

YIELD AND SOIL CONDITION STUDIES IN ORGANIC FERTILISATION EXPERIMENTS

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Introduction

The crop rotation-monoculture issue is a question of high interest. A lot of aspects arise from time to time and are being discussed from different points of view. Györfly (1975/a) using the Hungarian experimental results from this field evaluates the different theories of crop rotation or change of crops (organic matter-, nutrient-, nitrogen-, structure-, toxin- theory) and establishes that at present level of fertiliser use the application of crop change is not justified at least from soil fertility point of view –. At the same time experimental data of Györfly (1975/b) and Györfly and Berzsenyi (1992) prove that maize yield is lower in monoculture than in crop rotation. In the case of wheat the yield decrease is higher than that of maize. Györfly's studies (1975/a, 1993) reveal that regarding wheat the main reason of yield depression can be attributed to plant pathological reasons while in the case of maize it can be explained by water household problems and the occurrence of herbicide resistant weeds. The studies of Kismányoki (2001) and Baser et. al (2004) prove that the highest yields, the best soil physical- chemical- and biological conditions were achieved by the combined application of the carefully designed crop rotation, manure and fertilisers (Kreybig 1946, Kemenessy 1972, Sipos 1968, 1974, Nyíri 1973, 1982, Birkás 1987, 2002, Ruzsányi et.al 2003).

Methods

The studies were carried out at Veszprém University at the Experimental Station of the Institution of Plant and Environmental Sciences in a long-term crop rotation experiment.

The soil of the experimental site is a Ramann type brown forest soil with low humus and phosphorus and medium potassium content. The average humus content is 1.6-1.7%, the AL-soluble P₂O₅ and K₂O content is 60-80 and 140-160 mgkg⁻¹ respectively. The pH in water suspension is 7.0-7.5; the pH_{KCl} value is 6.8-7.0.

In the experiment the main plot is given by the rotation treatments arranged in a random block design and the fertilisation treatments mean the sub-plots in a strip arrangement. The size of the plots is 7.6x17 m = 129.2 m². The grown plant species were the following ones: rotation 1: winter wheat, lucerne, lucerne, winter wheat, maize. Rotation 2: Sudan grass, winter wheat, mixture of oats and vetches, winter wheat, maize. This study covers the data regarding maize in rotation 1 in 2004. The applied fertiliser rates were as follows: N, P₂O₅, K₂O: subplot a 0-0-0; subplot b 50-50-70; subplot c 140-210-290; subplot d 140-210-290 kg ha⁻¹ respectively. In addition 36 t ha⁻¹ farmyard manure was given to subplot d.

The penetration resistance studies were carried out with penetrometer type: 3T System, to a depth of 500 mm in 20 repetitions, two times per year, in July and in October.

The average precipitation at the experimental site is 650 mm. The weather in the experimental year was a little dry compared to the long-term average, especially in the vegetation period of maize. The amount of rainfall was 618.9 mm by 31.1 mm lower than the average.

Before sowing maize the following soil cultivation was applied: fall ploughing, levelling, disking, combined seedbed preparation.

Results and discussion

The penetration resistance in 2004 is lower than it was in July of the previous year, though even under the upper 5 cm soil layer the resistance values exceed 3.5 MPa. Deeper than 35 cm the values are decreasing but the condition of the soil is still unfavourable (Figure 1).

Regarding the soil moisture content we can establish that the values measured in July of 2004 are approximately 5% higher than the respecting ones taken in the same period of the previous year. In 10-50 cm depth the moisture content is evenly around 20%. These values are higher than the ones measured in maize monoculture (Figure 2).

