MONOTORING THE CONVERSION TO ORGANIC FARMING

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Key Words: organic farming systems monitoring, conversion to organic farming, stockless organic farming, landscape, biodiversity

Abstract

A long term field monitoring concerning the development of Organic Farming is performed at the bio-farm "Rutzendorf " of the BVW GmbH in the Marchfeld region east of Vienna. It is an interdisciplinary project of eleven research institutes, which started in 2003. The aims of the project are: examination of changes concerning soil and plant parameters accompanying the conversion to organic farming; investigation of the effects of different organic fertilisation systems (green manure, communal green forage compost, farmyard manure) on soil properties and on crop performances; analysis of existing biotopes (hedges and field stripes) on the farm, and planning and selective realization of new biotopes with the aim of enhancing the biodiversity of the area, offering habitats for beneficials and reducing wind erosion potential.

Introduction/Problem

In Eastern European Regions, organic arable stockless farming gains more and more significance as also bigger farms convert to organic farming. In those dry regions, with high wind erosion and high risk of heightened nitrogen concentration in the groundwater, low landscape element area and low plant, macro- and microorganism biodiversity, conversion to organic farming is a high challenge for every farmer. Referring to nutrient cycles and soil fertility, the stockless system operates without any compost input, but with green manure. To understand organic farming, its productivity and its impact on environment and economy, a long term farm trial, including landscape elements, was established in 2003. In field trials estimating the effect of different organic manure systems, transect trials for the analysis of erosion, water management, pests and beneficials, and monitoring of the whole farming system including landscape elements, 11 institutes cooperate in research and in monitoring the development of the farm.

Methodology

The long term field monitoring is performed at the biofarm "Rutzendorf", which is managed by the Landwirtschaftliche Bundesversuchswirtschaften GmbH. The farm is located in the Marchfeld region east of Vienna, Austria. The climate is warm and dry (average annual temperature: 9,8°C, average annual rainfall: 546 mm). The soil is a Calcaric Phaeozem, the soil texture is loamy silt to loam. The plough-land of the farm is 143,20 hectares, contiguous holding, and is equipped with different biotope structures. In eight fields, the following crop rotation is realized: 1st year: lucerne, 2nd year: lucerne, 3rd year: winter wheat + catch crop, 4th year: potatoes, 5th year: cereals + catch crop, 6th year: grain legume + catch crop, 7th year: winter wheat + catch crop, 8th year: cereals + underseed lucerne.

Eleven scientific divisions work at different investigation levels on the farm, depending on their research topic (Surböck *et al*. 2005). The data and results of the project are administrated in a common data base, improved soil maps are created. The Division of Organic Farming is responsible for the coordination of the overall project. The trial is carried out on three experimental levels, (i) on field plots, (ii) on transects in the fields, and (iii) on the farm and landscape level. On these levels, effects of (i) fertilisation systems, (ii) biotope elements, and (iii) the whole farm management are investigated (table 1).

Table 1: Research questions of the project partners depending on the investigation level.

Investigation level/ division	*Field plot trials* Influence of the fertilisation systems ...	Transect trials Influence of the biotope structures ...	Farm/landscape Influence of the farm management ...
IfOEL[1]	... on plant parameters, soil microbiology, soil structure and nitrogen cycle	... on crop yield, soil microbiology and soil structure	... on crop yield, plant health and weeds
IBF[2]	... on soil chemical parameters (nutrients)	... on soil chemical parameters (nutrients)	-
IHLW[3]	... on soil physical parameters	... on soil water	-
MET[4]	-	... on microclimate parameters	-
Zoology[5]	... on diversity of soil fauna	... as source respectively predator reservoir for soil fauna	... on resettlement of the fields with soil fauna
Zoology[5]	-	-	... on avifauna
Botany[6]	... on weeds and soil seed bank	-	-
LBI[7]	-	... on biodiversity and density of selected arthropod groups	
ILEN[8], ZUN[9]	-	Developing a concept of maintenance on the basis of a structural and vegetation mapping of existing biotope structures and interdisciplinary planning and planting of new biotope structures.	
ZUN[9]	-	... on biodiversity of wild bees	
Economic[10]	... on variable margin	-	... on variable margin
NUWI[11]	... on feed value of cereals	-	-
ILEN[8]	Creating and supervising of a data- and information platform for the whole project. Creating improved soil maps for the whole area of the farm based on point data from the Austrian soil taxation, relief parameters and crop data.		

- IfOEL[1] ... Division of Organic Farming, Department of Sustainable Agricultural Systems, University of Natural Resources and Applied Life Sciences (BOKU)
- IBF[2] ... Institute of Soil Science, Department of Forest- and Soil Sciences, BOKU
- IHLW[3] ... Institute of Hydraulics and Rural Water Management, Department of Water - Atmosphere – Environment, BOKU
- MET[4] ... Institute of Meteorology, Department of Water - Atmosphere – Environment, BOKU
- Zoology[5] ... Institute of Zoology, Department of Integrative Biology, BOKU
- Botany[6] ... Institute of Botany, Department of Integrative Biology, BOKU
- LBI[7] ... Ludwig Boltzmann-Institute for Biological Agriculture and Applied Ecology, Vienna
- ILEN[8] ... Institute of Landscape Development, Recreation and Conservation Planning, Department of Landscape, Spatial and Infrastructure Sciences, BOKU
- ZUN[9] ... Center for Environmental Studies and Nature Conservation, Department of Integrative Biology, BOKU
- Economic[10] ... Institute of Agricultural and Forestry Economics, Department of Economics and Social Sciences, BOKU
- NUWI[11] ... Division of Livestock Sciences, Department of Sustainable Agricultural Systems, BOKU

