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Attachments

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Organic farming for a new millenium
-status and future challenges

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Preface

The following pages present two contributions that were delivered after the deadline for the printing of the proceedings for NJF seminar 360, ”Organic farming for a new millennium - status and future challenges”. Further, it contains the abstract of two posters that by mistake were not included in the proceedings. We are sorry for the inconvenience this has caused for the authors. To link the contributions in this proceedings attachment to the proceedings, the page number where the contribution would have been placed in the proceedings is shown.

We will also use this possibility to express our gratitude to Ellen K. Syrstad, who has taken the picture of happy cows enjoying the winter, as well as to the owner of the cows, Steinar Dahl. The picture was used on the seminar poster and proceedings front page. Other photos were from Norwegian Centre for Ecological Agriculture.

Tingvoll June 2005,

Anne-Kristin Løes.

Contents

Laying hens in a mixed grazing system with cattle and geese

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Abstract

Preliminary results of the effects of mixed grazing with cattle and poultry versus cattle grazing alone on sward development and animal performance over two grazing seasons are presented. The frequency of rejected patches of grass was lower and the sward more evenly grazed in the mixed system. The proportion of legumes in herbage cut above grazing height tended to decrease more in the mixed grazing system. The number of white clover growing points tended to be higher and grass tiller density was significantly higher in mixed grazed paddocks. The daily weight gain of cattle did not significantly differ between grazing systems. Geese and laying hens performed well. The results suggest that there is a potential for integrating poultry in grazing systems with cattle.

Keywords: Mixed grazing, free range hens, botanical composition, sward density, sward height structure

Introduction

Mixed grazing is often claimed to have positive effects on both pasture quality and animal production per land area. This is explained by better utilization of the pasture, as the different species graze complementarily, resulting in less occurrence of rejected pasture and a better distribution of nutrients from faeces.

The overall objective of the present study was to evaluate the effects of integrating poultry in a mixed grazing system with cattle. The hypothesis to be tested was:
Poultry grazing is mainly complementary to cattle grazing, and increased herbage consumption is compensated by increased herbage production and quality. It is therefore possible to increase the overall output of animal products from a pasture area by adding hens and geese to a given number of cattle.

Materials and methods

The experiment was carried out at three farms in Uppland, Sweden during the whole grazing period (May-September) during two consecutive years. At each farm grass clover leys of 1.8 ha were divided into 8 paddocks. Four paddocks made up the mono system and were rotationally grazed by 3 young cattle, the other four made up the mixed system where cattle were followed by 12 young geese and 180 LSL hens with access to mobile houses. Hens were additionally fed whole wheat, whole oats, fishmeal, oyster shells and grit in free choice and *ad libitum*. Paddocks were changed once a week. No toppings of pasture was done.

Herbage mass and sward height structure was estimated by weekly measurements with a falling plate meter. Herbage chemical composition and the proportions between grass, legumes, weeds and dead plant material were based on herbage cut 2 cm above ground. Botanical composition and sward density was determined by counting grass tillers, red clover and lucerne shoots, white clover growing points and weed plants from circular cores taken at five occasions over the two years.

Cattle and geese where weighed at turn out, in mid term and at end of trial. Feed consumption, egg production, health status and mortality were recorded for the laying hens.

Preliminary results and discussion

Weather conditions during the two grazing seasons were different, the first summer being hot and dry whereas the following summer was rainy. This led to herbage shortage at two of the farms already at the end of July in 2003 whereas herbage production was high and tended to accumulate especially in the mono systems during the following year.

For some sward parameters there where consistent trends in time towards increased differences between the two grazing systems and in the end of the second season some of the effects were pronounced. In the mixed system the proportion of rejected pasture around cattle dung pats was reduced and hence the paddocks more evenly grazed. Figure 1 shows graphically the proportion of compressed sward height measures above or similar to a certain height taken at the end of trial in September 2004. The figure also illustrates the differences in herbage mass.

