NJF Report • Vol 8 • No 1 • Year 2012

Nordic Association of Agricultural Scientists

NJF Seminar 448

Soil compaction

- effects on soil functions and strategies for prevention

House of Science and Letters

Helsinki, Finland, 6-8 March 2012

NJF

Nordic Association of Agricultural Scientists

Soil physical properties under different cropping systems in Estonia

Diego Sánchez de Cima, Endla Reintam, Anne Luik

Estonian University of Life Sciences; Kreutzwaldi 1, 51014 Tartu, Estonia
+372 5594 6690; e-mail: diego@emu.ee

Introduction

Regarding a soil compaction survey carried out at the end of 2008 by the Estonian University of Life Sciences in collaboration with the Agricultural Research Centre, soil compaction was define as one of the currently bigger problems in Estonian soils (Reintam et al., 2010). Soil compaction reduces porosity, permeability and therefore water flow through the soil is blocked, increasing the soil erosion and creating anoxic conditions in the bulk which causes denitrification, and therefore the uptake of nutrients is reduced (Bakken et al., 1987). In conclusion soil compaction affects directly to the plant root development and crop yield.

Organic farming, which avoids or largely excludes the use of synthetically compounded fertilizers and pesticides, is presented nowadays as a sustainable alternative to conventional agriculture and as a practice that promotes the conservation of physical and chemical properties of soil. Despite of the increasing popularity of organic farming during the last decade, there is a lack of comparative research into the physical properties of soil between organic and conventional management (Stolze et al.. 2000).The aim of this research is to contribute to this field of study by assessing the effects on soil physical properties, focusing on penetrability and water retention capacity under organic and conventional farming systems in Estonia.

Materials and methods

Five-year crop rotation system (pea, potato, barley, red clover and winter wheat), based on 80 plots, was conducted on sandy loam *Stagnic Luvisol* at the experimental station of Estonian University of Life Sciences in Eerika, Tartu (Estonia) since 2008. From those plots, 40 were cultivated under conventional farming systems with different concentrations of mineral fertilizers. The remaining 40 plots were cultivated under organic farming conditions with the same rotation but having winter oil-rape after pea, winter rye after potato and ryegrass after winter wheat as cover crops. In addition 20 of them (organic II) receive yearly 40 t ha^{-1} of manure in those plots were pea is cultivated.

The present research is based on a total of 320 samples from the 80 plots (4 replications per plot), taken in October 2010 and 320 samples taken in October 2011, after harvest and before soil tillage. From these plots penetration resistance by cone penetrometer (Eijkelkamp Penetrologger with 60 degree 1 cm^2 cones) down to 80 cm depth and bulk density, total porosity, air filled pores, water permeability and plant available water by steal cylinders (57 mm diameter and 40 mm height) at 5 to 10 cm depth were studied. Currently, samples of the second year of experiment are being analyzed and comparison between these first two years of experiment is performed. For testing significant differences between cropping systems and among crops, one-factor ANOVA test was used.

Results and discussion

The distribution of penetration resistance with depth was uniform in the first year of study and very similar for every cropping system, but results from 2011 reveal an increase of resistance; especially in the conventional plots where pressure was almost double than in the previous year of experiment along the first 20-25 cm.

The water content at the moment of sampling varied between 16-17% under both cropping systems and did not cause differences in penetration resistance. However, in 2011, the diagram of pressure with depth shows a possible existence of plough pan at 30 cm probably caused by tillage at that depth, reaching values higher than 3 MPa.

Significant differences ($p<0.05$) were found among the different cropping systems for the rest of the physical properties analyzed. Conventional plots showed a lower bulk density and higher percentage of total porosity, air filled pores and plant available water in comparison with the organic ones. No significant differences were found between organic plots, therefore no manure influence was blatant in organic II plots, since at the time of sampling the rotation was not completed and consequently not all they had the addition of it.

Conclusions

Significant differences ($p<0.05$) have been observed in the data of the first year of experiment (2010) at the time of comparing both systems, showing a slightly better quality of the conventional soils. However, first analyses of the second year samples show a higher compaction of the conventional plots in comparison with the organic ones. Due to the early state of the experiment (rotation has not be completed yet) data from more years seem necessary for drawing further conclusions.

Acknowledgments

The study was supported by Estonian Scientific Foundation grant 7622, ERA_NET CORE-ORGANIC II project TILMAN-ORG and by target financing project SF0170057s09.

References

Bakken, L.R., Børresen, T., Njøs, A., 1987. Effect of compaction by tractor traffic on soil structure, denitrification, and yield of wheat. J. Soil Sci. 38, 541-552.

Reintam E., Penu P., Köster T., Trükmann K., Krebstein K., Kuht J., 2010. Soil compaction survey in Estonia. 19th World Congress of Soil Science, Soil Solutions for a Changing World 1 – 6 August 2010, Brisbane, Australia. Published on DVD.

Stolze M., Piorr A., Häring A., Dabbert S., 2000. The Environmental Impacts of organic farming in Europe In rganic Farming in Europe: Economics and Policy Vol 6 (Hago Druck and Medien: Germany).