DOC-trial: 20 years of organic and conventional farming affect soil microbial properties

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Introduction

In a long-term field trial (DOC; = bio-Dynamic, bio-Organic, Conventional) at Therwil, Switzerland, agricultural production systems have been compared since 1978. The production systems differ mainly in the amount and form of fertiliser and plant protection strategy. Crop rotation and soil tillage were the same. In the most prominent systems soil microbial properties were investigated for the first time after two crop rotations in 1990. In 1998, after 3 crop rotations, soil microbial properties were investigated in all field plots.

Material and methods

We compared the following farming systems: conventional (CONFYM; mineral and organic fertilisers, chemical and mechanical weed and disease control), bio-organic (BIOORG; organic fertilisers, mechanical weed control, no synthetic substances for disease control) and bio-dynamic (BIODYN; like BIOORG with the additional use of bio-dynamic preparations). These systems were performed at two intensities corresponding to 0.7 and 1.4 livestock units. One treatment remained unfertilised (NOFERT) and one was managed conventionally but with mineral fertiliser only (CONMIN). Three parallel but temporally shifted crop rotations represent three different crops at sampling time. In each replicate of all treatments, soil samples were taken in spring 1998 (0 — 20 cm depth). The following microbiological soil parameters were measured: microbial biomass (C_{mic}; SIR- and CFE-method), soil respiration (basal respiration), N-mineralization by aerobic incubation, catalase activity and dehydrogenase activity. Metabolic quotient qCO_2 and C_{mic}/C_{org} ratio were calculated.

Results and discussion

Soil microbial biomass, dehydrogenase and catalase activity were closely correlated to pH and the C_{org} content, whereas the correlation of basal respiration was weaker and N-mineralisation was not correlated to the abiotic parameters, nor to the biotic.

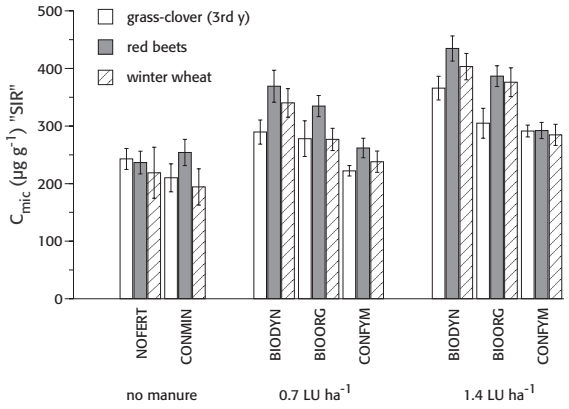

Fig 1: Microbial biomass in the DOC trial soils.

Tab 1: pH and C_{org} in 1998 and relative values for C_{mic} (CONFYM=100%) measured in 1998 and 1990/91 in soils of the DOC field trial

	pH ($CaCl_2$)	C_{org}	C_{mic} (%) 1998	C_{mic} (%) 1990/91
NOFERT	5.27	1.30	80.4	77.6
CONMIN	5.11	1.41	75.8	82.2
BIODYN	5.92	1.57	115.0	
BIOORG	5.53	1.37	102.5	
CONFYM	5.38	1.40	83.2	
BIODYN	6.12	1.69	138.6	134.3
BIOORG	5.83	1.55	123.0	117.3
CONFYM	5.56	1.49	100.0	100.0

Similar differences between the systems were obtained by the different soil microbial measures. At the same fertilisation intensity microbial biomass and activities ranged in the order BIODYN > BIOORG > CONFYM (Fig. 1). The amount of manure applied exerted a significant effect on the soil microbial parameters, however this was not found for the three conventional systems: microbial biomass was almost unaffected by the amount of manure (CONMIN, CONFYM). Unexpectedly the three crops showed only little effect on microbial parameters, except in the red beet plots values were higher since the intercrop that was growing on these plots before was mulched shortly before soil sampling. Differences among the systems were similar in 1990 and 1998. (Tab. 1)

Conclusions

Agricultural systems exert distinct effects on chemical and microbiological soil properties, prominently the bio-dynamic system with the application of composted manure. Part of the influence on microbiological parameters appears to be indirect through chemical properties. The differentiation of the systems remained stable for the last eight years of the trial.