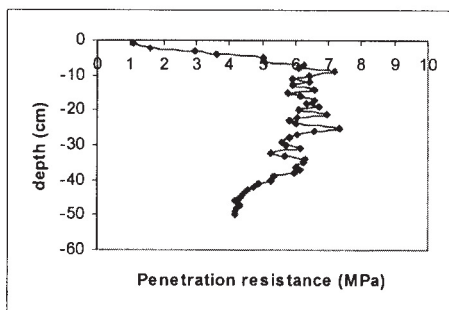


Fig 1. Penetration resistance in July 2004

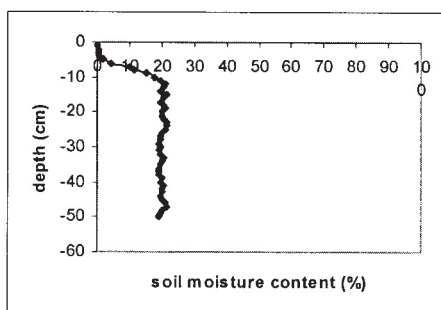


Fig 2. Soil moisture content in July 2004

Examining the values measured in October 2004 we can see that the penetration resistance in the upper 25 cm layer does not exceed the 3.5 MPa value, but under this depth the resistance is increasing and between 30 and 50 cm it is already higher than 5 MPa, which indicates a harmful compaction in the deeper soil layers. There is a significant decrease in the values compared to the compaction measured in July (Figure 3).

The soil moisture values show that the soil is wetter and contains a higher amount of water in the layer studied (Figure 4).

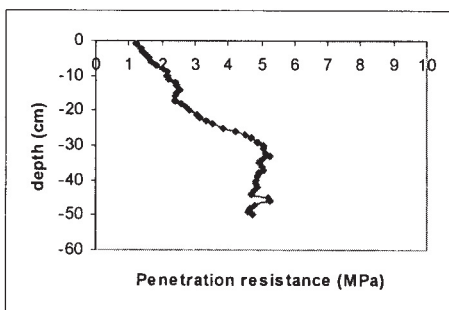


Fig 3. Penetration resistance in October 2004

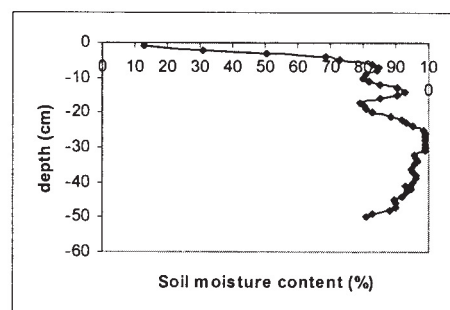


Fig 4. Soil moisture content in October 2004

Regarding the condition of the soil in the cultivated layer we can establish that it is unfavourable at both measurement times and refers to the lack of loosening cultivation. The low moisture content experienced at the summer testing period can be explained by the dry summer and high water consumption of maize. The second measuring was done after harvest, but since it was done after an intense rain the soil was wet in the depth of the layer studied.

With regard to the yield the results proved that fertiliser and manure doses influenced the yield of maize significantly. The lowest yield was measured in the control plot and the yield

increased with the rising fertiliser doses. The combined application of fertiliser and manure resulted in the highest yield. The statistical analysis of the experimental data proved that the results were significant at the 5% probability level ($LSD_{5\%} = 2.105$). The yield results are displayed in Figure 5.

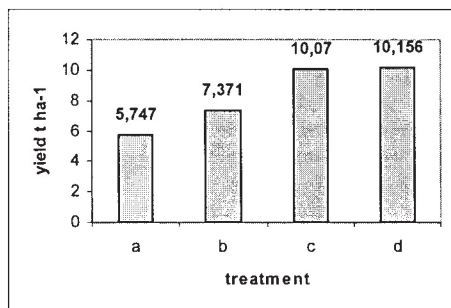


Fig 5. Yield of maize in rotation 1 2004

Conclusions

In lack of loosening cultivation the penetration resistance measurements do not prove the favourable effect of lucerne on soil condition. The cultivated layer is compacted and seems to be degraded.

Due to the dry summer period and the high water consumption of maize we experienced the extreme dryness of the soil and the increasing of the penetration resistance.

In accordance with literature data the highest yield was achieved when both fertiliser and manure was applied.

With the rising fertiliser doses the yield increased significantly.

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