Organic agriculture - the Nordic, European and global perspectives

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Abstract
The Nordic, European and global societies are focusing more and more on sustainable development including food production and the management of rural areas. Organic agriculture is based on explicit values and with its basic principles of recycling, precaution and proximity it can be considered as a concrete model for developing a sustainable agriculture. This presentation focuses on seeing organic farming as a perspective rather than a niche for agriculture and on how we can use organic agriculture and its principle for developing a more sustainable agriculture.

Introduction
In history we have seen that the fate of empires and civilisations have been determined by the way the land was used. In modern conventional agriculture we are faced almost everyday with problems about environment pollution and food safety hazards related to the production methods: e.g. surplus nutrients and pesticides polluting the aquatic environments, the atmosphere and natural ecosystems, disappearance of small habitats, flora and wildlife, zoonoses (BSE, Salmonella, Campylobacter) serious disease epidemics in animal husbandry (M&F, Newcastle disease, resistance to antibiotics), pesticides residues and surplus nitrate in food and rural areas being deserted. After the Second World War there was a requirement to increase the food production in Europe and this goal governed the agricultural policy. Despite enough food in Europe today the industrialisation of agriculture continues: still larger and more economically efficient units, e.g. large fields of monoculture crops and big stables with production methods that often allow sufficient consideration for animal welfare. The mainstream thinking of agriculture appears to remain industrial. However, the great difference between agriculture and industry is that agriculture is about the living and industry mainly about non-living or human created materials and resources.

There is a general view that organic farming is leading a development towards a more integrative view on agriculture, food production and environment. It is often suggested that organic agriculture solves many of the problems observed in conventional intensive agriculture. Is organic agriculture a paradigm for a sustainable agriculture?

Sustainable agriculture
The political agendas in Nordic, European and global societies are focusing more and more on sustainable development of the societies including food production and the management of rural areas. In the private sector many large companies have developed and concretised their profile for a sustainable development of their business. Most of us can agree about supporting the Brundtland–definition of sustainability: “sustainable development is a development, which satisfy the needs of the present generations without reducing the possibilities for future generations for satisfying their needs. Fundamentally a sustainable development is a process of change, in which the resource use, control of investments, the direction of the technological development, and changes in institutions, all are in balance and improves both the present and future possibilities for satisfying human needs and hopes.” The definition does not define a unique ethical perspective. We should agree on a basic ethic principle about the way we act in small and large scale and in technological choice we make and show consideration for the ecological system we are part of (Illem, 2000). A sustainable development involves a new way of thinking, e.g. in terms of use of natural resources and our lifestyle in developed countries, “a lifestyle designed for
permanence” (Schumacher, 1973) and thus more than just cleaning/solving the problems we already created. We need knowledge on and respect for the nature we are an integrated part of. This includes the consumer/citizen arguing that food is not safe and at the same time not being ready to pay the farmer the higher prize e.g. of organic food.

It is important to make clear the assumptions and values underlying the discussion, when addressing the concept of sustainability. This includes the values underlying the criteria for setting up thresholds and limits for what is sustainable and what is not sustainable in a natural science context (Gamborg et al. 2002). Here it is important not to create a sustainable technocracy only to protect Man from himself, but rather some ethical framework for sustainable behaviour (Illem, 2000). Furthermore, many stakeholders should be involved in a dialog on making priority and balance among the many dilemmas contained within the concept, e.g. do we want cheap or safe food or do we want to prioritise animal welfare over the environment (Gamborg et al. 2002).

In the discussion of sustainable development in agriculture and our work to operationalize sustainability we need to discuss the underlying assumptions and values as indicated above, but we may also need a starting point/framework. One framework to develop sustainable agriculture is to consider natural ecosystems. These are often sustainable and we can learn from these including carrying for and considering the ecosystem services provided from agro-ecosystems in terms of nutrient cycling, biological control, clean water, recreational landscapes etc. Organic agriculture is another starting point/framework which of cause should not be seen in isolation from the framework of natural ecosystems.

**Organic farming**

Organic agriculture is based on the explicit values saying that: Nature is a whole that we have a moral duty to care about. We as human beings are integral parts of Nature, which we have only limited knowledge about and we do not know the complete consequence of our action on Nature. We should make use of Nature by using its own mechanisms of self-regulation instead of trying to control and convert it with industrially manufactured inputs. Values of organic farming can be broken further down into three ethical principles (DARCOF, 2000):

- **Recycling principle** – collaboration should be promoted though the use, establishment and build up of natural cycles that ensure diversity and harmony, and the recycling and use of renewable resources. Cycles should be as closed as possible and self-regulatory process should be stimulated.

- **Precautionary principle** – Known and well-functioning technologies are better than risky technologies. It is better to prevent damage than to depend on our ability to cure the damage.

- **Proximity (nearness) principle** – Transparency and co-operation in food production can be improved by nearness. Direct contact between producer and citizen often reduce the alienation that characterizes modern societies

These principles have been further described in a series of aims that are broken down into standard/rules (certification) to describe the methods to make it clear to the farmer and society how organic agriculture differ from conventional farming. The standards/rules are in continuous development as we obtain more knowledge from research.

In the Nordic countries the following definition of organic farming is used: Organic agriculture is defined as a self-supporting and continuing agro-ecosystem in good balance. Use of local renewable resources is the foundation of the system. Organic agriculture is based on a holistic view, which includes the ecological, economical and social aspects of agricultural production, both in local and global perspective. In organic agriculture Nature is seen as a totality with its own value. We have a moral responsibility to conduct agriculture in such a way that the cultural landscape is included as a positive part of Nature.
Organic farming uses strictly naturally derived compounds and physical methods because organic pioneers had the suspicion that natural habitats and agro-ecosystems might become imbalanced though excessively efficient and fast acting or releasing inputs as well as though using compounds with biologically too unspecific effects (Niggli, 2000). I

The principles of organic agriculture can be considered a framework for the development of agriculture. It should be emphasized that organic agriculture is only be a step towards a sustainable agriculture. Several aspects of the organic agriculture as it is practiced in Europe, e.g. in some region relying on animal manure and feed from conventional farming, use of copper in plant protection in some countries, mining of soil nutrients in some stockless farming systems, is not sustainable and requires further development.

The Nordic and European perspective on organic farming
In the Nordic and European perspective organic farming can be considered a concrete model for sustainable development. Nordic countries are already in the front regarding conversion to organic agriculture with Sweden around 11% and Finland and Denmark with about 7% of the area converted in 2001. In the EU the Common Agricultural Policy (CAP) have defined objectives, to which organic farming contributes. This relates to: environmental-friendly production methods for high quality products, diversification of agriculture and public goods related to rural development and provision of non-food goods (e.g. animal welfare). In the EU Commission organic farming is considered a niche production management system based on some specific rules only and not a model for a sustainable agriculture based on some basic principles (CEC, 2002). However, organic agriculture is part of the CAP 2002 midterm-review as a means “to reward quality rather than quantity” and suggestion for response to questions regarding the improvement of CAP in which sustainable development is a key issue. A European Action plan for organic farming will be published soon and hopefully it will contain measures to support the development of organic/sustainable agriculture in the Nordic countries.

Analyses in USA and European countries indicate that most developed countries could be self-sufficient in organically produced food, but export supplies would vary. Now Western European countries consume nutrients from nearly 5 times its agricultural area, mainly in the forms of imported animal feeds. Less meat consumption in Western Europe would be in accordance with a more healthy diet as recommended to prevent coronary heart disease and obesity. However, to obtain self-sufficiency in the Western country it would require large changes in terms of investments, labour and skills.

The global perspective for organic agriculture
Organic certified farming is practised on 15.8 million ha of the world with Australia as the largest producer (7.6 mill ha) and only very little certified production in Asia and Africa. Now there is a growing interest in developing further organic production in many parts of the world. As an example Australia is planning to become the leading global organic food supplied by 2010.

