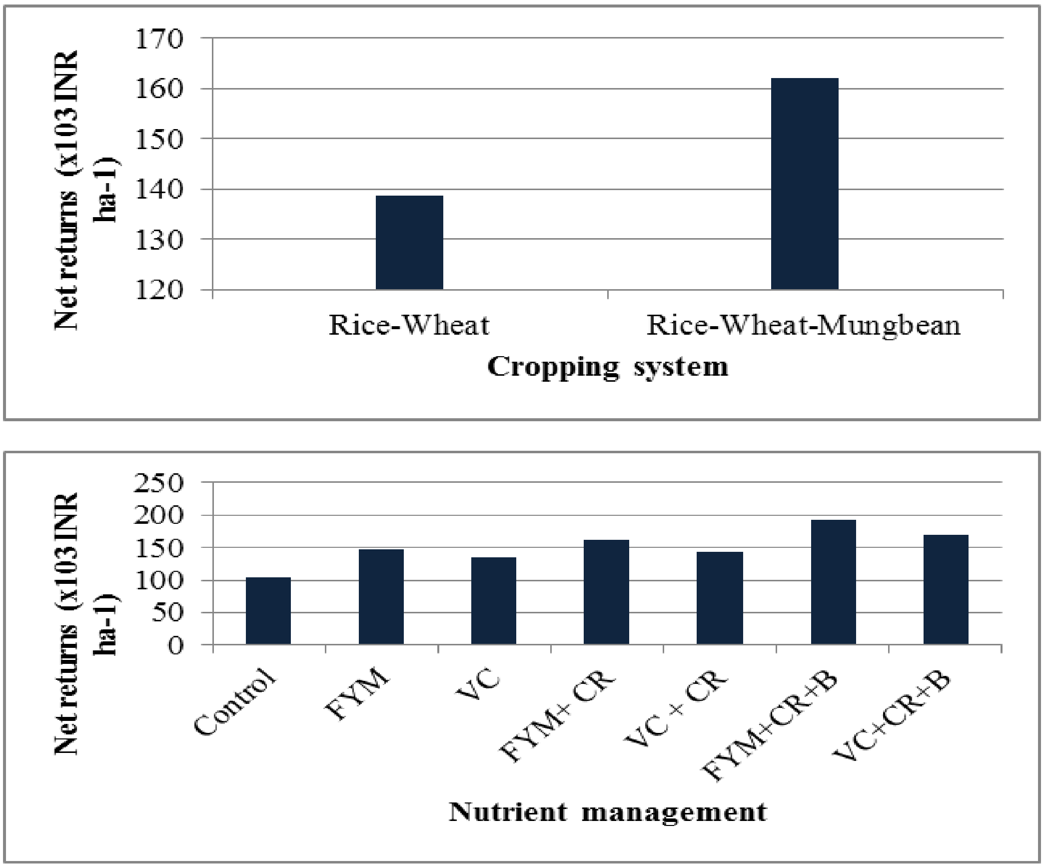

Figure 1. Net returns (x10^3 Indian Rupees ha^{-1}) as affected by cropping systems and nutrient management during 2011-12

Discussion

Inclusion of mungbean in rice-wheat cropping system (RWCS) was quite advantageous. Levels of organic carbon, total N, available nitrogen, phosphorus, potassium and micronutrients increased significantly and substantially due to inclusion of mungbean in RWCS. Simultaneously the soil microbiological properties, viz., microbial biomass carbon, microbial biomass nitrogen and enzymatic (alkaline phosphatase, acid phosphatase, dehydrogenase, glucosidase, FDA hydrolysis, etc.) activities were also significantly higher in soils of rice-wheat-mungbean cropping system (RWMCS) than in RWCS. Some earlier studies on organic grain production identify legume crops as a proficient way of providing nitrogen (N) to high N-demanding grain crops (Casagrande et al., 2009). Their capacity to fix atmospheric N and make it available to non-fixing plants (Fustec et al., 2010) has made them of increasing interest in organic grain systems subject to N deficiency (David et al., 2005). Combined use of either vermicompost or farmyard manure with crop residues and biofertilizers improved grain yields of rice and wheat crops, besides improvement in soil fertility. The increased activity of soil microbs was also notice under this situation. On the basis of seven years of investigation we conclude that inclusion of mungbean in RWCS enhanced grain yield, soil fertility and profits over RWCS. Use of FYM with crop residues and biofertilizers gave maximum profits and sustained soil fertility. Hence, organic systems are sustainable if legume is included in intensive rice-wheat system with appropriate organic nutrition.

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Organic animal husbandry development in developing countries: challenges, contentious issues & opportunities

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Key words: animal husbandry, challenges, developing countries, organic, opportunities

Abstract

Unlike cereals, spices, cotton, coffee, tea and herbs, organic animal husbandry is mostly confined to Europe and a few developed countries like USA, Australia and Canada. Besides limited export opportunities, problems of small farms, hygiene and existence of infectious diseases in developing countries are obstacles which need to be addressed to develop organic animal husbandry in these countries through enhanced research and development efforts.