(i) Field trials (1 factor block design with four replications) were implemented on homogeneous soil of intermediate quality in each of the eight fields of the organic farm. Additionally, two reference plots were established, one plot on a soil of low quality in one of the organic fields, and the other plot on an adjacent conventionally farmed field. The field trials were installed to investigate the effects of three different organic fertilisation systems on the development of crops and on soil properties over time. The three tested organic fertilisation systems are: System 1: Only green manure by cultivation of lucerne and catch crops. System 2: Additionally to green manure, communal green forage compost is applied to balance the export of phosphor and potassium within the eight year crop rotation. System 3: the lucerne crop and cereal straw according to the demand of a suckler cow herd of 0.5 livestock units per hectar is harvested, the farmyard manure of the herd is then returned to the plots.

The examined parameters on the field trials and reference plots are: soil water and other soil physical parameters, soil nutrient concentration, content and subsequent supply of nitrogen, nitrogen leaching, microbial and fungal biomass, soil structure, various soil animals affecting the soil fertility, crop yield and crop quality characteristics, plant health, field nutrient balance, above-ground vegetation and soil seedbank, economic performance.

(ii) Transect trials were established in organic fields in several, exactly determined distances to existing hedges and new fields stripes. At these sites, the influence of hedges as wind protection barriers on soil quality (soil water, soil nutrient concentration, microbial and fungal biomass, soil structure) and crop yield are examined. Specific microclimate investigations of the impact of the hedges on neighbouring fields are conducted, especially wind profiles and profiles of percipitation, global radiation, dew occurrence and evapotranspiration. Additionally, at these and further monitoring plots on the farm, selected groups of arthropods (beneficial insects and pests) and wild bees were monitored.

(iii) Thirdly, a monitoring at farm level is established. On the fields crop yield, weeds and plant health are examined. In the whole area of the farm, the territories of breeding birds (avifauna) are censused. In existing biotopes, the diversity of plants is analysed and will be, if necessary, improved. Newly established biotopes, particularly field stripes, with the aim of enhancing the biodiversity of the area will be applied. These ecological measures, such as maintaining of hedges and field stripes, integrate the results from different disciplines and the management of the farm.

Results and brief discussion

The first year of the project 2003 was used to establish the long-term monitoring areas at the organic farm and to determine the present state of the different examined parameters at the beginning of the conversion to organic farming and before the first organic fertilizer input. Concerning the data (soil parameters: content and subsequent supply of nitrogen, microbial and fungal biomass; crop yield) examined by the Division of Organic Farming, no significant differences were evident after the statistical analyses. Therefore, the selected plots are suitable for the investigation of effects on soil fertility and plant development caused by different organic fertilizers.

The first experimental plots were fertilized with farmyard manure and compost in autumn 2003, before cultivating winter cereals (winter wheat and winter barley). The inquiry of yields of the harvest 2004 showed small advantages for the variants with an additional organic fertilizer (system 2 and 3). However, these differencies were not significant in the statistical analyses. Concerning the grain quality in dependance of the different fertilisation systems, only crude protein content in winter wheat was significantly higher in the systems 2 and 3 than in system 1 with only green manure. All other quality parameters of winter wheat and winter barley were not significantly different. The average dry matter grain yield of the trial with winter wheat was 5.735 kg ha^{-1} and that of the trial with winter barley was 4.812 kg ha^{-1} (Freyer *et al.* 2005).

A significant regression regarding the influence of a hedge on the lucerne yield in the adjacent field was detected only at the third cut of the lucerne in August 2004. This could be explained by very dry conditions in summer and still higher availability of soil water closer to the hedge. Additionally, various soil parameters were measured in spring 2003 in several distances to a hedge. Soil microbiological values remained on the same level at the different examined distances. Therefore no significant relation between soil microbiology and hedge distance could be proved. For reliable conclusions on this topic however, investigations conducted over a longer period of time are necessary.

Conclusions

Details of monitoring of organic farms, and especially data on the environmental effects of organic farming including landscape elements from the beginning of the conversion to organic farming, are scarce. The implications of such monitoring systems are far reaching. Effects of the changed farm management are expected no sooner than three to five years after starting with the conversion process. Nevertheless, there are several lessons to be learned on how to manage, monitor and to archive such a system.

References

Freyer, B., Surböck, A., Heinzinger, M. & Friedel, J.K. (Hrsg.) (2005): Monitoring der Umstellung auf den biologischen Landbau (MUBIL), 2. Zwischenbericht. Institut für Ökologischen Landbau, Universität für Bodenkultur. (unpublished).

Surböck, A., Freyer, B., Friedel, J.K., Gollner, M., Heinzinger, M., (2005): Monitoring der Umstellung auf den Ökologischen Landbau. In: Ende der Nische, Beiträge zur 8. Wissenschaftstagung Ökologischer Landbau, 1. - 4. März 2005, Kassel, (J. Heß und G. Rahmann, Hrsg.), 667-668; Kassel University Press GmbH, Kassel; ISBN 3-89958-115-6.

Acknowledgment

We gratefully thank the Ministry of Agriculture and Forestry, Environment and Watermanagement for their financial support.