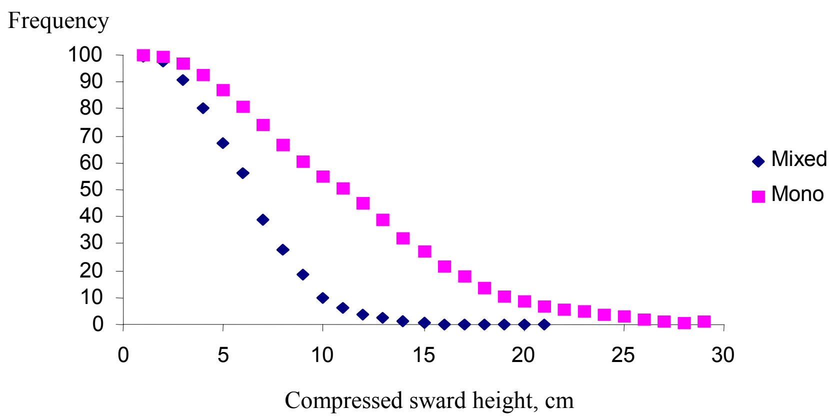

Figure 1. The effect of grazing system on compressed sward height structure, expressed as the proportion of measurements above or similar to a certain height based on 900 measurements (pooled over 3 farms) per treatment at the end of trial year 2004.

The leys of the two farms monitored for botanical composition were of first and second year respectively at the start of the trial and the legume fraction mainly contained red clover. Decrease of legumes was more pronounced in the mixed system. At the end of trial in 2004 the proportion of legumes on a DM-basis was 42.8 % in the mono system and 30.2 % in the mixed system in Farm A, as compared to 83.6 and 80.4 % respectively seven weeks after turn out in 2003. Corresponding values in Farm B were 28.1% (mono) and 3.1% (mixed) and seven weeks after turnout, 56.0 and 47.8 %.

As the leys were not older than 2-3 years, overall sward density was relatively low and drill rows were still recognizable during the second year. From the cores taken it was however shown that paddocks in the mixed systems of the sampled farms were becoming denser compared to corresponding paddocks in the mono systems. This was mainly due to higher grass tiller density in the mixed systems (figure 2). But also the number of white clover growing points tended to be higher in the shorter swards of the mixed systems. In both farms couch grass (*Agropyron repens*) increased over time in the mixed grazed paddocks while it was barely present in the mono grazed paddocks.

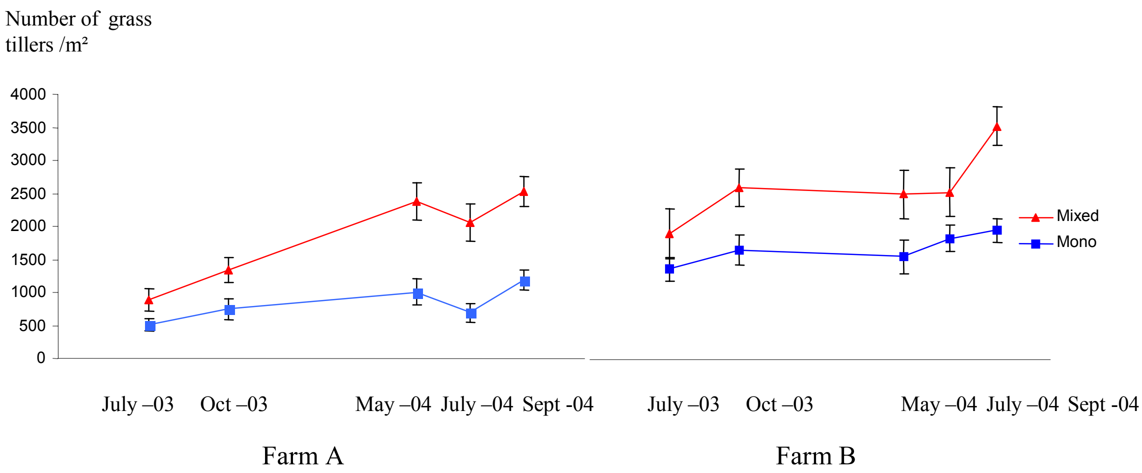

Figure 2. The effect of grazing system on grass tiller development on farm A and B, means and SE.

From the calculations of daily weight gains of cattle no significant differences between systems could be seen in respect to the whole grazing season. However, during the last six weeks of 2003, when herbage was scarce due to drought, weight gains of cattle in the mixed system was low on one of the farms. During that time, poultry grazing was competitive rather than complementary.

The geese performed well during the first half of the season whereas lower gains were obtained in the latter half. The hens had an average rate of lay of 85.9 ±1.3 %, and consumed 113±7 g/hen/day of the indoor feed. Feed conversion rate was on average 2.2 ±0.1. Mortality varied between farms and years and ranged from 1.1 to 12.5 %. High mortality was mainly due to ground predators as a result of electric fence failure.

