Aspects of Applied Biology 79, 2006
What will organic farming deliver? COR 2006

Organic farming - stewardship for food security, food quality, environment and nature conservation

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Summary

Conventional agriculture is associated with problems such as pesticide residues in soils and plants, contamination of meat with antibiotics and hormones, and eutrophication of water bodies. An alternative for consumers is the consumption of products from organic farming. Organic farming can contribute to environmental protection and nature conservation in many ways, for instance by improving soil porosity which yields higher infiltration rates and thus contributes significantly towards mitigating flooding peaks. It is the objective of this contribution to provide a holistic appraisal of what organic farming is going to deliver.

Key words: Organic farming, authenticity, earthworm, ecobalance, flooding, sustainability

Introduction

Organic farming, compared to conventional and industrialised farming shows fundamental differences from agricultural, environmental, social and economic points of view. Organic farming is a well defined production concept which provides practical solutions to various problems of agricultural production and therefore best meets the demand for sustainability as outlined by the *Brundtland Commission* which stated that “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Additionally, organic farming provides ‘authentic’ food, an aspect that is likely to gain increasing significance for consumers in future. It is the aim of this contribution to provide a comprehensive overview of what organic farming can deliver in the sectors food security, food quality, and environment and nature conservation. Here, special attention will be paid to prominent highlights.

Food Security

A common argument against organic farming is that it ignores the results of modern agricultural research and so is a deliberate step backwards in progress thus jeopardising food security on a global scale. However, quite the opposite is the case: based upon an exhaustive understanding of biological and physiological processes, it should be possible to replace chemical aid by a scientific appreciation of these processes.

A serious, but common allegation is that organic farming aggravates the problem of world hunger because of its lower yields compared to those obtained in intensive farming systems. Kimbrell (2002) points out that "world hunger is not created by lack of food but by poverty and landlessness, which deny people access to food. Industrial agriculture actually increases hunger by raising the cost of farming, by forcing tens of millions of farmers off the land, and by growing primarily high-profit export and luxury crops". Kimbrell (2002) concludes that the only solution to problems related to industrialised agricultural production is a return to sound organic agricultural practices.

The fact is that per capita food production in sub-Saharan Africa has declined in the past 20 years by 20% because of reduced soil fertility (Nwanze *et al*., 2004). Here, organic farming or small farming enterprises with similar lines of operation offer the chance to improve soil fertility and at the end increase food production (Halberg *et al*., 2006). The same authors pointed out that 'green revolution' technologies were not applicable in sub-Saharan Africa because of the basic problem of low yield potential, political and socio-economic constraints. Critical researchers even point out the risk that genetic engineering will strengthen the gap between rich and poor in developing countries (Jordan, 2002). Interestingly with regard to developed countries, the results of a case study from Austria suggest that even a total switch to organic farming will not compromise food security, but will fulfil the requirements of sustainable agricultural production (Kratochvil *et al*., 2004).

Food Quality

Food quality is an issue of increasing public interest. The subject targets not only the content of nutritional compounds, health promoting or otherwise beneficial substances and features, but more and more the way food is produced. System inherent organic products contain no potentially harmful food preservatives, pesticides and phytochemicals and thus provide authentic food. Organically produced foodstuffs may even have significantly higher contents of secondary metabolites (Brandt & Mølgaard, 2001).

Organic farming has been stirring the emotions of conventional farmers since its beginnings with the organic farming movement initiated by *Sir Albert Howard* (1873-1947) and the anthroposophical agriculture lectures of *Rudolf Steiner* in the early 1920's. Extended investigations were carried out in order to identify qualitative differences between products from both management systems and organic products usually had a significantly higher dry matter content and lower nitrate concentrations (Woese *et al*., 1997). However, nutritional quality implies not only physico-chemical parameters, which can rapidly be determined by laboratory analysis, but also 'dynamic' features, which Balzer-Graf (1987) describes as vitality, differentiation and regeneration. These have so far only been assessed by image forming methods.

Non-protein nitrogen compounds

The enrichment of non-protein nitrogen (N) compounds such as amides is primarily a problem of an excess N supply, and is promoted if sulphur (S) deficiency occurs at the same time. This is a particular problem on intensive livestock farms. In contrast, N is regularly the greatest limiting factor in organic farming.

