The Influence of Minimum Tillage Systems on Soil Organic Matter and Water Conservation in some Soils of Romania

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ABSTRACT

Organic matter is an extremely important constituent of soils and is vital to many of the hydrological, biological and chemical reactions required for sustaining plant life. We present the influence of conventional plough tillage system on soil, water and organic matter conservation in comparison with an alternative minimum tillage system (paraplow, chisel plow and rotary harrow). The influence of tillage soil system upon water supply accumulated in soil was studied on several soil types at the University of Agricultural Sciences and Veterinary Medicine of Cluj Napoca, Romania. To quantify the change in soil properties under different tillage practices, determinations were made for each cultivar (maize, soy-bean, wheat, spring rape / potato) in four vegetative stages (spring, 5-6 leaves, bean forming, and harvest). Soil parameters monitored included soil water content (gravimetric method, Aquaterr probe - Frequency domain reflectometry), soil bulk density (determined by volumetric ring method using the volume of a ring 100 cm^3), soil penetration (using a Fieldscout SC900 penetrometer), water stable aggregates, soil permeability (using the Infiltrometer method) and organic matter content. The average result values, obtained in the vegetal phases were statistically analyzed, using the last four cultivation years within the crop rotation for every type of soil. The results were analyzed using ANOVA and Duncan's test.

The application of minimum tillage systems increased the organic matter content 0.8 to 22.1% and water stabile aggregate content from 1.3 to 13.6%, in the 0-30 cm depth, as compared to the classical system. For the organic matter content and the wet aggregate stability, the statistical analysis of the data showed, increasing positive significance of minimum systems. While the soil fertility and the wet aggregate stability were initially low, the effect of conservation practices on the soil features resulted in a positive impact on the water permeability of the soil. Availability of soil moisture during the crop growth resulted in better plant water status. Subsequent release of conserved soil water regulated proper plant water status, soil structure, and lowered soil penetrometer resistance.

After ten years of applying the same soil tillage system, the data show that soil infiltration and soil water retention are higher when working with paraplow and chisel plow variant with values of 5.54 (c) and 5.08 (b) $l/m^2/min$, respectively. By contrast, the amount of water retained by traditional tillage was 4.25 (a) $l/m^2/min$. The paraplow and chisel plow treatments were more favourable for infiltration and water retention. Positive effects on the saturated hydraulic conductivity of the paraplow (35.7 cm/h) and chisel plow (31.5 cm/h) treated soils were observed compared with the traditional tillage (29.4 cm/h) of the soil.

On haplic Luvisols, a soil with a moderately developed structure and average fertility, the quantity of water accumulated was 1-6% higher under paraplow, chisel plow and rotary harrow tillage, compared to conventional tillage. On molic Fluvisols and cambic Chernozems, soils with good permeability, high fertility, and low susceptibility to compaction, accumulated water supply was higher (representing 11-15%) for all minimum soil tillage systems. In the four soils tested, the paraplow was the better at water conservation showing an increase in the water reserve in soil of 4.8-12.3%.

Keywords: minimum soil tillage, water, organic matter conservation.

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