Concluding remarks

Based on the preliminary results there seems to be a potential of letting hens and geese graze after cattle. The lower frequency of rejected patches of herbage in the mixed systems indicates a better utilization of herbage present. The increased grass tiller density and number of white clover growing points in the more closely grazed paddocks of the farms monitored indicates a potential for increased pasture productivity. However, to fully take advantage of the synergetic effects more flexibility in the system is needed. Some key factors seem to be the time for pasture regrowth, post grazing heights as well as grazing pressure. Also henhouse constructions need to be easy to move as repeated tractor driving is damaging the sward. Moving electric fences each week is also generating a lot of labor.

Organic farming, food quality and human health

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The aim of the paper is to give an actual report of scientific work done in the field of organic food quality in relation to health and to draw attention to the difficulties which occur to proof evidence of the importance of organic food for human health.

Introduction

There is no doubt that **the market for organic foods increased** during the last 10 years and that today this market share has been showing the highest level of growth of all food sectors. In USA the market for organic foods increased 40 fold (from 1986 to 1996) and is predicted to continue to grow at a rate of more than 24% per year (FISCHER,1999). In Europe Germany has the largest market of organic foods. It is estimated that in 2004 compared to 2003 the turn over expanded by 13% (3,5 billion Euro). Since 2000 the turn over increased totally by 70% and the growth is ongoing in 2005. Therefore Germany is the second important market for organic food in the world (United States No 1). This growth in products on the market is reflected by an increase of organically managed acres. Between 2000 and 2003 an increase of 34% could be observed (734.000 ha) and the numbers of organic farms increased by 29 % to 16.466 farms (German Ministry for Consumer Affairs, Food and Agriculture 2005). In UK the organic market accounts for 3 to 4% of all food sales (WRIGHT, 2000). In the Nordic-Baltic region the total market share for organic products are between <1% (Norway) and 3,5% (Denmark). Sweden, Denmark and Finland are the three countries with the largest organically produced areas. Sweden seems to experience a growth in conversion of agricultural land management to the organic system, while Denmark had a minor decrease during last year (6% of total farms are organic). In Finland nearly 7% of all farms converted to organic and in Estonia 1, 2% of farmers are going organic. A rapid increase of organic farms could be detected in Latvia (1998: 39 to 1043 farms 2004) and Lithuania (144 to 1.178 in the same period; NORDIC COUNCIL of MINISTERS, 2005). The annual report of COOP (2003) pointed out, that there is an increasing interest in organic produce especially in Sweden (+16% 945 products listed), in Norway (+9%, 152 products listed) and less in Denmark (+1%, 1200 products listed). The organic market as a portion of the total food market is for COOP Denmark 4,2%, COOP Norway 0,7% and COOP Sweden 3,8% (COOP norden, 2003). In New Zealand the organic market increased 3-fold and may be by end of 2005 to be worth NZ$ 500 million (BOURN & Prescott, 2002).

This development is due to the facts that **people seem to identify a better food quality for organic products**, they feel confident with the national and EU regulations about organic foods and that the food industry has developed a variation of organic foods in the convenient sector so that new groups of consumers are attracted and new sales point (organic discounters) have been installed. The relative importance of the different reasons to purchase organic food may vary from country to country. To stress the point: **Consumer's understanding of food quality is important** and not the scientific discussions about the term and concept of quality. A number of definitions have been suggested and applied in sciences. Food is the meeting point of numerous symbolic codes: personal, familial, cultural, biological, industrial and environmental, as well as ethical dimensions of social justice (Soil Association 2001, Woodward 1999, James 1993). In Germany e.g., consumers have tended to be more concerned with environmental issues than those in the UK (WOODWARD & MEIER-

PLOEGER, 1998) but this may be changing because more recent reports from Germany suggesting that 70% of organic consumers cite **health reasons** as the primary reason for purchasing organic food.
A group of adult Norwegian organic consumers identified health and environmental reasons for buying organic foods, whereas the younger consumer group (15 to 24 years) named consideration for the environment and animal welfare and the older age group concerns for their own health as key reasons for purchasing organic foods (WANDEL & BUGGE, 1997). Not only **age** may change the reasons for buying organic foods, a study in the Netherlands show a variation of motives for **incidental and heavy buyers**. Whereas heavy buyers claim the environment as the key motive to purchase organic foods, the incidental buyers claim health as the most important motive (SCHIFFERSTEIN & OUDE OPHUIS, 1998).