Introduction

Organic agriculture is rapidly growing around the world (37.2 Million ha in 162 countries) with 1.8 million producers including significant number of organic farmers in developing countries like India. The global market for organic products has reached to US$ 62.8 billion and 86 countries now have an organic legislation across the world (Willer et al 2013).It is also well recognized now that the organic animal husbandry has not grown as faster as cereal crops, fruits, nuts, spices, tea, coffee and cotton. While organic farming is rapidly gaining ground in developing countries, the research and development (R&D) activities in organic animal husbandry is confined to EU and a few other developed countries like USA, Canada and Australia. There are opportunities as well as challenges in organic livestock production in developing countries which need to be addressed.The organic livestock development opportunities in developing countries in Asia, Africa and Latin America can be enhanced with more scientific research in organic livestock production under local conditions and strengthening institutional support (Chander et al. 2011, Nalubwama et al. 2011, Rahmann and Godinho 2012, Chander et al. 2012). Further to this, here an effort has been made to analyze why animal husbandry is not coming up in developing countries despite good opportunities due to natural advantages, taking India as a case.

Material and methods

Apart from the secondary data collected from the various published information, web search, reports etc, data were collected from 2220 farmers across India on the pre-designed and pre-tested interview schedule with the help of *KrishiVigyan Kendra* (KVK-Farmer training institution at district level in India). The interview schedule contained 40 questions concerning inputs like medicines, fertilizers, feeds, fodder, prevalence of diseases in livestock etc. Total of 37 KVK distributed over 12 states. Jammu & Kashmir, Punjab, Himachal Pradesh, Haryana, Gujarat, Rajasthan, Madhya Pradesh, Orrisa, Assam, Tripura, Sikkim and Arunachal Pradesh were covered in the process of data collection. Out of the responses received from 2220 farmers, data from 1614 farmer respondents through KVKs in 12 states were further grouped in three major groups:1. Irrigated states consisting of Haryana and Punjab 2. Drylandstates consisting of the states of Madhya Pradesh, Orrisa, Rajsthan and Gujarat and 3.Hill states consisting of Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Sikkim and Tripura. Maximum respondents were from dryland states (1216) followed by Hill states (229) and irrigated states (169). As a Networking exercise, an ICAR sponsored short course for 10 days on Organic Animal Husbandry was conducted, wherein, 20 participants from State Agricultural Universities, ICAR institutes and Dairy federations participated in the course, who also gave valuable inputs for the research project as they presented the scenario with respect to their respective states. The project team delivered the lectures with respect to their disciplines in context of organic Animal Husbandry which were compiled in the form of an edited book for distribution among different stakeholders. An information system on organic livestock farming was also developed in the form of user friendly e-learning tool (CD) to give information to the network members and wider dissemination of information on organic livestock farming. Considering the suitability of hill regions for promotion and development of organic animal husbandry, a focused survey of 180 registered organic farmers (111 Male & 69 female) was undertaken in Uttarakhand state, to know the compatibility of local livestock production practices with the Organic Animal Husbandry Standards (OAHS). A total of 180 organic farmers registered with Uttarakhand

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Organic Commodity Board (UOCB), from three districts (18 villages from 9 blocks) were studied. The survey of organic farms and registered organic farmers was also carried out along with the case studies in Mizoram state (North Eastern region) where organic farming was being promoted by among others the state government. In Mizoram, 150 registered organic farmers and 50 officials involved with organic farming promotion were interviewed for SWOT analysis of organic livestock production in North Eastern Region by taking Mizoram as a case.

Results

Many constraints and opportunities as regards to organic livestock production in developing countries in general, and India in particular, have been discussed by the authors (Chander et al 2007, Chander et al 2012). Those which need further attention towards continuous development in this sector have been presented here:

1. Organic animal husbandry is land based activity, but livestock are kept by many landless livestock keepers in India. So a good number of livestock farmers are not eligible for organic livestock farming.
2. Even when farmers own land, the number of animals to be maintained per hectare are far too less (Table 1), considering 80% holdings in India are <1 ha and per farmer land ownership is going down due to division of land in the expanding families. The sustainability of organic livestock production at the given stocking rate is difficult to achieve, at least in developing countries like India.
3. Many developing countries in Asia and Africa are not yet free from infectious diseases like Foot & Mouth Disease (FMD), which restricts trade from these countries. The reduced opportunity for export discourages livestock producers to go organic.
4. Small farmers find it difficult to comply with traceability requirements.
5. Sanitary conditions at production sites and processing units need improvement.
6. There was little local demand for organic livestock products *per se*, though the quality consciousness was on the rise among the consumers. The domestic market for organic livestock products needs to be developed.

Table1. Maximum no. of animals per hectare (Draft Indian standards)

Species/Class	Maximum no. per ha
Equines over six months old	2
Calves	5
Other bovine animals less than one year old	5
Male bovine animals from one to less than two years old	4
Female bovine animals from one to less than two years old	4
Male bovine animals two years old or over	2
Dairy Cows	2
Female breeding rabbits	100
Sheep	14
Goats	14
Piglets	74
Breeding Pigs	7
Pigs for fattening	14
Chicken	580
Laying Hens	230

7. Grazing land is shrinking due to reducing community land and also change in land use pattern.

8. Natural sources of essential amino acids (Methionin, for instance) are not available good enough to meet the requirements of livestock particularly swine & poultry.
9. Green fodder supply is insufficient to meet the requirement of the livestock. Animal survive on poor quality roughages.
10. Housing conditions are often improper, increasing risk of zoonotic diseases.
11. Research and development investment in the area of organic animal husbandry is nearly nil.
12. The per animal health cost was negligible in traditional livestock keeping which was prominent though the trend was towards intensification where this cost is likely to go up.

