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## Soil Compaction by Slurry Injection and the Effect on Soil Quality

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## 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<sup>th</sup> of March 2005, treatments were established with a 25 Mg weighing tractor pulled sod-injector. On the 18<sup>th</sup> of March and the 9<sup>th</sup> 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, penetrometer), 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 trophic 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), 18 <sup>th</sup> of March				Earthworm biomass (g m <sup>-2</sup> )		Cell volume bacteria (μm <sup>3</sup> per cel)	
	0-10cm	10-20cm	20-30cm	30-40cm	40-50cm	18 <sup>th</sup> of March	9 <sup>th</sup> of May	18 <sup>th</sup> of March
Without trafficking	1.15 <sup>a</sup>	1.41 <sup>a</sup>	1.68	2.40	2.73 <sup>a</sup>	84	131	0.40 <sup>b</sup>
With trafficking	1.02 <sup>b</sup>	1.21 <sup>b</sup>	1.59	1.89	2.35 <sup>b</sup>	90	78	0.50 <sup>a</sup>

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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