In the literature also **profiles of consumers** could be found. For example a classification into four groups (presumably overlapping) is described by DAVIES et al (1995):

Those who are concerned with the environment
Food phobics who are concerned about chemical residues in foods
Humanists concerned with factory farming
Hedonists who believe that a premium product is better, tastes better.

Other studies describe the typical organic food buyer is more likely to be a woman with a higher education and income of the family as well as having children in the household. In contrast, the Norwegian study from Wandel & Bugge reported that interest in organic food was not related to income, occupation, age or presents of children in the household. We can state, that pur**chasing organic foods is part of a life style which reflects a particular ideology and value system**. This value system and the way in which consumers decide to buy organic foods have been concluded to a model with four stages (KYRIAKOPOULOS & OUDE OPHUIS P.A.M., 1997)

The importance of distribution (by health food shops, retailers, farm shops, supermarkets or food cooperatives) tends to vary from country to country (LATECZ-LOHMANN & FOSTER, 1997). The poor availability and lack of time to find retail outlets is one of the specific reasons for not purchasing organically produced food. Beside that, the high **price** (compared to conventional products) is an obstacle, **unsatisfactory quality** (sensory attributes or appearance compared with conventional) or even being **unfamiliar with the term** and meaning of “organic” in the agricultural and food technology systems (BOURN & Prescott, 2002). The use of food additives is a common concern of consumers, and choosing organic food might be one strategy to **limit additives** in food, as the usage of additives is limited by the regulations governing organic food processing (36 agents allowed instead of approx. 350 for conventional foods). The issue of **genetic modification** in food production is widely debated in public food discourse in many countries. It is known to be a major concern of consumers, and has been found to be explicitly connected with the preference for organic food (MEIER-PLOEGER & ROEGER, 2004).
Therefore some market researchers suggest that organic products should be marketed in a broader way as “environmentally friendly” foods (HUTCHINS & GREENHALGH, 1997). This denies the fact, that organically produced food is not only produced on farms but also processed. **Authenticity of organic food** in processing compared to conventionally produced food is one big topic in the discussion about the health aspects of food. Beside that, the ethical and social aspects of organic food production systems may be neglected using the term “environmentally friendly produced”.

Food quality – definition, assessment and facts

Definition

Nowadays when the term "quality" is used with respect to food, a **value judgement** is made. The partners in the market, producers, processors, medical doctors or consumers might have different judgements about the value of e.g. a functional food drink or yoghurt. To keep expanding the market, processors and retailers have to come up with new products **or** new results from scientific work that proof a better quality. Looking at the market for organic food, politicians, consumers and groups of farmers do want to increase the amount of organic food grown and processed according to European law (2092/91). This leads to the questions "Are there differences between the quality of organic and conventional food?" – and if so – "which parameters are able to show this?" And last but not least "Are organic foods better for health?"

These questions posed from the market and the new green consumers to scientists are not new, they are more than 20 years old and already addressed before the EU legislation decided to define the quality which is linked to organic food through the process which is described in the law. To make it clear: the definition of organic quality of food is **not product- but process orientated**. Therefore it is surprisingly, that now the question arises from the market "can we find and validate methods which are able to distinguish differences between blind samples from different farming systems (e.g. organic and conventional) or processing techniques" and thus showing **the process quality in the product itself**.

Reviews about food quality (Soil Association 2001, Woodward 1999, James 1993) are focussing today mainly on the topic of **comparison studies** of organically produced fresh food and conventionally fresh food. To be more precise – scientists should discuss the results of their comparison studies along the "story" which is behind the product (soil chemical and physical properties, soil microbiological properties, pest and disease burdens, crop rotation etc). Additionally to the agricultural quality management system, nutritional, environmental and social impacts associated with the product have to be taken into account to give a complete picture about food quality (holistic approach). **Life-Cycle-Assessments** (e.g. "ecological food print" or "ecobalance sheets") are able to present data for the environmental and social impacts of different food production systems. Especially alternative "guidelines for better food and nutrition" include topics such as "eat seasonal and regional" ensuring a sustainable food supply system considering energy supply, emissions and social aspects such as regional added value. All these aspects have to be considered to determine food quality correctly and in a "holistic way".