It is frequently asked: How will organic farming be able to feed the growing population of the world? As stated by Lawrence Woodward, Elm Farm Research Centre (2002): “this question is hardly ever raised by people who are seriously contemplating the subject and rarely by someone prepared to even briefly consider that feeding the world—whether by organic or conventional methods—has hardly anything to do with agriculture and is mainly to do with finance and power.” Basically alleviation hunger has to do with alleviating poverty. Indeed organic farming is not able to feed the world population a diet rich in higher proteins (meat), convenient to a developed world lifestyle (Woodward, 2002).

In developing countries organic farming principles can be used for improving the traditional farming systems, which are the source of food for the major part of the population in these countries. Ideally organic farming should take its starting point locally in the tradi-
tional farming practices. Developing organic farming systems based on traditional systems by introducing selected modern locally based technologies, may give the possibility of both higher yields and productivity. Thus introducing organic farming principles, such as maintaining/building soil fertility using organic residues, using nitrogen fixing crops to a greater extent, and greater soil protection are means of improving traditional systems and probably the most sensible approach compared to strategies based on external input of fertilizers, pesticides and GMO, which are often not affordable or accessible by the small holder in developing countries. However, such development requires education and training of local agronomists and farmers. Here the Nordic countries could strengthen their role in terms of education, teaching and support of organic farming projects in developing countries.

Organic farming has no or little interest for capital-intensive monoculture commodity production systems based on fertilizers, pesticides and GMO in developing countries used to trade and raise foreign capital (Woodward, 2002). Due to the huge debts in developing countries - plantations and cattle ranges – producing commodities for export have been encouraged at the expense of using land for the production of food to the people in the country. Organic farming based on locally adapted intensive biological systems work well and can be more productive compared to traditional farming systems in developing countries. In some regions pests and disease can be a problem. Here agro-biodiversity is important to spread the risk of crop loss.

Schumacher (1973) wrote: "Man’s management of the land has three primary aims: health, beauty and conservation. The fourth aim - the only one accepted by the experts (European agricultural experts report, 1970) – the productivity will be reached as a spin off". He continues: “Agriculture should fulfill at least three goals: 1) keep Man in contact with the living Nature, of which he is and will remain an utmost vulnerable part, 2) humanize and improve the greater personality of Man, and 3) produce the food and other goods, which are required for a reasonable living. Citation continued: I do not believe that a civilisation that only acknowledge the third aim, and pursue it with such ruthless and violence, that the two other goal are not only neglected, but systematically opposed, has any change to survive in the longer perspective.”

References
Cropping systems for sustainable agriculture –
Eight year results from the Apelsvoll cropping system experiment

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Introduction
Development of environmentally and economically sound agricultural production systems is an important aim in agricultural policy and has a high priority in agricultural research worldwide. In this summary we use results from the first complete crop rotation period (1990-1997) of the Apelsvoll cropping system experiment in central southeast Norway, to discuss the effect of cropping systems and their management practices on environment, soil fertility, crop yields and farm economy, and how this knowledge may be used to develop a more sustainable agriculture.

Materials and methods
The experiment includes organic arable, integrated arable, conventional arable, organic forage, integrated forage and conventional forage cropping systems. These systems, which differed in crop rotation, fertilization, soil tillage and plant protection, were established on model farms of 0.2 ha. The model farms were equipped for measuring drainage and surface runoff (by tipping buckets). Measurements of environmental, soil fertility, yield and economic characteristics were recorded and used for calculation of system indices by means of the characteristics. These indices were used for comparisons of the cropping systems.

Results and discussion
The negative environmental effects (nutrient runoff, soil erosion and pesticide contamination) increased in the order: integrated forage < organic forage < organic arable < integrated arable < conventional forage < conventional arable. N and P runoff losses were very much linked to the proportion of ley in the system. Thus, major improvements to reduce nutrient runoff from agriculture, cannot be achieved without changing the cropping systems in the direction of more mixed farming with reduced cropping intensity. Nutrient balance calculations showed that there were considerable deficits in the organic systems, a fact which must be taken into consideration in the development of sustainable organic cropping systems. The yield reduction experienced with integrated and organic cropping, relative to conventional cropping, was smaller for forage crops and potatoes than for cereals. This suggests that it is easier to maintain the yield level by reduced cropping intensity in mixed farming systems with livestock than in arable farming systems without livestock. Because of the premium prices and government subsidies to organic farming, the economic results were equally good in the organic systems as in the conventional ones. Economically, integrated farming was less favourable than the other systems.

Conclusions
Overall, integrated and organic forage systems results in the least environmental harm, and based upon the present government subsidies, the forage systems also seem the most profitable, along with the organic arable system. Negative nutrient balances is a serious concern that has to be taken into consideration in development of sustainable organic farming systems.

Reference
Crop production and N leaching in arable organic crop rotations

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The possibilities for increasing grain yields and reducing N leaching losses in organic cereal production through manipulation of crop rotation design were investigated in a field experiment on different soil types in Denmark from 1997 to 2000. Three experimental factors were included in the experiment in a factorial design: 1) proportion of grass-clover and pulses in the rotation, 2) catch crop (with and without), and 3) manure (with and without). Three four-course rotations were compared (Table 1). Two of the rotations had one year of grass-clover as a green manure crop, either followed by spring wheat or by winter wheat. The grass-clover was replaced by winter cereals in the third rotation. Animal manure was applied as slurry in rates corresponding to 40% of the N demand of the cereals.

The largest effects on both dry matter and N yields were caused by differences between sites caused by differences in soils, climate and cropping history. The rotation without a green manure crop produced the greatest total yield. Dry matter and N yields in this rotation were about 10% higher than in the rotation with a grass-clover ley in one year of four. Therefore, the yield benefits from the grass-clover ley could not compensate for the yield reduction as a result of leaving 25% of the rotation out of production. There were no differences in dry matter and N yields in grains between the rotations, where either spring or winter cereals followed the grass-clover ley. There were only small yield benefits from the use of catch crops at the crop rotational level.

Nitrate leaching declined with increasing soil clay content and with decreasing rainfall (Table 2). Nitrate leaching was reduced more by catch crops on the sandy soils. There were no difference in nitrate leaching between rotations 1 and 2, but nitrate leaching was considerably lower in rotation 4.

Table 1. Crop rotations tested. * shows the places in the rotation, where catch crops are used in the catch crop treatments.

<table>
<thead>
<tr>
<th>Rotation 1</th>
<th>Rotation 2</th>
<th>Rotation 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring barley: ley</td>
<td>Spring barley: ley</td>
<td>Oats</td>
</tr>
<tr>
<td>Grass-clover</td>
<td>Grass-clover</td>
<td>Winter wheat*</td>
</tr>
<tr>
<td>Spring wheat</td>
<td>Winter wheat</td>
<td>Winter cereals</td>
</tr>
<tr>
<td>Lupins</td>
<td>Peas/barley</td>
<td>Peas/barley</td>
</tr>
</tbody>
</table>

Table 2. Effect of crop rotation and catch crop (CC) on average nitrate leaching (kg NO₃-N ha⁻¹ yr⁻¹) at the three experimental sites for four years (1997 to 2000).

<table>
<thead>
<tr>
<th>Site</th>
<th>Rotation 1 CC</th>
<th>Rotation 1 + CC</th>
<th>Rotation 2 CC</th>
<th>Rotation 2 + CC</th>
<th>Rotation 4 CC</th>
<th>Rotation 4 + CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jyndevad (coarse sand)</td>
<td>102</td>
<td>68</td>
<td>95</td>
<td>63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foulum (loamy sand)</td>
<td>49</td>
<td>35</td>
<td>34</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flakkebjerg (sandy loam)</td>
<td>32</td>
<td>23</td>
<td>25</td>
<td>24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References

Annual pastures, seed mixtures and supplementary feeding in organic milk production

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Grazing is an essential part of organic dairy farming. During growing season cattle must have an access to pasture and when possible the feeding should be based on grazing (EU 1804/1999, CEC 1999). Consequently farmers are interested in new practices and pasture species supporting efficient grazing management. The current study was aiming to evaluate annual legume-grass-cereal mixture as a basal feed for dairy cows under organic or other low fertiliser input systems in Nordic conditions. An additional aim was to evaluate the effect of concentrate feeding regimen in order to simplify grazing management.