Discussion

Inspite of the favorable situation existing like traditional animal husbandry, Indigenous Technical Knowledge, limited or no antibiotic use, limited chemical fertilizers application, less dependence on market for inputs in many developing countries like India, the limitations too are seriously restricting the growth of organic animal husbandry in these countries especially the stocking density, feed and fodder scarcity, sanitation, infectious disease prevalence etc,. May be the increasing interest in this underdeveloped organic sector by *inter alia* FAO (http:// www.fao.org/docrep/017/aq381e/aq381e.pdf) and IFOAM would help develop organic animal husbandry in developing countries. The recent initiative i.e International Animal Husbandry Alliance (IAHA) by IFOAM (http://www.ifoam.org/en/sector-groups/iaha-animal-husbandry-alliance) may help in this direction.

Suggestions to tackle with the future challenges of organic animal husbandry

The Research & development agencies in developing countries as also international organizations should augment funding for research and development efforts to develop organic animal husbandry sector to improve the availability of high quality, safe, organic animal products for the consumers.

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A study on the efficiency of low cost vermicomposting structure

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Key words: Low cost vermicomposting, Perionyx excavates, vermiwash, cocoons

Abstract

The present study was conducted with the objective to find out the efficiency of the low cost vermicomposting unit as compared to conventional units involving higher cost of construction. The experiment was laid out in a five-replicated randomized block design (RBD) with 4 treatments using Perionyx excavates in low cost vermicomposting unit of various dimension with conventional unit as control. Among the 4 treatments T_1 ,T_2 and T_3 were found to be at par in terms of quantity of vermicompost harvested. Result revealed that among the different low cost vermicomposting units T_2 was efficient in terms of quantity of vermicompost harvested, vermiworms and numbers of cocoons produced followed by T_3. Production of vermiwash was highest in T_1 (12 to 10 L per week) followed by T_2(10 to 9 L per week). Daily temperature recorded in the vermi composting tanks was initially higher and gradually decreased with the decomposition process. Benefit: Cost ratio was highest in T_2 (6.56:1)followed by T_3(4.46:1).

Introduction

Vermes is a Latin word for worms and vermicomposting is the term given to the process of conversion of biodegradable matter by earthworms into vermicast. In the process, the nutrients contained in the organic matter are partly converted to the more bioavailable forms (Gajalakshmi *et al.,* 2003). The vermicomposting technology for conversion of solid organic wastes to useful product has been ranked higher than composting in certain aspects (Dominguez *et al,* 1997).Vermicompost contains more of available nutrients than regular FYM or compost. Secretions of earthworms that are in the vermicompost serve as plant growth stimulatory factor (Galli *et al*, 1990; Tomoti *et al*, 1990; Graff and Makeschin, 1980). Vermicompost can be effectively utilized as a carrier medium for *Azospirillum, Rhizobium* and phosphate solubilisers. To popularize the vermicomposting process among the small and marginal farmers there is a need to fabricate a vermicomposting unit involving lower cost so that the economically weaker section of the farmers can adopt the vermicomposting technology as the construction of conventional concrete structure involves higher cost. Therefore, keeping in view the above an experiment was carried out to fabricate a low cost vermicomposting unit for efficient production of vermicompost at par with the concrete structure. This will aid in mass production of vermicompost resulting in reduced application of chemical fertilizers detrimental to soil health.

Material and methods

The present study was conducted at the Dryland Technology Park, All India Coordinated Research Project for Dryland Agriculture, Biswanath Chariali Center Biswanath College of Agriculture, Assam Agricultural University, District Sonitpur Assam, India during 2012 -2013. Low cost vermicomposting units were fabricated using locally available low cost materials such as bamboo, dried banana leaves (for shading as side walls) and polythene sheet for roof and laying in the tank. A PVC pipe (1.27 cm diameter) was used for connecting the vermicomposting unit with an earthen pit (0.31 m x 0.31 m x 0.31 m) for collection of vermiwash. A layer of pebble (≈15 cm) and layer of sand (≈15 cm) were placed over the plastic sheet in the vermicomposting tank and a layer of bedding material was placed over the sand and pebble layer. Earthen drains were provided (0.61m x 0.31m) surrounding the vermicomposting unit as a bio-control measure against attack of earthworm enemies primarily for preventing entry of ants. The experiment was laid out in five replicated randomized block design consisting of 4 treatments viz., T_1: Vermicomposting in concrete tanks (Control) with dimension 2.5 m(L) X 0.91 m (B) X 0.91 m(D),T_2: Vermicomposting in low cost vermicomposting unit with dimension 2.5 m(L) X 0.91 m (B) X 0.91 m(D),T_3: Vermicomposting in low cost vermicomposting tanks with dimension 2.5 m(L) X 1.2 m (B) X 0.76 m(D),T_4: Vermicomposting in low cost

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vermicomposting tanks with dimension 2.5 m(L) X 1.2 m (B) X 0.46 m(D). *Perionyx excavates* worms were used for vermicomposting purpose. The units were filled with pre decomposed composting materials composed of biomass (chopped banana pseudo stem) and dried cow dung in 60:40 ratio which was allowed to decompose for a period of one month prior to vermicomposting in the tank. The pre-decomposed mixture was placed in the vermicomposting units and 750g *Perionyx excavates* worms were released in each tanks after two weeks of filling the tanks. The two weeks period was allowed for stabilization of temperature of the semi decomposed biomass mixture. Daily temperature of the tanks was monitored during the vermicomposting process using an ordinary thermometer. The results were statistically analyzed (Panse and Sukhatme, 1989) for interpretation.

