

Long-Term Tillage, Lime Matter and Cover Crop Effects under Heavy Soil Conditions in Northern Lithuania

Authors : Aleksandras Velykis, Antanas Satkus

Abstract : Clay loam and clay soils are typical for northern Lithuania. These soils are susceptible to physical degradation in the case of intensive use of heavy machinery for field operations. However, clayey soils having poor physical properties by origin require more intensive tillage to maintain proper physical condition for grown crops. Therefore not only choice of suitable tillage system is very important for these soils in the region, but also additional search of other measures is essential for good soil physical state maintenance. Research objective: To evaluate the long-term effects of different intensity tillage as well as its combinations with supplementary agronomic practices on improvement of soil physical conditions and environmental sustainability. The experiment examined the influence of deep and shallow ploughing, ploughless tillage, combinations of ploughless tillage with incorporation of lime sludge and cover crop for green manure and application of the same cover crop for mulch without autumn tillage under spring and winter crop growing conditions on clay loam (27% clay, 50% silt, 23% sand) Endocalcaric Endogleyic Cambisol. Methods: The indicators characterizing the impact of investigated measures were determined using the following methods and devices: Soil dry bulk density - by Eijkelkamp cylinder (100 cm³), soil water content - by weighing, soil structure - by Retsch sieve shaker, aggregate stability - by Eijkelkamp wet sieving apparatus, soil mineral nitrogen - in 1 N KCL extract using colorimetric method. Results: Clay loam soil physical state (dry bulk density, structure, aggregate stability, water content) depends on tillage system and its combination with additional practices used. Application of cover crop winter mulch without tillage in autumn, ploughless tillage and shallow ploughing causes the compaction of bottom (15-25 cm) topsoil layer. However, due to ploughless tillage the soil dry bulk density in subsoil (25-35 cm) layer is less compared to deep ploughing. Soil structure in the upper (0-15 cm) topsoil layer and in the seedbed (0-5 cm), prepared for spring crops is usually worse when applying the ploughless tillage or cover crop mulch without autumn tillage. Application of lime sludge under ploughless tillage conditions helped to avoid the compaction and structure worsening in upper topsoil layer, as well as increase aggregate stability. Application of reduced tillage increased soil water content at upper topsoil layer directly after spring crop sowing. However, due to reduced tillage the water content in all topsoil markedly decreased when droughty periods lasted for a long time. Combination of reduced tillage with cover crop for green manure and winter mulch is significant for preserving the environment. Such application of cover crops reduces the leaching of mineral nitrogen into the deeper soil layers and environmental pollution. This work was supported by the National Science Program 'The effect of long-term, different-intensity management of resources on the soils of different genesis and on other components of the agro-ecosystems' [grant number SIT-9/2015] funded by the Research Council of Lithuania.

Keywords : clay loam, endocalcaric endogleyic cambisol, mineral nitrogen, physical state

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