Eight lactating Finnish Ayrshire cows were used. The design was 4 x 4 Latin square with two replicates and four 21-day feeding periods including a 14-day adjustment period and a 7-day recording period. Four experimental treatments in a 2 x 2 factorial arrangement consisted of two sward mixtures and two concentrate feeding regimens. Clover mixture (CM) contained 12 and 2 kg ha⁻¹ Persian clover (Trifolium resupinatum L.) and white clover (Trifolium repens L.), respectively. Vetch mixture (VM) contained 20 and 14 kg ha⁻¹ common vetch (Vicia sativa L.) and hairy vetch (Vicia villosa Roth.), respectively. Both mixtures contained also 80 and 14 kg ha⁻¹ barley (Hordeum vulgare L.) and Italian ryegrass (Lolium multiflorum Lam.), respectively. Concentrate was offered either once (4 kg) or twice (2 + 2 kg) daily. Herbage allowance (HA) was 21.5 kg DM (above 3 cm) cow⁻¹ day⁻¹. Paddocks of three to four days were used. The size of paddocks was determined by herbage mass basis to meet the HA demand.

Milk production differed neither between cows grazing CM and VM nor between cows supplemented once and twice per day (ns = non significant, P>0.05, Table). Barley predominated early in the summer but it was rapidly replaced by other species, while legumes dominated increasingly in late summer. Despite of major changes in botanical composition, herbage chemical content was relatively constant during entire grazing season. VM had lower (P<0.01) mean in vitro organic matter digestibility than CM (0.742 vs. 0.778), but similar (P>0.05) crude protein (223 vs. 212 g kg⁻¹ DM) and neutral detergent fibre (401 vs. 381 g kg⁻¹ DM) content. During the last feeding period cows grazing CM had temporary bloat problems, indicating too high clover proportion (0.675).

| Table. The effect of pasture and supplementation on milk production |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Sward mixture                   | Clover mixture  | Vetch mixture   | Significance    |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Concentrate feeding             | Twice           | Once            | Twice           | Once            | Sward           | Feeding         |
| Milk yield kg day⁻¹             | 21.8            | 22.0            | 22.0            | 20.6            | ns              | ns              |
| Fat yield g day⁻¹               | 892             | 892             | 907             | 859             | ns              | ns              |
| Protein yield g day⁻¹           | 733             | 735             | 739             | 682             | ns              | ns              |

The present study demonstrated that both annual clover and vetch pasture to have potential in organic farming. Sward mixture had no effect on milk production suggesting similar total nutrient intake in CM and VM. HA of 21.5 kg DM seemed to be near optimal for both. Concentrate feeding regimen had no effect on milk production indicating that moderate level of concentrate supplement can be offered once per day to simplify feeding. When grazing legume rich sward the risk of bloat should be recognised.

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Genotypic variation in cereal yield levels at low nutrient input and the influence of fungal disease

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As a part of a study on the impact of modern plant breeding on the suitability of cereal genotypes for organic farming, plant disease development was recorded. The primary objective was to study root characteristics, since, as breeding is usually conducted on fertile soils, it has been questioned whether the high yield potential of modern varieties has been achieved at the sacrifice of their ability to take up nutrients efficiently from less fertile soils. In organic cereal production, nutrient availability and available plant protection measures are restricted. In Norway, root characteristics are usually not assessed during plant breeding. Hence, it was of interest to study to what extent traits such as root hair length and root fineness vary among Norwegian cereal genotypes when they are grown at relatively low nutrient levels. The aim was thus to explore the genetic variation in such characteristics as a potential basis for future breeding of nutrient efficient cereals, and to study whether modern genotypes perform better than older ones in contemporary organic farming systems.

Fifty-two accessions of spring wheat and barley were chosen to represent Norwegian genotypes, ranging from old land races to modern lines still not released. Initially, all were compared in a field trial with moderate fertilization levels (70 kg N, 13 kg P, 33 kg K ha⁻¹). Thereafter, all accessions were compared in low-P nutrient solution, and finally a subset of 20 accessions was studied in the field at low nutrient levels (50 kg N ha⁻¹, low available P). As well as studying root traits, records were made of yields, nutrient uptake and other agronomic features such as lodging, fungal attack at various developmental stages etc.

Fungicide was applied in the first field trial, and the incidence of fungal disease was recorded once in late July. No fungicide was used in the second trial, and fungal attack (F) was estimated in mid-July and mid-August by recording the percentage of leaves infested. There was a significant impact of late fungal disease on cereal grain yields (y, kg DM ha⁻¹), with y = 4175 – 12 x F (R² = 0.28) in barley and y = 4080 - 20 x F (R² = 0.31) in wheat. However, there was no relation between fungal disease development and total above-ground DM on either of the dates. This may indicate that the fungi had a greater impact on grain filling than on plant dry matter production. The dominating fungi were leaf blotch (Rhynchosporium secalis) in barley and powdery mildew (Blumeria graminis) in wheat.

In both field trials, there was much less fungal disease in recently released varieties than in older ones. Old land races, and varieties of wheat approved before 1980, were generally very susceptible to mildew. Amongst the newer accessions, wheat cv. “Brakar” (approved 1995) was very susceptible whereas “Snagg” (approved 1940) was fairly resistant. This suggests that resistance was not determined solely by accession age. Recently released Norwegian genotypes of spring wheat and barley produced higher grain yields than did older genotypes, both at moderate nutrient levels with the use of fungicides, and at low nutrient levels without fungicide. Hence, the experiments demonstrated that modern plant breeding has been very effective in producing cereal varieties that perform well under conditions relevant for organic farming. We could not find any indication that breeding had been detrimental to root traits important for the uptake of nutrients in the field at low nutrient levels. However, the genetic variation in root hair length and root mass was significant and this may be a topic of interest in future breeding with focus on nutrient-efficient genotypes.
Efficiency of legumes and legume-grass mixtures as previous crops in cereal cultivation in organic farming systems

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Soil fertility and biological activity improvement is the problem of the day in farms devoted to cereal cropping as well as on land area which lack organic fertilizer application. It is matter of current interest in organic farming systems. Reduction in the activity of microbiological processes, organic matter content and porosity in soil result in diminishing fertility of soils. Agricultural field experiments were conducted on Stagnic Luvisol to study after – effect of legume, legume – grass, and pure grass swards on the productivity and yield quality of cereals. After one-, two-, four-, and six years of sward utilization 2nd cut herbage was plowed down not later than 20 days prior to in the last sward utilization year. Cereals after herbage plowdown were seeded during three successive years: winter wheat in the 1st year, spring wheat in the 2nd year, and spring barley in the 3rd year. Black fallow was used as the control. Two series of experiments were carried out. Diverse amounts of botanically different herbage green mass, root dry matter as well as different quantities of nitrogen were found to be plowed down. The use of diverse herbage swards had a different effect on soil organic matter, bacteria count as well as aeration of soil.

Top yields of winter wheat ‘Kosack’ and ‘Pamjati Fedina’ were obtained after legumes. After legume – grass stands winter crops resulted in grain yields lower by 0.59 – 1.64 t ha⁻¹ and by 1.19 – 2.42 t ha⁻¹ lower after grasses and their mixtures compared to growing after legumes.