Results

Temperature during the decomposition process: Temperature plays a very vital role in the growth and development of the earthworms. Requirement for optimal result is 20-30 °C (Sharma, 2009) .The bed temperature was monitored after one week of transferring the decomposed materials in the tanks for each cycle i.e. three cycles in a year. During the whole vermicomposting process (filling of tank to harvesting of worms) the initial maximum temperature after two weeks of filling of tank was 27.5 °C in T_1 and it slowly decreased with the decomposition of composting materials and the lowest value was recorded to be 23.5 °C. Similarly, in other tanks i.e. T_2 the daily temperature was slightly lower than T_1 and ranged between 26.5 to 22.0 °C followed by T_3 which ranged between 24.5 to 19.5°C and T_4 recoded the least daily temperature of 21.3 to 17.8 °C. The temperature in the vermicomposting tanks was maximum during summer months as compared to winter months.

Earthworm population and yield of vermicompost: The data on earthworm population and yield of vermicompost is presented in table 1. The highest production of vermicompost was recorded in the tank T_1 of (914 kg/tank). Among the low cost vermicomposting tanks T_2 and T_3 was found to be at par in terms of production of vermicompost. The production of vermicompost in T_2 was 903 kg/tank followed by T_3 of 6.78 q/tank. The lowest production of vermicompost was recorded in the tank T_4 of (5.78 q /tank). The maximum quantity of vermiworms was recorded in T_2 (3.39 kg/tank) and was at par with T_1 (3.22 kg/tank). Whereas, numbers of cocoons was recorded highest in T_1 (108 nos/0.03m^3) and found to be at par with T_2 (107.3 cocoons/0.03m^3**)** followed by T_3 (1.91 kg/tank, 92 cocoons/0.03m^3). The lowest value was recorded in the T_4 (1.12 kg/tank, 54.1 cocoons/0.03 m^3).

Table.1: Yield of vermicompost, vermiworms and number of cocoons/0.03m^3 **(Stat. method: RBD)**

Treatments	**Vermicompost harvested (q/tank)**	**Vermiworms harvested(kg/tank)**	**No. of cocoons/0.03m^3**
$T_{1\ (Control)}$	9.14 ^{a}	3.39 ^{a}	108 ^{a}
T_2	9.03 ^{a}	3.22 ^{a}	107.3^a
T_3	6.78 ^{a}	1.91 ^{b}	92 ^{b}
T_4	5.78 ^{b}	1.12 ^{c}	54.1 ^{c}
CD 5%	4.12	0.19	2.34

Composition of vermicompost: The average chemical composition of vermicompost (banana pseudo stem) is presented (Table 2) which shows that the vermicompost is alkaline in reaction with a pH value of 7.43 containing macro and micronutrients required for plant growth Table 3 also shows that the vermicomposting process is also helpful in carbon sequestration as indicated by presence of high level of organic carbon content (26.45%).

Table: 2: Average Chemical composition of vermicompost (banana pseudo stem)

Composition of vermicompost											
pH	**Org.C**	**N**	**P_2O_5 (%)**	**K_20 (%)**	**Ca** (ppm)	**Mg** (ppm)	**S** (ppm)	**Fe (%)**	**Mn** (ppm)	**Cu** (ppm)	**Zn** (ppm)
7.43	26.45	2.30	2.90	3.10	170.0	64.0	182.0	0.078	207.0	11.98	81.55

Production of vermiwash and its composition: Vermiwash is a mixture of earthworm urine and water applied for keeping the biomass in the vermicomposting tank in a moist condition. The vermiwash is reddish in color with an alkaline reaction (pH =7.87) and carries the dissolved nutrients present in vermicompost. The vermiwash is collected through a drainage pipe fitted at the bottom of the vermicomposting tank and connected to a small chamber (earthen pit lined with polythene).An analysis of vermiwash (Table 3) revealed that it contains 1482 mgL^{-1} nitrogen, 189 mgL^{-1} phosphorus and 1513 mgL^{-1} of potash. The electrical conductivity value indicated that vermiwash is non saline and non alkaline (EC 0.09 dsm^{-1}).

Table: 3: Composition of vermiwash

pH	E.C (dsm^{-1})	Total N (mgL^{-1})	Total P (mgL^{-1})	Total K (mgL^{-1})
7.87	0.09	1482	189	1513

The maximum quantity of vermiwash (12 L per week) was collected from the tank T_1 (Control) followed by T_2, T_3 and T_4. Among the low cost vermicomposting units maximum vermiwash was recorded in T_2 (10 L per week). The higher quantity of vermiwash collected in T_1 because there was no loss in the conveyance process due to concrete structure as compared to low cost units owing to wear and tear of the plastic lining material laid in the tank.

Economics: Among the low cost units the highest Benefit: Cost ratio (Table 4) was recorded in T_2 (6.56:1) followed by T_3 (4.46:1) and T_4 (3.41:1).The Benefit: Cost ratio was recorded negative in the $T_1$with a net return of -3513.00 which is due to involvement of higher cost in construction of the concrete pits.

Table: 4: Economics of concrete and low cost vermicomposting unit

Treatments	Cost of structure	Gross Returns(Rs.)	Net Returns (Rs.)	B:C Ratio
$T_{1\ (Control)}$	21000.00	17487.00	-3513.00	---
T_2	2700.00	17715.00	15015.00	6.56
T_3	2620.00	11684.50	9064.50	4.46
T_4	2540.00	8665.50	6125.5	3.41

Figure 1. Low Cost Vermicomposting Unit

Economics: Among the low cost units the highest Benefit: Cost ratio (Table 4) was recorded in T_2 (6.56:1) followed by T_3 (4.46:1) and T_4 (3.41:1).The Benefit: Cost ratio was recorded negative in the $T_1$with a net return of -3513.00 which is due to involvement of higher cost in construction of the concrete pits.