Focussing on comparison studies, it is not surprising, that scientific studies are designed as **fertilizer treatment studies**, because they are cheaper and easier to carry out than whole farm comparison studies. But the results **do not reflect** "organic" and "conventional" food quality because more aspects of those farming systems - such as the effects of crop rotation on nutrients in food or pesticide application on e.g. secondary plant compounds – are neglected. Potentially more useful information about differences in nutritional value would be obtained from the analysis of food produced from organic and conventional farms (**effect of whole systems**). Human health studies evaluating all factors along the food chain (comparison studies with food derived from "paired farms", system authentic food processing and eating habits / lifestyle focussing on all aspects of health (physical, social and mental well-being) would be the optimal for answering the very important question of consumers "Is organic food better than conventional for human health?"

Fertilizer treatment comparison studies

It is clear, that a number of factors affect plant composition (e.g. genetics, soil type, climate, irrigation, cultivation practices, harvest time) so that the factor of fertilization is only one part of the total agricultural system. Fertilization in crop production affects the composition of plant material (Salunkhe & Desai 1988, NAGY & WARDOWSKI, 1988, LINDER, 1991, WOESE et al, 1997, TAUSCHER et al 2001). The majority of the studies claim that the higher amount of nitrogen, mostly quickly available to crops, consequently leads to higher nitrogen and nitrate in crops. The most common crops which have been investigated in comparison studies are carrots, lettuce, potatoes, spinach and other green vegetables. A randomized block with replicates is the most common design for fertilization treatment comparison studies. In the last few years a review of studies have been made which summarized and criticised the reported studies (WORTHINGTON, 1998, TAUCHER et al, 2001, Soil Association, 2001, BOURN & PRESCOT 2002, WILLIAMS, 2002). Only few studies have been made using appropriate statistical techniques to study the relative importance of fertilizer treatment, soil type and plant variety on crop composition (e.g. PCA). BOURN & PRESCOT (page 8 – 12) as well as the report from the German Government (Tauscher et al) and the British SOIL ASSOCIATION give an excellent overview about the results obtained. Overall these studies indicate that the effects of fertilizer types and amount of fertilizer applied depend on local conditions (water, temperature, soil) so that results cannot be repeated in another location. Some studies indicate that the use of organic fertilizer such as compost may result in lower nitrate levels of some crops than when using soluble mineral fertilizers.

Comparisons done on farms

Farm comparison studies have the advantage that effects of whole farming systems are compared. This chance is also a challenge because of the appropriate statistical tests to clarify the individual factors of the farm management system on the nutritional value of the products. Beside that, only a few numbers of studies have been done over a period of 3 years (DLOUGHY, 1989, WOLFSON & SHEARER, 1981). Because of the interaction of a larger number of variables influencing the nutritional value of crops, the results **from farm comparison studies are also highly variable**. A consistent finding is that organic produce have lower nitrate levels and higher beta-carotene levels in some crops. Results of differences in the vitamin C content of organic and conventional foods have not been consistent (DLOUGHY, 1989; FISCHER, 1984; CLARKE & MERROW, 1979, TAUSCHER et al, 2001). Recent studies concluded (BRANDT & MOLGAARD, 2001) that nutritionally important differences relating to contents of minerals, vitamins, protein or carbohydrates are not likely, primarily since none of these are deficient in industrialized countries. But more and more studies proof evidence that on average, organic vegetables and fruits contain more **secondary plant compounds** than conventional ones and thus may infect **benefit human health** more than conventional ones.

On the international congress (6-9 January 2005) in Newcastle on Tyne, Carlo Leifert presented under the title "Is organic food good for you?" (LEIFERT, 2005) an overview about present situation in literature. He showed that organically produced food had higher vitamin and CLA content in organic milk and dairy products, and a higher level of omega- 3 fatty acids in organic milk compared to conventional. Furthermore organic fruits and vegetables were shown to have a higher content of phenolic and flavonoid. Concerning deleterious minerals, organic fruits and vegetables had a lower level of lead, aluminium and mercury while the level of beneficial minerals was higher compared to conventional fruit and vegetables. Even the question of mycotoxin levels in grain was addressed presenting several studies reporting a higher Fusarium infection and/or mycotoxin levels in conventional than in organic samples.

Conclusion about the results of Fertilization and Comparison studies and their relevance for the topic of health

The view that organic foods are healthier than conventionally produced foods appears to be based on the perception that organic foods have superior sensory attributes, contain lower level of pesticides and have higher amounts of nutrients.