The spring wheat ‘Eta’ produced the highest grain yields after hybrid alfalfa in mixture with white clover in the second year. During the first two years biologically fixed nitrogen resulted in increase of grain yields. Effect of applied mineral nitrogen dressing on the level of grain yield was insignificant. A yield response to nitrogen was essential after grasses. The spring barley yield increased from 3.98 to 4.82 t ha⁻¹ in both nitrogen fertilizer backgrounds in the third year. In the third year of research the difference in grain yields of spring barley was more expressed when growing after legume – grass and grass swards. It could be explained by more rapid mineralization of legume roots and cut plant residue compare to grasses.

Different was the effect of grass swards on the quality of grain. The crude protein content in the grain of winter wheat accounted for 11.9 – 12.7 %, gluten content from 21 to 25 %. It should be noted that gluten content and quality didn’t provide the needed level of grain quality and additional mineral fertilizer was necessary to reach it.

In the grain of spring wheat the crude protein accounted for 12.7 – 14.3 % and gluten content 26.3 – 29.4 % depending on variants. Essential differences in gluten quality were observed between variants. Significant were changes of gluten content in grains under the influence of legumes. After – effect of biological nitrogen resulted on raise of gluten content in grain by 2 – 5 % average compared to grain crop grown after grasses.

In spring barley the crude protein and starch contents changed insignificantly between variants in the 3rd after – effect year and averaged 12.9 – 13.2 % and 52.5 – 53.1 %, respectively.
Requirement of potassium in organic meadow cultivation

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Introduction
Organic meadow cultivation on soil with low K-status gives the farmers huge challenges. In Norway we have a lot of sandy and peat soils with very low acid-soluble K-values. In conventional dairy farm systems meadows on these soils normally are fertilized with 100-200 kg K ha\(^{-1}\), but according to Debio, the Norwegian control and certification body for organic agricultural production, fertilizing with mineral K can only be done if special license is given. In such cases the farmer has to prove that lack of potassium.

Material and Methods
In 1999 four field trials (2 on peat soils and 2 on sandy soils) investigating extra potassium dressing were established. The experiment is part of a larger randomised complete block design where the effects of K on total yield, timothy and clover content and concentration of N, K, Mg and Ca in plant tissue are investigated. The meadows at the trials were sown with a grass and clover mixture with 10% red clover and 10% white clover in may 1999 and are cut twice a year. All plots are fertilized with 30 t ha\(^{-1}\) diluted slurry with about 1.8 kg K ton\(^{-1}\) in late April. Three levels of extra K (0, 50 and 100 kg ha\(^{-1}\) year\(^{-1}\)) is given as potassium chloride (K49%), and half the amount is dressed in spring and the rest after the 1\(^{st}\) cut. The project-period is five years. In 2002 grass and clover from one of the trials were sorted and analysed separately (table 1).

Results and discussion

Table 1. Total herbage yield (t ha\(^{-1}\)), timothy and clover content (%), and K, Ca, Mg concentrations (% of DM).

<table>
<thead>
<tr>
<th>Extra K</th>
<th>DM</th>
<th>Timothy</th>
<th>Clover</th>
<th>K Grass</th>
<th>Clover</th>
<th>Ca Grass</th>
<th>Clover</th>
<th>Mg Grass</th>
<th>Clover</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(^{st}) cut</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 K</td>
<td>5</td>
<td>54</td>
<td>5</td>
<td>1</td>
<td>0,9</td>
<td>0,5</td>
<td>1,5</td>
<td>0,16</td>
<td>0,48</td>
</tr>
<tr>
<td>5 K</td>
<td>6,4</td>
<td>71</td>
<td>13</td>
<td>1,2</td>
<td>1,4</td>
<td>0,5</td>
<td>1,3</td>
<td>0,14</td>
<td>0,40</td>
</tr>
<tr>
<td>10 K</td>
<td>6,4</td>
<td>72</td>
<td>15</td>
<td>1,4</td>
<td>1,6</td>
<td>0,4</td>
<td>1,2</td>
<td>0,12</td>
<td>0,34</td>
</tr>
<tr>
<td>2(^{nd}) cut</td>
<td></td>
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Four years after sowing one of the trials on peat soil shows that application of 30 t ha\(^{-1}\) diluted slurry alone does not provide sufficient potassium to maintain yield at an acceptable level in the long run. Application of mineral K has raised yield and concentration of K in plant tissue in both timothy and clover. It has also raised the clover content in both first and second cut. Without extra K clover content is very low and this will also affect the level of yield. This means that application of mineral K is necessary to maintain yield and clover content in organic meadow cultivation on soils with low K-status.

Results from this project also show that the concentration of K in plant tissue may be lower than earlier recommended without reducing yield of organic ley. Visual K deficiency can not be detected with K-concentrations above 1.5% of DM whereas earlier Norwegian investigations concluded that concentrations above 2% was needed to get acceptable yield.
Changes in soil quality in three cropping systems after conversion from conventional to organic farming

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The three organic cropping systems Landvik (in Grimstad), Voll (at Ås) and Kvithamar (in Stjørdal) were established in 1993 on previously conventionally farmed soils of marine origin. The six-year crop rotation at Landvik was designed for an organic stockless farm producing cash crops. These crops were fertilized with composted organic household waste from the nearby community (maximum 100 kg N ha⁻¹) and composted waste from the system itself. The rotation at Voll was designed for an arable farm with beef production from suckling cows (0.9 animal units ha⁻¹), and the rotation at Kvithamar was designed for a dairy cattle farm (1.0 animal unit ha⁻¹).

During the first six years of organic farming, the soil reserves of K were slightly depleted. The nutrient balance was –250 kg K ha⁻¹ at Voll and –420 kg K ha⁻¹ at Landvik, and the content of easily soluble K in the plough layer decreased at these sites. At Kvithamar, however, where the K balance for six years was –380 kg ha⁻¹, no changes in soil content of K were recorded. For P, the six-year balance was positive at Landvik, where altogether 120 kg P ha⁻¹ was supplied from composted household waste. The P balance was negative (–40 kg ha⁻¹) at Voll and Kvithamar, and at Voll the content of easily soluble P in the plough layer was lower in 1999 than in 1993.

In the study period, the yields were variable both within and between the systems. We have not identified any trends or variations in yields that might have been directly caused by changes in soil nutrient status or other soil quality components. At Voll and Kvithamar, however, the number of earthworm and the soil macroporosity increased from 1993 to 1999, with a concurrent slight increase in the yields of leys (Voll) and grain crops and swedes (Kvithamar). In the system at Landvik the yields of potatoes and carrots were higher the first two than the last four years. At this site the soil structure was good, and the porosity and earthworm activity high, during the whole study period.
Working out environment-friendly, integrated protection system in the summer rape fields which corresponds to long lasting agricultural system conditions

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In intensive growing technologies widely use pesticides. It s considerable increase the possibilities of pollution of environment. In our project will work out the integration growing technology where the chemical preparative will change partially with biological. The research work was carried out at Skriveri research center of the Latvian Agricultural University in Aizkraukle district situated at the control park of Latvia. The field experiments were settled on drained soddy weakly podzolic loamy soil.

The variants of the experiments were: control (without any treatment); Seed treatment with Cruiser 15 l t\(^{-1}\); Biomix 10 kg ha\(^{-1}\) in soil + U-solution 300 l ha\(^{-1}\); Trichodermin 200 l ha\(^{-1}\) in soil + U-solution 300 l ha\(^{-1}\); Trichodermin 200 l ha\(^{-1}\) in soil, AS 60 and AS 70 + U-solution 300 l ha\(^{-1}\); Trichodermin 200 l ha\(^{-1}\) in soil + Folikur 1 l ha\(^{-1}\) AS 70 + U-solution 300 l ha\(^{-1}\). Preparation trichodermin water solution was applied. Spraying the surface of soil before rape sowing and the rape plants flowering (AS 60) and cod development (AS 70) phases. The biological preparation trichodermin supresses pathogenic microorganisms (especially fungi) in soil and stimulates growth of crops. Biomix includes 9 active components (7 bacterium, 2 fungi species), which affect Rhizoctonia, Alternaria, Botrytis, Peronospora, Fusarium, Verticillium, Pseudomonas and Sclerotinia pathogenic fungi. As a result the group is stimulated and flowering is accelerated. To control rape blue flea (Phyllostreta) U-solution was used. It was prepared from 10 l water, 300 g ash, 50 g homogenized garlic, 40 g soap and a pinch of kalium permanganate.