Discussion

Temperatures in the summer months have the potential to rise to relatively high levels when air temperatures increase and this could have a detrimental effect on earthworm population. The ambient temperature was found to be lower as compared to the temperature of the decomposing biomass in the initial stages of the vermicomposting process probably due to initial higher level of microbial activity in all the treatments. The production of vermiwash was higher in the initial stages of vermicomposting process, which subsequently declined, with the advance of the vermicomposting process. In the control treatment vermiwash production continued till harvest probably due to absence of seepage loss in the concrete tanks. The end product of vermicomposting process yields an organic manure having a number of plant nutrients essential for growth and development of the plant without having any adverse effect on soil and the environment .Benefit: Cost ratio indicate that by adopting the low cost technology the farmers can get substantial benefit and augment farm income .

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Homoeopathy in agriculture

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Key words: Homoeopathy, Agrohomoeopathy, Homeodynamic, Homeopathy in agriculture

Abstract

Homoeopathy medicines have found recognition in healing human beings. Some application is also done in Animal Husbandry. Applied Homoeopathy Research in agriculture is also finding place. The mode of action of homoeopathy remedies and simillinum of drug pictures for use in agriculture; basic principles of Homoeopathy and drug administration are being discussed. Significant results have been observed using Homoeopathy medicines Silecea12, Dulcamara 30 and Sulphur 6c to fight stress caused during wet weather and also during hot and dry conditions. Research results in improving germination and growth; to control pest, disease and viral infection, etc. on various crops have been reported. Plants are unique when compared to humans and animals and need different approach. The science of Homeopathy has great potentials and could give a new direction that requires attention of the researchers in alternative agriculture. Constructing a Material Medica for Plants is inevitable.

Introduction

The fall back of traditional agriculture had been mainly due to two advantages demonstrated by Chemical Agriculture:

1. Chemical fertilizers being water soluble, plants could take them immediately, leading to faster growth. Micronutrients are used in traces to restore nutritional disorders.
2. They being concentrated, *small quantity* could be applied in larger area, in comparison to organic manures, which are required in bulk quantity.

Chemical agriculture dominated traditional organic farming with these two advantages only. But, over a period of time, we started experiencing damaging effects of chemical applications.

Farmers and researchers started working on renovation of organic farming techniques. Out of many initiatives, "Biodynamic Farming" incorporated the *principles of Homeopathy*, which is based on use of, *minimum doses*.

Triturated Biochemic medicines are used to cure diseases caused due to biochemical imbalances. Homoeopathy remedies stimulate the immune system to fight disorders.

Material and methods

Theory: In Biodynamic Agriculture, special BD preparations are made and are used in *minimum* doses, Incidentally, it must be realized that, even in chemical agriculture, there are substances like plant growth regulators and plant protection chemicals that are used in very small quantities, with one exception that, they are *diluted* but **not** *"dynamised"* to *"potentise"* the substance that is being used. Dynamisation or potentisation is unique aspect of the science of *Homeopathy* as experience reveal that simple dilution, at higher levels is not effective but becomes so, after undergoing the process of trituration or succussion.

The law of "*minimum doses"* is applied in Homeopathy which could be achieved by:

1. Increasing the dilution and "*potentised"* to "*arouse the latent powers"* of the substance being used and released into the *"organism"* (i.e. on human beings, or animals and now – on plants) to release their *forces* to heal.
2. Application of *single dose* and allowing its action to be exhausted, before administrating subsequent dose, if at all required.
3. Reducing the frequency or increasing the time span, before next dose is administered.

The difference between the small doses applied in Chemical agriculture and *Homeopathy* in Agriculture

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Is, whereas in chemical agriculture, the substance is used to restore *"material imbalance"* administered in "physical" doses, but in Homoeopathy, the ***mode of action*** of small, but potentised substance is to stimulate the organism's *intrinsic defensive mechanism* and re-establish the balance of '*vital forces'* within it that is capable of fighting the disorder and *restore health*. Because of triggering effect set by the medicine, it does not require frequent application. The frequent administration, rather may arrest the progress of the healing action and may also counter the benefits achieved, sometimes worsening the problem.

Disease is ultimately an affair of the reactions of protoplasm, and in the response of protoplasm to stimuli, would find, if anywhere, material for generalizations upon disease and treatment. Considering only the behavior of *'protoplasm'*, we should be left to argue that since in disease the cells specially attacked are the cells specially in need of a stimulus (since their life activities are threatened), that stimulus will be found in a small dose of the agent which in large dose can damage or destroy precisely those particular cells. Drugs given to "*organism"* in health will influence certain cells and tissues according to their individual "affinities"; when by symptoms thus produced, we know that a drug can damage this or that set of cells, then we can use a small dose of the same drug to stimulate the same set of cells if opposed by disease. The response of protoplasm to stimuli would justify the recommendations:

a. Test drugs on the healthy and note the symptoms.
b. When treating disease, look for a drug which has produced similar symptoms on the healthy, for only thus can there be any confidence that it will influence the tissues affected.
c. Give a small dose.

Homeopathy signifies, **"Similia Similibus Curantur"**. The aim of the homoeopathists is to discover the *simillinum* for the disease while it expresses itself in such preliminary symptoms, and this he is most likely to find among drug pictures gradually build up by administration of small doses during a considerable time than in the overwhelming effects of large quantities. Tissues once destroyed cannot be reintegrated. It is thus essential to identify the *drug picture* and find out the *similarity* of the symptom. The remedy which shows the similarity is best used to achieve the desired response.

