Analysis of the Soil Foodweb Structure on Organic- and Conventional Dairy Farms

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Introduction The below ground biodiversity of soil organisms plays an important role in the functioning of the soil ecosystem, and consequently the efficiency of the above ground plant production on dairy farms. However, for farmers, soil biology remains a black box. It is difficult to interpret soil biology on dairy farms and to identify management measures to improve it. The objective of this study was to investigate if it is possible to classify the soil foodweb structure on a dairy farm in relation to management practices.

Materials and methods In an empirical study, soil foodweb structures of 49 dairy farms (including 10 organic farms) on sandy soils were related to farm and site characteristics. Soil life records included densities of bacteria, nematodes, enchytraeids, earthworms, springtails and mites. Sampling was done in 1999 under the Dutch national programme 'Biological Indicator for Soil Quality' (BISQ) (Schouten *et al.,* 1999). Data were agglomerated in eleven trophic groups, and standardised to the group maximum. Samples were classified by means of TWINSPAN (Hill, 1979).

Results TWINSPAN clearly distinguished 5 main soil foodweb structures within 45 of the 49 dairy farms (Table 1). These soil foodweb structures, combined with farm characteristics, can be described as follows:
Type 1: Intensively managed organic farms with a high biomass of enchytraeids and earthworms;
Type 2: Organic- and extensive conventional farms with a high soil organic matter, high numbers of nematodes and a high biomass of bacteria;
Type 3: Extensive conventional farms with a high percentage of grassland and a high biomass of earthworms;
Type 4: Intensive conventional farms with more arable land and a reduced soil life;
Type 5: Intensive conventional farms with a reduced soil food web but high numbers of mites.

Table 1 Classification of 45 dairy farms in 5 types of soil foodweb structures

Dairy farms				Site characteristics					Average quantities (see key)									
Type	No. organic	No. conv. ext.	No. conv. int.	% grassland	LU/ ha	SOM %	P-Al mg/100g	Bacteria	Nem hf	Nem pf	Nem bf	Nem mp	Enchytraeid	Earthworm	Mite top	Mite bhf	Mite pf	Miet mp
1	4	1	0	92	2.2	7.7	48	146	1	22	23	3	8	40	0	11	8	8
2	5	4	0	80	1.8	9.2	48	240	2	22	33	5	3	41	0	12	7	7
3	0	4	3	80	2.8	5.8	53	151	1	16	41	5	3	102	0	13	4	9
4	0	6	11	68	2.9	6.7	50	142	0	10	28	3	2	28	0	18	6	11
5	0	1	5	80	3.3	5.9	59	147	1	13	31	2	2	28	1	51	11	30

Key: LU=Livestock Unit, SOM=Soil Organic Matter; Bacteria (µg C/g soil), Nem=nematodes (number/g soil), hf=hyphen-feeding, pf=plantfeeding, bf=bacteria-feeding; mp=micropredator; Enchytraeid (g/m^2); Earthworm (g/m^2); Mite=mites and springtails (number/$10cm^2$), top=arthropod predator, bhf=bacteria- & hyphen-feeding, pf=plant-feeding, mp=micro-predator.

Conclusions The results of this study demonstrate that the soil food web structure can be classified and is related to farm characteristics. The next step would be to determine the performance of the different structures in terms of soil functions and above ground production.

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