The plant protection biological preparations – trichodermin and biomix - are suitable for effective control of spring rape diseases. The application of trichodermin and biomix together with U-solution, which was effective against rape flea, resulted in the seed yield gain 0,54-0,82 t ha\(^{-1}\), oil yield gain 266-395 kg ha\(^{-1}\). The effect of biological preparations was almost the same as that of the chemical means Cruiser and Folikur, so it is possible to replace them with environment–friendly preparations of natural origin.
Trace elements in rye – comparison of organic and conventional cultivation

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Rye is well adapted to organic cultivation and also the quality of the crop is usually good. In Finland the rye is mainly used as whole grain food products. Thus it is important cereal source of trace elements in the diet. In the present work the effect of conventional and organic cultivation on the nutritional quality of rye was studied. The purpose is to find suitable cultivars for different farming conditions and industrial applications.

The trials included comparison of 4 rye cultivars (Anna, Amilo, Bor 7068 and Picasso) grown in organic and conventional farming systems at 3 locations (Pälkäne, Mietoinen and Ylistaro) during 1999-2002. The conventional and organic farming systems were carried out on the same field. Copper, zinc, manganese and iron were determined by ICP method and selenium after extraction by electrothermal atomic absorption method.

No systematic difference were found between organic and conventional cultivation except for selenium. In Ylistaro (1999, 2001 2002) and Pälkäne (2002) organic cultivation resulted slightly higher trace element contents in rye whereas in other experiments trace element contents were higher in conventional cultivation. Mean copper contents of rye were 5.1 and 5.0 mg kg⁻¹, zinc 33 and 34 mg kg⁻¹, manganese 27 and 29 mg kg⁻¹ and iron 42 and 41 mg kg⁻¹ in conventional and organic cultivation, respectively. Se content of rye was significantly lower in organic cultivation. The selenium supplementation of compound fertilisers does not reach organically grown products. Thus the mean selenium content of rye was very low, <0.005 mg kg⁻¹ in organic cultivation. This corresponds to the Se levels of rye in 1970s before the Se fertilisation was started.

Cultivar differences in the trace element contents of rye were detected. The cultivar Picasso resulted systematically lower trace element contents than other cultivars. Picasso is a hybrid cultivar with large grains of high starch content. Thus the amount of bran, aleurone layer and cell membranes of the endosperm where most of the trace elements are located is relatively smaller in large grains. However, cultivars did not respond differently to organic or conventional cultivation.
Risk and risk management in organic farming: an empirical analysis of Norwegian farmers

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During the past few years, there have been intensive efforts to increase the scope of organic farming in Norway. Organically certified farmland and land in conversion increased from 2,443 ha in 1991 to 26,673 ha in 2001 (Debio, 2002). In 2001, the total organic acreage amounted to 2.6% of the total agricultural area in Norway.

The Norwegian Ministry of Agriculture has announced its goal of converting 10% of the total agricultural area to organic farming methods by the year 2009. In addition to consider the traditional profitability aspect it will be especially important to account for risk, when the conversion of a farm is planned.

Internationally, there have been many studies about economic issues related to organic farming and on the issue of agricultural risk management. Studies of risk and risk management in organic farming have been lacking in Norway. Only very few such studies have been carried out internationally, thus showing that there is a definite need for more risk and risk management research in organic farming.

For the moment we are doing a questionnaire survey (sent to 1800 dairy and crop farmers) to provide insight into: (1) conventional and organic farmers’ perceptions of risk and risk management strategies; (2) characteristics of a farm and/or farmer that relate to these perceptions; and (3) differences in perceptions of risk factors and risk management strategies among conventional and organic farmers’. In other countries, there have been studies of what conventional farmers consider being the major risk factors and of which risk-management strategies they use (e.g., Patrick & Musser 1997; Meuwissen et al. 2001). We have not found any comparable studies of organic farmers. In Norway, no such studies have been conducted among either conventional or organic farmers.

The results from the survey will give useful insights for policymakers, advisers, and conventional and organic farmers about risk and risk management strategies. A paper with analysis and results from the questionnaire survey will be finished in the springtime and presented at the NJF 2003 Congress.

References


Cadmium content in bread wheat (Triticum aestivum L.) as affected by cropping system

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Introduction

The production of organic foods, including cereals, is increasing worldwide, often supported by governmental decisions. In Sweden the government has put up a goal to have 20% of field production turned into organic production by 2005. Health advisory authorities also recommend an increase in cereal consumption. Relatively few studies have been made to investigate the nutritional quality of organically grown cereals. What effects will those two factors have on nutritional quality of cereal foods and intake?

Cadmium, Cd, is a toxic heavy metal naturally occurring in the bedrock. The average Cd content in top soils in Sweden is 0.23 mg kg⁻¹, but about 5 percent of the soils have 0.49 mg Cd kg⁻¹ or more, and the levels are increasing. About 50 percent of cadmium intake today (for a non-smoking person) originates from cereal products like bread, pasta, breakfast cereals etc and since 2002 the maximum permitted level of wheat and wheat bran is 0.200 mg kg⁻¹ fw within the European Union. Is there a difference in cadmium uptake between different crop growing systems?

Material and methods

- Winter wheat, cultivar Kosack, and spring wheat, cultivar Dragon, were grown in conventional and organic cropping systems during three years, 1998-2000. The farm, situated in southern Sweden, had one part converted to organic farming (according to IFOAM, International Federation of Organic Agricultural Movements) starting in 1994. The Cd levels in soil is 0.20-0.27 mg Cd kg⁻¹.
- Three levels of nitrogen were applied into both systems: in winter wheat 90 kg N ha⁻¹, 140 kg N ha⁻¹ and 190 kg N ha⁻¹ and in spring wheat 70 kg N ha⁻¹, 120 kg N ha⁻¹, 170 kg N ha⁻¹ and 220 kg N ha⁻¹ in the conventional cropping system. In the organic system there was added 0 kg N ha⁻¹, 50 kg N ha⁻¹ and 100 kg N ha⁻¹ (in the form of dried hen manure) respectively, the effect of preceding crop being estimated to about 70 kg N ha⁻¹. Ordinary pest treatments were done in the conventional part.
- Protein content of kernels was decided by Kjeldahl analysis.
- Cadmium analysis was done on whole milled kernel by atomic absorption spectrophotometer, AAS (Varian Spectra AA 400) with a graphite furnace.

Results

The mean cadmium content in winter wheat from the organic system was 0.042 (0.022-0.060) mg kg⁻¹ fw and for winter wheat from the conventional system 0.065 (0.029-0.108) mg kg⁻¹ fw. For organic spring wheat the mean was 0.061 (0.034-0.094) mg kg⁻¹ fw and for conventionally spring wheat 0.054 (0.029-0.079) mg kg⁻¹ fw. For winter wheat there was significantly lower cadmium content in organically grown kernels compared to conventional winter wheat (P<0.05), but there was no significant difference in cadmium content in spring wheat depending on cropping system.