Hahnemann inferred that, the more poisonous and destructive a poison is, in its crude form, the more curative and constructive virtues it has at its fine stage. That, "All existing poisons, either organic or inorganic, on the earth are health givers, to mankind or to all lifeful bodies. The worst poison is the best medicine in quite small and even in far far lesser than microscopic (molecular or atomic) doses for the disease resembling to its poisoning or toxicological effects". The curative actions of the medicine are only on those parts of the body which are affected adversely or are damaged during the poisonous action by large cumulative and toxic doses of the same medicine.

Adverse weather could cause stress to plants making them vulnerable to diseases. Reference to Biodynamic Calendar can give an insight to kind of weather to be expected, which is also influenced by the position of the planets, particularly the transition of Moon through the path of *12 Zodiac constellations.*

Experiments have been conducted to fight stress caused during monsoon season. In both the following cases, 10 drops of Homeopathy preparation was diluted in 13 liters of water and sprayed on the leaves. I think, simply diluting the potencies in a volume of water and watering or spraying is not going to be effective. It is essential that all Homeopathy preparations are "Dynamised" for at least one hour, clockwise and anti-clockwise, in rhythmic way, as followed in Biodynamic Agriculture practices for making BD preparations, before application.

Leaves could be considered as to be the tongue of the plants. As plants too are made of cells which could get stressed and becomes diseased, the remedies are better sprayed. Homeopathic influence may lose effect if administered through roots due to contamination of soil and energetic forces present within the soil.

Results

Case 1: An advance study of the BD Calendar In May, 2007, the planetary position during the last three days of August, indicated the weather to be wet and moisture laden. On the predicted days the weather indeed was wet with 90% humidity and no air circulation, for at least 3 consecutive days. This situation is not favourable for chrysanthemums. Usually *BD prep 501* (a *silica* preparation could be advisable to increase the immunity to fight stress conditions caused due to wet condition). In its absence, Homeopathy preparation *Silesia 12C* was selected.

Two weeks prior to predicted weather in August, 500 potted *chrysanthemums* were sprayed with Homeopathy medicine *Silesia 12C* and 500 pots were untreated which served as Control.

***Observation*:** It was observed that 82% of the plants under control wilted and subsequently died. But all 500 plants treated with *Silesia 12C* remained unaffected and maintained their healthy growth. They grew to their full term and yielded quality blooms, without any disease or stress.

Case 2: It has been observed every year, during every monsoon, often the sky remains clouded and there is continuous shower for even seven days. This affects the vegetative growth of the *Chrysanthemum.* The leaves lose their elasticity, develop necrosis and black spot and eventually die. There is no remedy for such conditions in any other sciences.

Homeopathy remedy *Dulcamara 30C* is sprayed on the leaves. The subsequent doses are applied at an interval of 3 or 4 days, when the action of the medicine seems to be exhausted. Maximum 3 doses were required to restore health.

***Observation*:** The plants regain their turbidity (spring action) and resist the black spot infection. All Plants treated show 100% success while all untreated plants grow sickly and eventually succumbed to death.

This has been practiced for more than 8 years now with full success. There is no solution to this problem, either in chemical or organic practices. The solution is found only in Homeopathy.

Research: (Betti et. al. 1997) laboratory experimental results showed, using 45x potency of *Arsenicum album* on wheat germination and stem growth was statistically significant. (Khanna and Chandra 1976) demonstrated, *Natrum Muraticum 200C* controlled fungal attack causing fruit rot on post harvested tomato and mango and increased shelf life. (Kayne 1991) used four homoeopathy sprays on rye grass to determine if any significant effect on growth could be achieved comparing application of nitrogen fertilizer, and a control. But, at a particular dosages and strengths chosen, no such effect was perceived. (Kolisko and Kolisko 1978) reported the results of their 20 years of numerous experiments and research. They observed that, growth was promoted by lower potencies, then inhibited with higher potencies and finally stimulated at even higher dilutions. (Wannamaker 1966, 1968) tested the effect of *Sulphur* and *Boron* potencies on the growth of onions and found significant improvement in weight and dimensions. *Sulphur 6c* may prevent or remove 'stresses of the plants, especially in hot dry summer weather. (Pelikan and Unger 1971) provided statistically significant evidence that potentized substances do influence the plant growth. (Sinha 1976) observed *Tabacum 30c* when applied on virus affected papaya plants, the leaves began to spread open within four days. (Baumgartner et. al. 2000) reported their findings on the dilutions and their possible role in organic production. (Garbim et. al. 2013) reported *Arsenicum album* and *Sulphur* on the development of wheat seedlings (*Triticum aestivum*). Both remedies stimulated the development of seeds in a positive manner. *Arsenicum album* stimulated shoot and radical length compared to control in 12CH, 30CH and 60CH dynamisations. *Sulphur* stimulated radical length in 12CH, 60CH and 200CH.

General Advice

a. Use exclusive watering can or backpack sprayers, for applying homoeopathy medicines.
b. Clean rain or spring water should be preferably used to prepare the medicine. Do not mix homoeopathic medicine with anything other than water. The pH of water should be neutral, if possible. Acidic or Alkaline water may affect the efficacy of the medicine.
c. No commercial plant protection chemicals or fertilizers should be used for at least 10 days after administrating the medicine.
d. Use 6x potency of any remedy.
e. Rate of application: use 1 ml in 10 litres or 125 ml in 500 Ltrs per hectare.
f. Stir clockwise and anticlockwise for at least one hour, before application. It must be realised that small stimuli encourage life activity, medium to strong stimuli tend to impede it, and very strong stimuli to stop or destroy it.