Even if we summarize the results of those studies as LEIFERT did, the question should be allowed which impact do have these chemical compounds on health?

Kirsten Brandt (2005) claims to widen the view and discussions but within the mainstream scientific concepts. She suggests e.g. to look at the intrinsic resistance of plants to diseases and pests. Her aim is to understand the crop as a living plant focussing on plants health parameters. The results she reported at Elm Farm Research Centre Conference in November 2004 show big differences of apples on resistance to diseases and pests effected by different N-fertilization (annual clover grass= high N; perennial clover grass = medium N and perennial grass = low N). The parameters shown were apple scab, sooty blotch and apple saw fly (from a study done by Berthelsen & Pedersen, 2002). She stressed the point that we should put more emphasis to discuss the dose response relationships of plant defence compounds and human health. She reported of one of her own studies on carrots (Bolero) where 72 aromatic compounds have been measured under conventional, organic fertilization plus pesticide application and organic cultivation treatment. These aromatic compounds are important for taste but defend the carrot against diseases and pests at the same time. Looking at the growth conditions in general first step is to build plant mass, followed by differentiated mass and secondary metabolites. The relationship between nutrient resources (nitrogen mainly leading to a higher productivity of plant mass) and secondary plant compounds show clearly an adverse effect. The content of secondary plant compounds is decreasing with higher plant mass. Her conclusion was, that much work is still needed to investigate growth conditions combined with dose response relationship to clarify the question what might be beneficial for plant, animal and human health.

Animal feeding trials and Human health studies

By discussion the results in this research field, one should consider that **health** in these investigations is seen as reproductive health, excluding the aspects of "social and mental well-being" as described by the World-Health-Organization (WHO).

Most of the studies have been done already years ago (VOGTMANN, 1988). Some of these have even been criticized for an unbalanced diet given to the animals (HODGES, R. & SCOFIELD, A.M, 1983). A well designed studies done at University of Bonn (Germany) by STAIGER (1986) reported an improved reproductive health from the consumption of organically (bio-dynamic) feed for hare, especially in the second and third generations (6.3 and 6.3 per hare compared to 10.8 and 9.7). The biodynamic group show more embryos and a higher number of offspring born as well as lower infection rates compared to those with conventional feed. Because the composition of the feed was designed as equal/similar, the investigation suggested, that other factors than chemical components might be responsible for a better health of those rabbits. Other studies, in contrast to the privies one couldn't show differences in results of animal studies comparing organic and conventional feed (e.g. GREAVES &SCOTT, 1959). Most of the experiments done could be criticized because of the use of feed obtained from fertilization trials and not from organic or conventionally farms (e.g. AEHNELT & HAHN, 1978, PLOCHBERGER, 1989). The work done by Alberta Velimirov from Austria is one of the better designed **feeding studies using organic and conventionally produced feed from neighbouring farms**. She compared the effects of feed on rat fertility over three generations (VELIMIROW, 1992). The test feeds had been analyzed and based on these results, the vitamin and mineral composition of the feed mixture was adjusted and feed to 20 pairs of rats each feeding system. The results obtained show no significant in the pregnancy rate, birth weight or weekly gain of the offspring, but there was evidence over 3 generations of rats that the organic fed group had lower perinatal deaths compared to the conventional fed group. Recent studies reported by Carlo Leifert (2005) claim for research on food pathogens showing that grass based "organic" cattle diets reduce the risk of E. coli contamination, while grain based "conventional" diets increase the risk. An increased share of grains in the diet (as it is used in conventional farming systems) decreased pH and increased E. coli in rumen and colon and increased the percentage of animals shedding E. coli. In addition to that, a study from Scotland found a higher share of ampicillin resistant E.Coli in conventional than in organic dairy herds. .

Looking for **human intervention studies** with organic and conventional produce, there are rare to find. SCHUPAN (1972) has done some and more recently the semen quality of men involved in the organic food industry (farmers, consumers) compared with that of men in other industries (Abell et al, 1994, Jensen et al, 1996; Larsen et al 1999; Juhler et al, 1999). These studies attempted to correlate organic food consumption resp. dietary pesticide residue levels with semen quality or compare semen quality of organic farmers/consumers with nonorganic eating consumers. Whereas Abell found that organic farmers had a higher sperm density, Jensen et al found no clear relationship between eating habits and semen quality beside the fact, that sperm concentration was higher in members of organic food associations compared to the control group. The very well designed study of Larsen et al compared three different groups of farmers according to the amount of organic food consumed and dietary pesticide intake (lower in organic food). The group of men who consumed no organic food was found to have a significantly lower proportion of morphologically normal sperm but for the other 14 parameters of sperm quality no significantly differences could be found.