Funding

This project is funded by the Faculty of Agriculture, Landscape Planning and Horticulture at the Swedish University of Agricultural Sciences, The Agricultural Research Programme of southern Sweden (SSJ), The Swedish Farmers Foundation for Agricultural Research (SLF) and Direktör Albert Pålssons Foundation for Research and Charity.
Soil and harvested herbage were investigated in 3 leys at each of 28 organic farms. The farms were selected from 4 different regions of Norway that represent coastal and inland areas for dairy and sheep farming. All farms had maintained organic production for more than 3 years. Soil samples (0-20cm) were analysed for pH and the content of plant-available Na, Mn, Cu, Zn, Se, Co, Fe, and Mo in 2001. The yield, botanical composition and trace element content of the harvested herbage were analysed at two cuts both in 2001 and 2002. The stage of phenological development for the most frequently occurring grass species (*Phleum pratense*) was also determined (at the first cut). The relationship between soil and weather conditions, yield size, botanical composition and phenological stage of the herbage on one hand and the trace element content of the herbage samples on the other, was investigated.

Compared with normal values for recommended content of minerals in roughage, the concentration of Se, Zn, and Co in the roughage was rather low in the present investigation. At some dairy farms the content of Mo in the roughage was so high that there might be risks for Cu-deficiency in the herd. There were significantly higher concentrations of trace elements in the second harvest than in the first harvest and there were no differences between years.

The concentration of Zn in roughage increased with decreasing soil pH and with increasing content of the element in the soil. There was higher concentration of Zn in roughage from sheep farms than in roughage from dairy farms. This was related to the higher content of herbs in roughage on sheep farms. Manganese in roughage increased with decreasing soil pH. The concentrations of Mn in roughage were significantly higher at the coast (117 mg kg\(^{-1}\) DM) than in the inland areas (55-74 mg kg\(^{-1}\) DM). The molybdenum roughage content decreased with decreasing pH and increased with increasing clover content and Mo-content in soil. Molybdenum in roughage was higher at dairy farms than on sheep farms. Highest concentrations were found in Hedmark, where the roughage from some farms was close to 20 mg kg\(^{-1}\) DM. The concentration of Co decreased with increasing grass content of the roughage, but was also dependent of the Co-content of the soil. Trøndelag had an average Co concentration of 0.09 mg kg\(^{-1}\) DM while the mountain area had a concentration of 0.05 mg kg\(^{-1}\) DM. Concentration of Se was highest at the coast (0.032 mg kg\(^{-1}\)) and lowest in the inland areas (<0.01). The overall content of Se was so low that there was a risk for shortage of Se in the animal roughage.
Cation-anion balance in organic silage in relation to prevention of milk fever

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Studies of organic farms in Norway have documented that cows in organic herds are less prone to milk fever compared to the overall average incidence of milk fever in Norway. Milk fever occurs most frequently in high-yielding cows, fat cows and older cows. On average, cows on organic farms are lower yielding, but also older. Dry cow diets relatively high in the anion chloride (Cl\(^-\)) and low in the cations potassium (K\(^+\)) and sodium (Na\(^+\)) can prevent milk fever. In organic farming no inorganic fertilisers are used. This may result in low content of K in the plants and with that a low content of K in the fodder. Often there also is greater diversity of plants (clover, herbs, “weeds”) in an organic meadow than in a conventional meadow. Plants vary in their uptake of different elements. One can therefore expect a different composition of minerals in organically produced fodder compared to fodder from conventionally managed fields.

Therefore, the mineral content in fodder from eight organic farms and eight conventional control farms was examined to see if low frequency of milk fever is connected to the cation-anion balance (CAB) in the fodder. Seven cows were selected from each farm. Fodder given to the cows in the dry period was analysed for Na, K and Cl, and the botanical composition of the roughage were determined. The cows' urinary pH was measured during the dry period, using pH-papers. The fodder was also analysed for other minerals (Ca, Mg, P, Mn, Fe, Cu, Zn and Mo) to get a broader picture of the ration. The cows' body condition scores in the dry period were measured.

The mean CAB in both the organic and conventional fodder was 366 mEq kg\(^{-1}\) DM, and the cows' urinary pH was around 8.5. Based on results from this project we cannot see any connection between the lower frequency of milk fever in organic milk production and CAB in organic fodder. Not unexpectedly, the organic fodder contained more Ca and Mg. There was no difference in content of Fe, Cl, Na, K, P, Mn, Zn and Cu. Several fodder samples had more then 2% K of DM. The Ca/P ratio was high, together with a relatively low content of P. Both high K content and high Ca/P ratio together with low P content are connected to increasing risk for milk fever. The results from the mineral analysis of the fodder samples indicate an unfavourable mineral composition regarding milk fever in both conventionally and organically produced fodder.
The effect of different mulches on the growth and yield of organically grown strawberry

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Different mulches were studied in field trials over a three-year period under organic production in Mikkeli and Ruukki. In June 2000, organically produced strawberry plants, cv. Jonsok, were planted in four replicates in double rows, 10 plants plot⁻¹, 45 cm apart. The mulching materials were black plastic, flax fibre mat (woodchips+buckwheat husk in 2002), green mass, straw, buckwheat husk, birch woodchips and pine woodchips.

In the planting year, the growth of strawberry plants was the most vigorous in buckwheat husk at both sites. Growth was measured as number of leaves, runners and runner plants. Strong vegetative growth was mostly due to the fairly high nitrogen content of mulch increasing the soil mineral nitrogen content. Vegetative growth was moderate both in plastic and green mass mulch and low in straw, flax fibre mat and woodchips. The canopy was very dense in buckwheat husk throughout the trial period.

In 2001, the highest marketable yield per plant resulted from plastic mulch, 259 g and 205 g on average in Mikkeli and Ruukki, respectively. In 2002 there was no difference in the mean marketable yield per plant between plastic and green mass.

In 2001, the mulching material had a significant effect on the incidence of grey mould. In buckwheat husk, grey mould (Botrytis cinerea) infected 36 % and 17 % of the total berry yield in Mikkeli and Ruukki, respectively, in the other mulches 3-14 % and 2-7 %, respectively. In 2002, the highest percentages of grey mould infection in Mikkeli occurred in buckwheat husk, woodchips+buckwheat husk, green mass and plastic. In Ruukki, grey mould infection was low in all mulches. Fruit size was not affected by the mulching material.
Organic piggery models for Finnish climate

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Organic Piggery in Finnish Climate has been a development project done by Agrifood Research Finland in cooperation with five other research, advice and design partners. The research has been funded by the ministry of forestry and agriculture in Finland. The aim of the project was to develop functional piggy layouts for organic production especially designed for Finnish climate. The results consist of both combination and fattening piggeries. The small size combination piggeries are for 40 and 64 sows. The fattening compartment is in the same building forming one solid unit. A large farrowing piggery is for 96 sows, and it is an independent building so that fattening unit can be added as an annex building. The most important part of a farrowing piggery is a farrowing pen and its layout. Five individual farrowing pens and one group pen are introduced.

Five fattening piggeries with 5 different maintenance concepts are introduced. The differences concentrate mainly on manure handling. Four models are based on straw litter systems and one is purely for slurry system. Straw is promoted because of its beneficial affects on animal behaviour and pen activity. The finishing pens are allocated for 20 pigs. There is 1 tube feeder for each 10 pigs. This is a proper dimensioning from animal behaviour’s point of view. The pens have a precision dimensioning so that pigs between 30 and 85 kg have 1,1 m2 each and have access to exercise yard. The fattening pigs between 85 and 110 kg have 1,3 m2 each and no access outside because exercise is not compulsory for them during the last 30 days of finishing.

The buildings are principally well insulated and heated during the wintertime. Natural ventilation is recommended as an energy saving concept for all buildings. Still all models can be equipped with electric fans. One fattening piggery model is uninsulated. It is based on deep straw litter system. There are no traditions for pasturing in conventional effective pig production in Finland. Pasturing in organic system is recommended for dry sows yet there is no restriction for pasturing for all pigs.

The buildings are designed to be organic as well. The building materials should be natural, recyclable and can be safely terminated after use. The concrete is recommended for floors and for lower parts of the walls. The rest of the building frame, claddings and insulation can be made of wood. The roof cover can be metal sheet or bitumen felt. The heating system is based on heated water circulation and the energy source is local fire wood.