Discussion

Research needs to be conducted to find out the drug pictures, as has been done on human beings. It is important to study the right substance, the right potency and the right doses. Blind tests needs to be carried out. It is also important to study the method of application, i.e. either through roots or through the leaves by spraying and how to prepare the medicines for larger area.

It is also necessary to realize that *plants are unique when compared to humans and animals and may need different approach.* It needs to be tested if *healthy* plants will exhibit any symptoms, which can be cured in a *diseased* plant, exhibiting the *same symptoms*.

Use of different Homeopathy medicines in different potencies to develop immunity in plants, control pest and disease and influence plant growth opens new vistas for further research in Applied Homeopathy in Agriculture.

A suitable **Materia Medica for plants** with proper ***Repertory*** is required to be prepared. However, (Vaikunthanath Das 2006) took an initiative to present his work in the format of Materia Medica, but the efficacy of all the drugs referred to needs to be established in line with the Materia Medica of the Masters of Homoeopathy.

Investigation is also needed to find the best and suitable mode of administration i.e. through foliar spray or soil application.

Numerous papers are published during the recent International Conferences on Homeopathy in Agriculture (2011) and (2013). Pooling of experience can lead to cheap and effective way of controlling disease and pests as well as stimulate growth and specially "*vitality".* One can share their experience on http://www.considera.org.

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Participatory Cotton breeding and cultivar Evaluation for organic smallholders in India

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Key words: Bt cotton, *Gossypium*, seed sovereignty, participatory breeding

Abstract

Stakeholders of the organic cotton sector in India are highly concerned about the overdominance of Bt cotton and the disappearance of non-GM cotton seeds on the market. Organic cotton production can only survive if farmers have access to high quality seeds of suitable cultivars free of GM contamination. With the help of public plant breeders, local cotton grower organisations started on station and on farm trials for the evaluation of cotton cultivars. Moreover, the got engaged in decentralized participatory cotton breeding to develop locally adapted cultivars including traditional Desi cotton species. The close collaboration of breeders, farmers, extension agents, as well as stakeholders of the ginning and spinning industry allows for the identification of cultivars that suit the specific growing conditions of smallholder farmers. Training of farmers in cultivar evaluation and seed propagation restores their seed sovereignty. Participatory breeding is an important tool to get prepared for future challenges.

Introduction

Up to 80% of world's organic cotton has been produced in India. Now organic cotton production in India is under severe threat (Klaiss et al 2012). Genetically modified F_1 hybrids of the tetraploid upland cotton (*Gossypium hirsutum*) carrying a gene from *Bacillus thuringiensis* (Bt cotton) account for more than 90% of the cotton area in India (Qaim 2013). The non-GM cotton seed market has become completely eroded (Nemes, 2010, Marty 2013) and locally adapted diploid Desi cotton (*G. arboreum, G. herbaceum*) getting lost. Fast action is needed to re-establish GM-free seed supply chains and breeding programs to support organic and low input cotton farmers in India. Participatory plant breeding (PPB) offers a great opportunity for developing locally adapted cultivars as well as for maintaining and increasing genetic diversity (Lancon et al. 2004, Ceccarelli et al. 2009). The main aim of the study is to (i) foster collaboration among stakeholders, (ii) introduce participatory breeding approaches for organic cotton (iii) evaluate improved cotton cultivars in smallholders' organic cotton fields and (iv) gain information about the suitability of different types of cotton species and cultivars for organic and low input farming in India.

Material and methods

The project was initiated in 2011 and is driven by two local organic cotton producer organisations bioRe Association in Madhya Pradesh and Chetna Organic in Orissa and the cotton breeding department of the University of Agricultural Science (UAS) Dharwad, Karnataka and is scientifically supported by the Research Institute of Organic Agriculture (FiBL) Switzerland with expertise in transdisciplinary research. In order to improve the access of organic cotton farmers to high quality non-GM cotton seeds a national workshop on 'Disappearing non-GM cotton – ways forward to maintain diversity, increase availability, and ensure quality of non-GM cotton seed' was organized in Dharwad in June 2011. The goal was to involve the joint expertise and knowledge of breeders, organic farmers, advisors, and representatives of the textile industry along the whole market chain. The resulting Dharwad declaration towards safeguarding the heritage of Indian Desi cotton, maintaining genetic diversity, avoiding GM contamination and supporting the organic farmers with suitable cultivars was important to create public awareness and initiate first projects.

The Cotton Cultivar Evaluation Project has started in 2011 with systematic evaluation of available non GM cultivars and is focusing on the fast identification of suitable cultivars and the reestablishment of a cotton seed supply chain under control of the farmers to safeguard the organic cotton production. Existing non-GM cotton cultivars and breeding lines were evaluated combining on-station and on-farm participatory trials to

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safeguard the threatened organic seed supply. Each year around 50 cultivars including standard hybrids are tested under organic conditions in on station trails with two replications on heavy and light soil and in two geographic regions reflecting the different growing conditions of small holder farmers. In addition, on farm cultivar evaluation trials are conducted by farmer in their own fields after training by the research team. Vegetative growth, plant morphology, health of plant as well as seed cotton yield per plant and acre were assessed for the different pickings. Ginning output and fiber quality parameters (fibre length as Upper half mean Length UhmL (mm), fibre finesse (micronaire), fibre strength (g/tex), Maturity Index (MI), Uniformity Index (UI) and Short Fibre Index (SFI)) were assessed for the first two picking and the last picking. Farmers were highly interested in the project and participated not only in the on farm trials but also in several workshops on identification of ideal genotypes, practical cotton evaluation, training in cross breeding, seed multiplication and single plant selection. Farmers shared their vast experience and knowledge about cotton cultivation.

