Soil Compaction by Slurry Injection and the Effect on Soil Quality

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Key words : grassland , soil compaction , slurry injection , soil physical , soil biological

Introduction In (organic) dairy farming , fertilization of grassland with manures , such as slurry , is important to maintain yield level and soil quality . Slurry is mainly applied by shallow injection (4 cm) into grassland . During injection , trafficking may adversely affect soil structure by compaction . This risk is largest in early spring , when the soil is relatively wet . Soil compaction can result in deterioration of physical and biological soil characteristics . The objective of this experiment was to quantify the effect of soil trafficking in early spring on physical and biological soil parameters .

Materials and methods The experiment was carried out on a sandy soil with a 10-year old permanent grass-clover sward (*Lolium perenne* and *Trifolium repens*) . The experimental design consisted of four treatments in five replications : with and without trafficking , and with and without slurry application . On the 14 th of March 2005 , treatments were established with a 25 Mg weighing tractor pulled sod-injector . On the 18 th of March and the 9 th of May 2005 , soil samples were collected on the unfertilized treatments to determine physical and biological characteristics . Soil physical characteristics were bulk density (0-30 cm , undisturbed ring samples of 5 cm high) , penetration resistance (0-50 cm , penetrologger) , soil structure (0-20 cm , visual score) , number of roots and macropores (at 10 and 20 cm depth , visual score) . Soil biological analysis were number , biomass and development stage of earthworms (0-20 cm) , number and species distribution of nematodes (0-10 cm) , and bacterial and fungal biomass (0-10 cm) .

Results After the single pass with the sod-injector , tracks were clearly visible . However , the single pass with the tractor pulled sod-injector had no effect on bulk density , soil moisture content , visible soil structure , number of roots and macropores , number and development stage of earthworms , number and species distribution of nematodes , and bacterial or fungal biomass (see Table 1) . Specific for nematodes , Bouman and Arts (2000) found a shift in tropic groups of nematodes when the soil was compacted frequently for five years . Soil penetrability in the upper 50 cm was always lower in the tracks , but only significantly lower in the soil layers 0-10 , 10-20 and 40-50 cm . The cell volume of bacteria in the tracks had significantly increased . This could point to lower predation by protozoa and nematodes in the soil food web . Nine weeks after the single pass of the tractor , the biomass of earthworms seemed to have decreased ($P=0.09$) . Aritajat et al . (1977) found no effect on earthworms after trafficking the soil once . However , after ten passes , the number of earthworms was significantly reduced .

Table 1 *Selection of soil parameters measured in soil with and without trafficking .*

	Penetration resistance(MPa) , 18th of March					Earthworm biomass ($g\ m^{-2}$)		Cell volume bacteria (μm^{-3} per cel)
	0-10cm	10-20cm	20-30cm	30-40cm	40-50cm	18th of March	9th of May	18th of March
Without trafficking	1.15[a]	1.41[a]	1.68	2.40	2.73[a]	84	131	0.40[b]
With trafficking	1.02[b]	1.21[b]	1.59	1.89	2.35[b]	90	78	0.50[a]

Values indicated by the same letter within a column are not statistically different at the 5% error level .

Conclusions A single pass of a heavy tractor-pulled sod-injector had only small effects on physical and biological soil characteristics . However , frequent trafficking leads to significant changes in physical and biological soil characteristics .

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