The share of organic pork production is approximately 0,7 % of all pork production in Finland. The consumers’ demand seems is continuously higher than production. Still the farmers are cautious to invest on new production facilities. The reason is partly due to poor price from the market and partly the lack of efficient piggery models. These new models are supposed to promote organic pork production into a new phase. At least they assure a better animal welfare compared to conventional production environment.
The effect of irrigation method on the quality and shelf-life of strawberry fruit in organic production

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Organic production of strawberry was investigated at MTT Agrifood Research Finland during 2000-2002. Research topics included irrigation method and its effect on fruit quality. The experimental field at MTT Plant Protection in Jokioinen was equipped with drip irrigation and sprinkler irrigation systems.

Organically produced cultivars ‘Jonsok’ and ‘Bounty’ were planted in black plastic mulch in double rows, 20 plants per plot in four replications. The area was fertilized before planting and no fertilizer was added during the production years. The field was divided into two areas: drip irrigation and no drip irrigation after start of flowering. Half of the area without drip irrigation was irrigated with sprinklers and the other half was left with natural rain only. Drip irrigation, and in 2002 sprinkler irrigation, was given according to tensiometer measurements. No fungicides or organic products were used to control grey mold and other diseases. One plot of both ‘Jonsok’ and ‘Bounty’ was covered with a small open plastic tunnel from the beginning of flowering to the end of harvest to investigate grey mold infection in a covered crop.

The fruit were harvested three times a week. To determine the shelf-life of the fruit, 40 berries of marketable quality were placed in plastic Jiffy pots on trays and covered with moist tissue paper. The trays were stored in room temperature (+22-24°C) in black plastic bags. The berries were checked every day for grey mold and the infested ones were removed.

The fruit yield of ‘Jonsok’ was lower than that of ‘Bounty’ which was high especially in 2001, but in 2002 it suffered from a cool and rainy period during fruit ripening. Drip irrigation increased the yield of ‘Jonsok’ slightly as compared to the sprinkler-irrigated and non-irrigated plants. In ‘Bounty’, the increase was greater. The amount of grey mold in fruit was quite low in 2001 on both cultivars. Drip irrigation did not reduce grey mold in the harvested fruit in 2001 in ‘Jonsok’ and in 2002 it seemed to increase the amount of infested fruit as compared to sprinkler irrigation. ‘Bounty’ showed minor reduction of grey mould in 2001. The fruit from plots covered with plastic tunnels showed a very low grey mould infestation rate.

The shelf-life of strawberry fruit in room temperature was dependent on the weather conditions during harvest. During rainy periods more than 50% of the fruits were spoiled in two days, in 2002 in some pickings more than 30% were discarded after one day. During dry periods the spoilage was delayed by a day or two. In general, ‘Jonsok’ had a shortened shelf-life than ‘Bounty’ and the shelf-life was longest for the fruit from plastic tunnels. If less than 40% of the fruit in these tests are discarded before the third day, the quality and storage properties in normal cool storage temperatures can be considered good. The irrigation method did not affect either the shelf-life or the quality of fruit.

In organic strawberry production grey mold is a major problem. Strawberry varieties differ from each other in disease susceptibility and the quality and shelf-life of the fruit is affected more by their properties and weather conditions than by the irrigation method.
Gantry technology in organic crop production

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Objectives: Costs of agricultural machinery and farm buildings are substantial, comprising about 40% of production costs also in organic farming. What are the tasks of agricultural machinery and agricultural engineering research in organic farming? Which agricultural engineering results support the basic principles of organic farming?


Method: A literature review of scientific gantry research publications within the past ten years.

Results/discussion: Present gantry research results show that gantry technology saves energy and work, increases profitability, improves and preserves soil structure, extends working time periods and assures timeliness of critical operations, offers independence from weather and day light during field work, allows precise fertiliser distribution and irrigation, supports high precision intra-row weed control, field mapping for various objectives, automation of repeating work steps, automated operations by computer vision, and grants better working conditions.

Gantry technology may in future support organic crop production by
- continuous mapping of plot specific soil and flora data,
- plot mapping for habitat specific operations,
- cultivation of perennial vegetation covering,
- mixed cropping/alley cropping systems using allelopathic effects for weed and pest resistance,
- precise distribution of compost and preparations,
- in time sowing, in time weed and pest control,
- mulch based cultivating and fertilising.

Gantry technology renders excellent opportunity for transdisciplinary research and cooperation between life scientists and engineers. Scientists from different disciplines are required for measuring and observation of biodiversity indicators, energy balance, soil tilth, nutrient balance, quality of work, and quality of products. Dynamic observation methods like appearance of plants during all stages of development using computer vision and image-processing methods may support human observation. The habitat specific information can be used to plan a crop rotation including mixed cropping or strip cultivation solutions, green mulch fertilisation, and allelopathic effects best suited for a given plot or even for a specific location of a given plot.

References


Viselga, G., 1998: Investigation of the usage of ordinary working parts in the circular gantry system. Ecological aspects of mechanized fertilizer application, mechanized pesticide
Organic, integrated and conventional farming systems on a clay soil in Sweden

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An efficient use of added nitrogen and of site-depending available nitrogen is one of several aims of great concern for developing sustainable arable farming systems. On sandy soils excess nitrogen can be easily leached through the soil profile as nitrate. On heavier soils with higher clay content, denitrification and other processes for nitrogen losses can be more crucial. Nitrogen use efficiency is of importance for production economy as well as environmental concern, product quality and bio-diversity.

This study was carried out on the Logården farm in south-west Sweden having soils with an average clay content of 40%. Organic matter content varies between 2-3%. Organic matter content varies between 2-3%. A small river is crossing the farm through a culvert. This causes a slightly undulating landscape with small hills with clay content < 40% on the highest points. Since 1991, the farm has been managed divided into three different arable farming systems without manure: conventional farming (A), organic farming (B), and integrated farming (C), in total 60 ha. Each system has an eight year crop rotation. In both B and C, green manure leys with red (Trifolium pratense L.) or white clover (Trifolium repens L.) or alfalfa (Medicago sativa L.) are used. In B, nitrogen fixing crops are grown every second year. No manure has been added in any of the systems during the last years. Yields of all crops were recorded every year, from 1999 by yield mapping. All crops and all measures have been documented since 1991. Crop and soil nitrogen dynamics have been followed in reference areas.

During 1992-2002, the most important factor for the yield level in the organic farming system was the nitrogen supply. Especially wet years the yields were low due to nitrogen shortage. This is probably explained by losses from the soil during wet periods by N₂O. Despite lower yields the economy of the organic farming system was better than in the integrated and the conventional farming system.

In 2003 the tile drain system at the farm will be replaced by a new system. Changes in soil conditions after tile draining will be followed. For this, the soil is being characterised during 2002 and 2003. Soil physical, biological and chemical parameters will be determined. Soil sampling points were chosen by using the software FuzMe to create zones from soil electrical conductivity determinations (EM 38), topography data and data from soil mapping in 1991. Discharge from each field will be measured and drain-water analysed in the new system. Losses of N₂O from the system will be quantified as well.
Mineral supply for ruminants in organic agriculture

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Since low amount of external inputs for fodder production is purchased in organic farming than in conventional farming the mineral content in soil and plants are determined by soil and climatic condition to a greater degree in organic than in conventional farming. Herbage in organic farming systems often contains high proportion of legumes and other dicotyledons that have a higher content of Mg, Ca and S than grasses. Due to differences in production regimes, it is probably incorrect to recommend the similar mineral supplements to animals in organic agriculture as in conventional agriculture. In order to make good recommendations it is important to have reliable information on mineral content in fodder in the organic farming systems.