A more recent published study by GRINDER-PERDERSEN (2003) focuses on the **intake and excretion of flavonoids and antioxidative defence in humans**. The study was a double-blinded randomized crossover design with two intervention periods each lasting 22 days with a strict control of dietary intake. Four menus have been presented to the people. The menus and the food quantities used in the two diets were identical (35 energy% fat, 51% carbohydrates and 14% protein). Six males and 10 females (21- 35 years of age) attended the investigation. In conclusion the authors point out, that growing conditions of fruits and vegetables (conventional vs. organic) affected the content of five selected flavonoids (higher in organic food) and resulted in differences in the urinary excretion of major dietary flavonoids. Makers of antioxidative defence were affected by the food production method. The intake of organic food resulted in an increased protein oxidation and a decreased total plasma antioxidant capacity compared to the baseline ($p<0.05$). Because selection of more resistant varieties is of central importance to organic farming, the authors stated that this investigation reflect a realistic composition of the diet seen from consumer's perspective.
HUBER et al (2005) reported at the 8th scientific conference for organic agriculture in Kassel, the results of an intervention study conducted with 17 nuns (59 to 80 years) for 8 weeks. The life style was similar and the calculated nutrients in the diet as well. The participants got meals from biodynamic food and conventional food and had to fill in a daily "nutrition report" which was than calculated with the German food tables for nutrient intake. This study tries to focus not only at the reproductive health of the participants, but approaches the WHO definition of health by including a questionnaire about well being. The results as being presented indicate a reduced daily energy intake in the biodynamic food period, a reduced protein intake from animal produce but not from plant products and no change in fat intake

but increasing the intake of dietary fibres. The body weight remains constant and the blood pressure was reduced. The authors mention that the parameter "well feeling" investigated by protocols and interviews increased significantly under organic food. More parameters investigated will be published soon. The results indicate that beside the nutrient content of organic food there might be other factors which are positive for human health.

Our working group at Kassel University aimed for the last three years to validate according to ISO standard 70025 so called holistic methods to determine food quality in the product itself. These methods should show the process of growth and differentiation, as well as the total influence of an agricultural system in the product itself. First results from these investigations made with the methods of copper chloride crystallisation, fluorescence excitation spectroscopy as examples for holistic methods could distinguish on blind samples from well documented trials organic and conventional foods (KAHL et al 2005). Now we are coordinating a project where the results of these methods are correlated to single nutrients in the products to answer the question if e.g. the quality seen in the pictures can be explained by nutrient composition or if the pictures reflect more than the sum of nutrients. At the same time investigations on human (e.g. allergic reactions on food) are done and holistic methods are applied on the food at the same time. This should give us the possibility to discuss the value of those holistic methods in correlation to human health aspects.
To increase the scientific work on organic food quality and health, an international research association has been founded two years ago. Please see the homepage under www.organicfqhresearch.org and our newsletter. We researchers aim to establish a network and to develop a common conceptual framework. What is needed for future scientific studies are system approach, transdisciplinarity, open discussions about the interpretation of results and a theoretical back up of holistic/complementary methods.

Conclusion
The paper presents data for the increasing market of organic produce worldwide. Although the scientific definition of food quality includes many aspects such as environmental, social and nutritional parameters, it seems that consumers indicate a higher nutritional quality for organic foods.

Research results on the effect of organic and conventional farming systems on nutritional value of food are mostly done in the field of plant produce and focussing on fertilization trials. Some studies include research on products of paired farms (conventional and organic). The results indicate especially in the field of secondary compounds advantages for organic foods which might be useful not only for resistance against pests for the plant itself but for human health as well.

Animal health studies indicate a better start for the offspring. Food preference tests with rats (and apes) show a statistically significant preference for organic feed. Research on cattle health indicate with increasing grain in conventional diets an increase in risk of contamination with E. coli.