The most important non-protein N compound enriched following S deficiency is nitrate. Nitrate is prone to microbiologically induced reduction to nitrite by nitrate reductase during storage and processing of vegetables and nitrite is toxic to humans by blocking the oxygen carrying capacity of haemoglobin or as a potential precursor for carcinogenic nitrosamines. An intake of 0.17 mg nitrate per kg body weight yielded a spontaneous mutation rate of 12.5% (Wiesner, 1984). There is a still ongoing discussion whether an increased intake of nitrate enhances or reduces the risk of gastro-intestinal cancer. The generally lower nitrate concentrations in organically produced crops can only be beneficial given this background.

Medicinal plants

There are many plants with therapeutically active compounds claiming to act as anti-carcinogenic, antibiotic, anti-hypertensive and cholesterol reducing agents (Verhoeven *et al*. 1997). There is an increasing market for phyto-pharmaceuticals and such products are of interest for human and animal application. The latter aspect is of prime interest as medicinal substances are strictly regulated in organic farming. Conventional farmers are also seeking effective substitutes for antibiotics since their use as feedstuff additives has been prohibited in the EU since 1 January 2006.

The validation of the curative effect of different medical plants is important for developing new, efficient phyto-pharmaceuticals. The cropping of medicinal plants could positively contribute to the income of organic farms as the guidelines for good agricultural practice for medicinal and spice plants demand products which are not contaminated by pesticides (Europam, 1998).

Environment

Precision agriculture technologies

Independent of the management system, it is not possible totally to exclude nutrient losses to the environment from agricultural fields, but acceptable loads need to be defined. For an efficient reduction of diffuse N losses it is necessary to take the spatial variability of soil features into account which affect N dynamics in the soil and N utilisation by the plant. A site-specific, variable rate nutrient management could therefore be the solution to this problem.

In organic farming systems where legal guidelines exclude or restrict the use of fertilisers, the relative significance of soil-borne nutrients for the nutrition of plants increases. This stresses the particular value of a variable rate nutrient management for small scale farming and low input systems, while usually precision agricultural technologies focus on large-scale farming (Haneklaus & Schnug, 2006). The strategy would imply spatially variable measures, which increase the utilisation of soil nutrients by improving their mobility or uptake efficiency by the crop. The first option would be feasible for nutrients with an expressed dependency on soil pH such as micronutrients and phosphorous, the second by promoting root growth in order to improve the source:sink ratio of nutrients (Haneklaus & Schnug, 2006).

Precautionary measures for soil and flood protection

The infiltration rate (mm h^{-1}) defines the velocity with which water passes through the soil profile. High values minimise not only the risk of run-off and erosion, but also local flooding events by reducing peak values during extremely high precipitation. Sparovek *et al*. (2002) showed that the risk of extreme floodings increased over-proportionally if infiltration rates were lower than 15 mm h^{-1}. Important factors causing reductions of infiltration capacity in agricultural soils are compaction, loss of mechanical stability and biological activity. Maintaining a high infiltration capacity of soils is one of the most significant achievements of agriculture, which is not covered by the price received for agricultural products. Independent of the production system, conservation soil tillage improves significantly the infiltration capacity (Schnug *et al*., 2004). On organic farms there are, however, a number of factors with positive effects on infiltration rates such as a diverse crop rotation, abandonment of pesticides and higher organic matter content together with the stimulation of soil life. Organically farmed soils have more “biopores” because of a larger biomass and density of earthworms and particularly a higher number of anecic earthworm species, as a result of which infiltration rates can be twice as high as on conventionally farmed soils (Schnug *et al*., 2004). The spatial extension of organic farming consequently provides an efficient counter-measure against the adverse effects of the anthropogenic sealing of soils resulting from conurbation expansion.

Nature conservation

A comparative study on the influence of the farm management system on nature and landscape in Ireland revealed that organic farming had a positive effect in every respect (MacNaeidhe & Culleton, 2000). Organic farming contributes distinctly to nature conservation on different levels: it stimulates the micro-flora and micro-fauna in the soil, yields a higher number and biodiversity of meso, macro and mega-fauna (Pfiffner, 2004). A strong beneficial effect of organic farming was also found for birds, butterflies and bumblebees and herbaceous plants with two to five times higher figures compared to conventional farms (Belfrage *et al*., 2005). The reason behind this effect is the diversified crop production with a balanced nutrient supply. A higher diversity of arable field plants is part of a successful pest and disease control strategy (van Elsen, 2000). These environmental effects of organic farming are components of the ecobalance (Haas, 2003). In system-based comparative studies, organic farming had a more positive appraisal (Haas, 2003).

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