The Green Cotton Project is a long term project aiming for developing new cotton cultivars, which are specifically suited for organic farming. Here the focus is on networking, capacity building, training farmers in cross breeding and single plant selection. Collaboration among the local cotton growers organisations will foster synergistic effects. The aim is the establishment of decentralized participatory cotton breeding programs that will allow for local adaptation and improve the resilience of organic cotton to counteract the challenges of climate change. Besides the dominating *G. hirsutum* cotton a special focus is put on the traditional Indian Desi cotton (*G. arboreum*) as they have better drought resistance. Specific crosses suitable for low input farming are made by the UAS Dharwad. The progenies were provided to the organic cotton organisations for single plant selection starting from F3 generation (now F5). Phenotypic selection by farmers was compared with selection by researchers and experienced cotton breeders. Final selection in each generation was based on growth habitus, yield potential and fibre quality requirements given by the textile industry. In parallel the farmers are continuously trained in all aspects of plant breeding, seed multiplication and GM testing to obtain a "farmer's breeder curriculum". Female farmers are especially encouraged to participate together with their husbands or in separate groups.

Results

In the season 2011-2012 in total 49 cultivars of different species and cultivar types received from UAS Dharward were examined for their suitability under organic and low input farming. *G. arboreum* varietal lines showed good vegetative growth and yield per plant, however on average rather low fiber quality, especially short fibre length. *G. hirsutum* varietal lines showed in general good yield per plant, and seven of these cultivars reached the required fibre quality requirements (Roner 2012).

In the season 2012-2013 we evaluated 50 cotton cultivars, out of which 3 were G*. hirsutum* hybrids, 6 were *G. arboreum* varieties and 41 were *G. hirsutum* varieties. This selection included standard cultivars as well as 8 cultivars that were selected in the precious trial (2011-12). The 50 cotton cultivars were screened at two locations, i.e. at heavy soil with irrigation and light soil with limited irrigation. However, due to severe water logging in the heavy soil trial only few plants survived. Based on the performance on light soil we identified several cultivars with satisfying agronomic performance and fibre quality. The most promising were three *G. arboreum* varieties and five *G. hirsutum* variety which are multiplied by bioRe for pilot cultivation. A total of 21 cultivars were selected to be evaluated again in the present season 2013-14. In addition to these trials, eight on farm trials were performed as well as several farmers' workshops. *G. hirsutum* varieties performed similar to F_1 hybrids. *G. arboreum* varieties performance well under stress conditions like drought, while fibre length was often too short and micronair too high for fine yarn spinning. While yield is highly dependent on location and management, the fiber quality parameters are highly heritable. In general, it was very difficult to meet the fiber quality required by the textile industry. However, the three selected *G. arboreum* varieties can be used for fine yarns and are foreseen for variety release in the state Madhya Pradesh. This season (2013-14) we have included a total of 78 cultivars in the cultivar evaluation trial that had been tested for fiber quality before sowing. In addition 30 new *G. arboreum* lines were screened under heavy soil with drip irrigation and light soil with limited flood irrigation conditions as a stress environment under organic growing conditions. In addition, we have established 24 on farm trials testing the most promising cultivars from last year's trial on farmer's fields. Detailed analysis of the last two seasons (2012-2014) across the different regions and its implementation for the future breeding work will be presented during the meeting.

Discussion

The close collaboration of breeders, farmers, extension agents, as well as stakeholders of the ginning and spinning industry allows the identification of cultivars that suit the circumstances of resource-poor farmers in marginal environments. The performance of the cultivars depends strongly on the climatic conditions and the soil type and access to irrigation within region. In addition farmers have different preferences for plant architecture and cotton species. *G. arboreum* genotypes have better drought resistance and can better compensate unfavourable weather conditions due to the longer picking period, but have on average smaller cotton bolls that are more labour intensive for picking compared to the *G. hirsutum* cotton. Under favourable growing conditions the additional effort of hybrid seed production is justified, whereas under less favourable conditions varietal lines show similar performance as hybrids. Therefore a set of 20 to 30 cultivars are needed for each cotton grower organisation so that the farmers have a choice to choose the 3-5 cultivars that fit best to his farming practise. On farm trials offers a great opportunity to keep farmers engaged. Motivated and trained farmers can take up seed production of the cultivar they like best and start small local seed business for the cotton grower organisations. However, special measures need to be taken to avoid GM contamination during seed production. This way seed sovereignty of organic cotton farmers can be restored.

Including farmers in the breeding process not only ensures that cultivars are adopted by farmers, but studies also show that promising lines were selected earlier and were better adapted to local conditions (Ceccarelli et al. 2009). Farmers' selection was efficient and partly different from breeder's selection having different visions of the optimal plant type in mind. Thus, the participatory selection increases the diversity of genotypes. Since breeding is a long term activity the future developments need to be envisioned. On one hand farmers need to prepare themselves on more extreme weather conditions (drought stress, flooding events) but also on changing technologies (hand picking versus mechanical harvest) or new demands from the textile industry (requirements for fiber quality). Regular workshops are needed to discuss the different aspects and scenarios among the stakeholders and to adjust the breeding goals accordingly.

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