Intervention studies with humans were done in the field of reproductive parameters. Semen quality seems to be better consuming organic produce compared to conventional products. Recent publications describe the effect of secondary plant compounds, which are higher in organic food, on human excretion of flavonoids and the antioxidative defence in humans which seems to be better. A study with nuns in Germany tried to include the topic of well being when investigating human health and stated a significantly better well being in the period eating organic food. The paper raises the question if complementary, so called holistic methods may show additional quality parameters. There is a need – and first steps are done – to validate these methods and to link them to human health studies. Although the efforts to investigate the influence of organically produced food increased, there is still a tremendous need for further investigations. Therefore a network of researchers established three years ago (FQH) focussing on the topic of organic food quality and human health.

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Soil fertility in three cropping systems after conversion from conventional to organic farming

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Abstract

Temporal changes in the scores of selected soil fertility indices were studied over six years in three different cases of organic crop rotation located in southern, eastern and central Norway (Bakken et al. in press). The cropping history and the initial scores of fertility indices prior to conversion to organic cropping differed between the sites. Crop yields, regarded as an overall, integrating fertility indicator, were in all rotations highly variable with few consistent temporal trends following the first year after conversion. On the site in eastern Norway, where conversion followed several years of all-arable crop rotations, earthworm number and biomass and soil physical properties improved, whereas the system was seemingly degrading with regard to P and K trade balances and contents in soil. On the other two sites, the picture was less clear. On the southern site, which had a relatively fertile soil before conversion, the contents of soil organic matter and K decreased during the six-year period, but the scores of other fertility indices showed no trends. On the site in central Norway, there were positive trends for earthworm-related indices such as worm biomass and tubular biopores and negative trends for soil porosity. The results, especially those from the eastern site, illustrate the general difficulty in concluding about overall fertility or sustainability when partial indicators show divergent trends. Consequently, the study gave no unambiguous support to the initial working hypothesis that organic farming increases inherent overall soil fertility, but rather showed that the effect varied among indicators and depended on status of the cases at conversion. It is concluded that indicators are probably better used as tools to learn about and improve system components than as absolute measures of sustainability.

Keywords: biopores, crop rotation, earthworm, nutrient balance, soil porosity, soil structure, sustainability.

Reference

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Accumulation and losses of nitrogen in white clover plant organs

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Abstract

Introduction

White clover (*Trifolium repens L.*) is widely used in clover–grass leys and pastures and as green manure in organic farming, predominantly undersown in small grain. A major challenge when using white clover, is to maximise N transfer to the subsequent growing season in order to minimise the risk of loosing a production resource much needed and the risk of environmental detriment due to off-season N losses. Therefore, to better understand N cycling in white clover stands under northern temperate climatic conditions, improved knowledge is needed on how harvesting affects plant N content in late autumn, N losses during winter and plant N uptake in the following spring.

Materials and methods

White clover plants were established from stolon cuttings, planted in PVC tubes and dug into the field at Apelsvoll Research Centre in central southeast Norway (60°42'N, 10º51'E) in spring 2001 and 2002. During the growing season, plants were totally stripped of leaves, harvested at 4 cm height or left undisturbed. The plants were sampled destructively in late autumn, early spring the second year and after six weeks of new spring growth. The material was sorted into leaves, stolons and roots. Dry weight and N concentration were measured in all fractions. Soil inorganic N and N uptake in plant root-simulator probes (PRS^{TM}) were also measured.

Results

In the autumn, the largest part of accumulated N was stored in white clover stolons. However, intensive harvesting, as compared to no harvesting, favoured N transfer to the leaves on the expense of stolon and root biomass production. Independently of treatment, about 75 % of the N present in leaves in the autumn was lost, while N stored in stolons and, particularly, in roots was conserved much better. However, the stolons of intensively harvested plants seemed to be less winter hardy and lost more N (55%) than did undisturbed (21%) and less intensively harvested plants (13%). Relative plant growth and N uptake rate in spring were almost equal for all treatments. The main reason for a lower total N accumulation in white clover plants that were intensively harvested the growing season before was that these plants were smaller than no harvested plants when the new leaf growth re-started in spring. The amount of inorganic N in soil after snowmelt and mineralization of white clover-derived N during the spring was small, suggesting that leaching and gas emissions may have been important N pathways.

Our results suggest that off-season losses of N from systems based on legume N input may be significant as seen both in production resource and environmental perspectives. Thus, to conserve N in crop rotations comprising white clover, e.g. on many organic farms, one should choose winter-hardy cultivars that tend to reallocate resources from foliage to more persistent storage organs before the onset of winter or, alternatively, harvest the foliage in the autumn.