

The effect of tractor wheel passes on air-water properties of soil and production from red clover/grasses sward

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Abstract

This paper presents results of the researches carried out in 1997-1999 on sandy soil. The aim of this study was to show influence of multiple passes of tractor wheels on air-water properties of sandy soil under grassland. The results show that multiple passes of different tractors wheels and different number of passes have not significant influence to air-water properties of soil. The only difference is between control (non-compacted) and compacted soil in the 10-15 cm layer.

It was found that yield of the red clover/grasses mixture depends on weight of tractor and number of passes. Decreasing of plant yielding can reach approximately 20% on strongly compacted plots (six passes of Ursus C-1002) in comparison with non-compacted plot.

1. Introduction

The soil compaction by tractor wheels is one of the most important factors, which decrease plant yielding [DOMZAL et al., 1987]. It is especially important on grasslands and perennials species because there are not ploughing and other opening operations. The soil compaction accumulates during many years and cause to plant yielding. All machine passes take places on the field surface covered by plants. Damages to the shoots and roots decrease plant yield [GRYNIA et al., 1997]. Worsening of the soil physical properties such as: increasing of the soil density, decreasing of the porosity, changes in the structure of the porosity and decreasing of the air permeability lead to decreasing of plant yield [DOMZAL et al., 1984; FRAME and MERRILEES, 1996; KOPEC et al., 2001].

2. Materials and methods

Research was carried out during 1997-1999 in Mydlniki near Krakow. The ex-

periment was established using randomised blocks in four replicates on loamy sand. Red clover (*Trifolium pratense*) and grasses (*Lolium preenne*, *Dactylis glomerata*, *Phleum pratense*) were sown in a mixture. The plots were compacted by wheel of Ursus C-360 tractor (weight 2056 kg), Ursus C-1002 (4180 kg) and Ursus C-4514 (3300 kg). Wheel passes covered a whole plots surface (7 m²). The combination of the passes was as follows: control (0), two passes (2), four passes (4), six passes (6). Plant yields were determined after each cut. In autumn 2000 soil samples (volume 100 cm³) were collected from three soil layers: 0-5 cm, 10-15 cm and 20-25 cm. The prepared samples were saturated with water on a suction plate (according to Richard's method) and then air-water properties were determined.

3. Results and discussion

3.1 Air and water properties of soil

The results show that multiple passes of different tractors wheels have not significant

influence to air-water properties of soil. The only statistically significant difference is between control (non-compacted) and compacted soil. Changes in porosity were observed only in the 10-15 cm soil layer. It was connected with decreasing of volume of macro and mezopores on compacted plots. This changes in differential porosity results in water retention of soil. Soil compaction

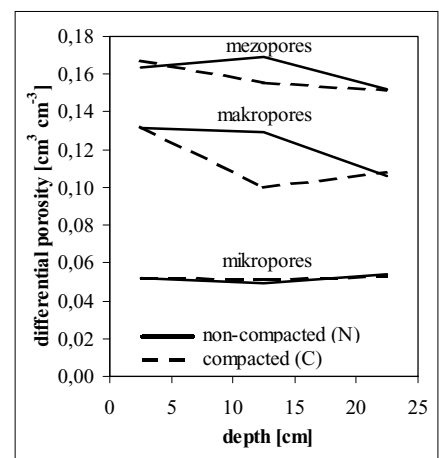


Figure 1: Differential porosity of compacted (C) and non-compacted (N) soil.

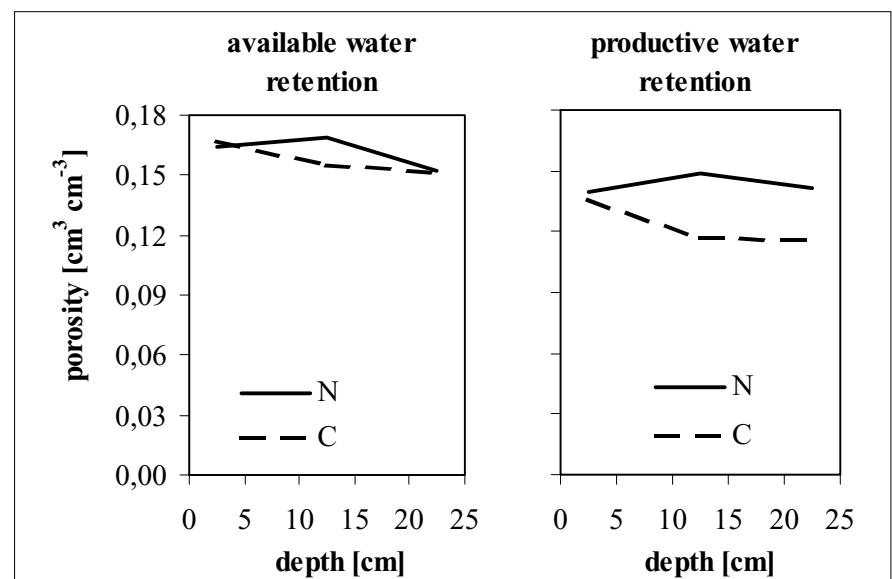


Figure 2: Water retention of compacted (C) and non-compacted (N) soil.

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results in decreasing in available and productive water retention. We can notice it in the 10-20 cm soil layer. The 0-10 cm soil layer is resistant to soil compaction. The reason for lack of changes in this layer is numerous roots of plants and animals activity (spiders, ants, earthworms etc.).

3.2 Red clover/grass sward yielding

Wheeling treatment significantly reduced annual DM production (see *Figure 3*). Both experimental factors, weight of tractor and number of passes, were significant. Number of passes and weight of tractors caused in decreasing of plant yielding. The biggest annual DM were noticed on non-compacted plots (13,64 t DM ha⁻¹) with compare to compacted plots (average 11,32 t DM ha⁻¹). The reason for this decreasing in plants yielding is not only changes in physical properties of compacted soil but also damages and injuries to plants caused by tractor wheels. This physical damages to

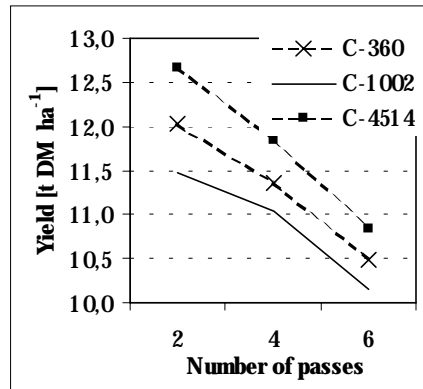


Figure 3: Mean annual yielding of red clover/grasses mixture in 1997-1999.

plants seems to be more important factor responsible for decreasing of plants yield on sandy soil.

4. Conclusion

☉ Sandy soil under perennial plants is resistant to process of compaction. The only significant differences in air-water properties are in the 10-20 cm soil layer. In this layer soil compaction results in

decreasing of available and productive water retention.

- Weight of tractor and number of passes cause in decreasing in yield of red clover/grasses mixture on sandy soil.

5. References

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