The objective of this poster is to present results from a survey of the mineral content in herbage on organic farms. Eighty-four grassland fields on 28 organic farms in 4 different regions of Norway, that have maintained organic dairy or sheep production for more than 3 years, were selected for this investigation in year 2001 and 2002. The four regions represent coastal and inland mountain areas for milk-cow farming and sheep farming. The total content of Na, Cl, K, S, Ca, Mg, P were analysed in herbage samples from 2001 and 2002. Standard analytical methods were used to analyse crude protein (Kjeldahl-N), digestibility, neutral detergent fibre (NDF) and the energy content. The relative proportion of grass, clover and herbs were determined by sorting about 700 g of fresh plant biomass. Mineral content are compared with standard norms for mineral requirement of sheep and dairy cows. Comparisons were done to investigate potential imbalance in the mineral composition that can be a health risk for cattle and/or sheep without mineral supplements. Further the effect of the animal production level, herbage botanical composition and development stage on the mineral supply are discussed.

On a great deal of the farms there are lower levels of P and S than recommended in the mineral requirements of sheep and dairy cows. 78% of the herbage samples have a Ca/P-ratio larger than the recommended limit of 2. The N/S-ratio were larger than the optimum in 83% of the samples. All the herbage samples have a K/(Ca+Mg) lower than the recommended upper limit of 2.2. For all minerals except Cl, there are higher mineral content in the herbage in second than in first harvest both years. The content of N, Mg and Ca in the herbage decrease with increasing grass content. Increasing development stage lowered the content of N, P and K.
Weed control in organic farming in the Netherlands

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Backgrounds
The cropping area and the market for organically grown arable products is increasing. However in the Netherlands the production of organic crops is small compared to other countries (ca. 2% of the total arable area in 2002). The government aims for 10% in 2010.
In these crops weed control is based on preventive measures and mechanical weed control. Mostly hoeing is used within the rows. In-row harrows, finger weeders and torsion weeders are used. In some crops cover materials or crop mulches and pre-emerging flaming are in addition used.

Research
In the Netherlands in 1998 the BIOM-project started. Through this project organic farming is being promoted and studied. Farmers can join the project for extension and research. It contains a national pilot farm network for organic arable and open field vegetable farms. The BIOM-project started with:
- Works with existing organic farms on two levels:
  - innovation, 25 farms in 5 regions,
  - optimisation; 40 farms in 5 regions
- Focus on development and improvement of farming systems based on clear targets
- Full agronomic, environmental, economic evaluation of performance
- Prepares conventional farms for conversion by regional series of technical conversion courses (46 farms in the first series)
- Performs economic studies on cost price and farm economic perspectives

Weed control at the organic farms
In the BIOM project farmers registrate their weed control strategies and the hours of additional hand weeding needed (Table 1). Common chickweed (Stellaria media, STEME) and meadowgrass (Poa annua, POAAN) are most problematic in many crops. These species can continue to grow through the winter and set seed. Perennial weeds often give problems and are difficult to control mechanically. Research will focus on the control of perennial weeds, the innovation in mechanical weed control and in preventive measures (allelopathic crop residues; using light and covers to trigger or prevent weed germination and others). Strategic weed control in the rotation and the role of farm management in this will be studied at a selection of the organic farms in the BIOM project.

Table 1. Amount of hours hand weeding per hectare at organic farms in the Netherlands.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>9</td>
</tr>
<tr>
<td>Lettuces e.a.</td>
<td>47</td>
</tr>
<tr>
<td>Cereals</td>
<td>7</td>
</tr>
<tr>
<td>Cabbages</td>
<td>45</td>
</tr>
<tr>
<td>Carrots</td>
<td>152</td>
</tr>
<tr>
<td>French beans e.a.</td>
<td>42</td>
</tr>
<tr>
<td>Sugar beet</td>
<td>82</td>
</tr>
<tr>
<td>Onion</td>
<td>177</td>
</tr>
</tbody>
</table>

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Research news on organic agriculture in the Nordic countries

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Knowledge about Scandinavian research in organic farming
The paper "Forskningsnytt om økologisk landbruk i Norden" supplies knowledge and viewpoints from the Nordic research to researchers, advisors, teachers, politicians and farmers interested in the development of organic farming. It enables you to take part of the latest research results. Different perspectives of organic farming are presented in broad special feature issues.

Nordic co-operation
The paper is published in four numbers per year (in the Scandinavian languages) and is produced in co-operation with nine research departments in Scandinavia:
- Forskningscenter for Økologisk Jordbrug, Denmark
- Den Kgl. Veterinær- og Landbohøjskole, Denmark
- Helsingfors Universitet, Finland
- Lantbrukets forskningscentral and Landsbygdcentralernas Förbund, Finland
- Landbúnaðarháskólinn, Hvannmyri, Iceland
- Norges landbrukshøgskole, Norway
- Norsk senter for økologisk landbruk, Norway
- Planteforsk, Norway
- Centre for Sustainable Agriculture, Swedish University of Agricultural Sciences, Sweden

The Centre for Sustainable Agriculture at the Swedish University of Agricultural Sciences, is responsible for the editorial work of "Forskningsnytt".
Possibilities to improve yield of green manured spring barley crop by delayed sowing in organic production

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In the northern growing conditions, with increasing daylengths (16-24 h) and temperatures in the beginning of the growing season, the spring barley crop rapidly develops from the vegetative to the generative stage. The speed sets high requirements for the availability of soil nitrogen, which influences tiller formation and survival, ear density and spikelet formation. In the organic production the nitrogen requirement of the tillers at this time is difficult to meet. Better utilizers of soil mineralisable nitrogen are crops with longer growing period such as oats. Due to the lower yields in barley cultivation than with any other cereals, barley is not a competitive crop in the organic rotation.

During 2000-2002 field trials were carried out at two locations (Juva (61º55'N) and Ruukki (65º40'N) to investigate the effect of delayed sowing on green manured barley crop. The delay in sowing could allow better nitrogen supply during the growing period as the soil is warmer and the build-up of mineral nitrogen from the soil organic nitrogen pool is higher. A drawback in delayed sowing is known to be the weaker and uneven tillering and the susceptibility to several leaf area defecting diseases.

Three sowing dates, occurring 7-10 days apart, were used, the last date being between 5. - 7. June. A typical seeding rate of 500 viable seeds m⁻² was used. In Juva, we additionally increased the seeding rate to 600 viable seeds m⁻² at the two latter sowings. In Juva delayed sowing weakened the tillering of Filippa, the cultivar used in year 2000, but strengthened the tillering of Saana, cultivated the last two years. In 2002 improved tillering was also observed in Ruukki (cultivar Artturi) in the 7 days delay.

The latest sown crops developed very fast to the milk maturity stage, but the crops sown at the normal date and ten days after required almost the same growing time to reach maturity. Delayed sowing increased the grain protein content, except in Ruukki in 2002, but decreased the grain yields due to slightly lower grain weights. The hectolitreweight, which is the most important quality parameter in barley, declined in Ruukki, but remained quite constant in Juva. Increasing the seeding rate of cv. Saana had small but variable effect on the grain and protein yield.

In Juva the leaf chlorophyll contents, which indicates N uptake of plants, tended to be higher with the later sown crops compared to the earliest sowing, especially in the beginning of the season. No such phenomena was observed in Ruukki. Only in 2002 the one week delay showed better leaf chlorophyll content, but at the late season after anthesis. All the crops were more or less infected by leaf diseases each summer, although the seeds were treated with Cedomen®, a biological seed dressing. As the leaf diseases infected the later sown crops at the earlier stages, their grain filling period was shortened, resulting in lighter grains and smaller total grain yields.

In this study we conclude that no more than a week or ten days delay from the earliest suitable sowing date can be recommended, if the soil class and moisture conditions are not determining the date. Green manure is not the best nitrogen fertilizer for the barley. If possible, slurry, cattle manure or compost, containing more plant available nitrogen, should be used in organic production. Otherwise it is necessary for the future of organic cereal production that new methods to control the leaf diseases are to be developed.