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THE INFLUENCE OF CONSERVATION WORKS ON SOIL PHYSICAL AND CHEMICAL CHARACTERISTICS IN PADINA COMMUNE, MEHEDINȚI COUNTY

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Abstract

A study was carried out in the case of experiments on soil Works located at Padina, Mehedinti county (Romania), on a soil of reddish Preluvosol type with a texture on the depth of 5-10 cm, medium clay and clay loam on the sampling depths 25-30 cm and 45-50 cm). The apparent density was significantly affected by the soil works systems, with the lowest values for the conventional system on the depth of 5-10 cm, and on the depth of 25-30 cm, the highest values being recorded in minimum tillage. This difference is given by the higher clay content. The degree of susceptibility of reddish Preluvosol for the two systems of works is moderately susceptible for conventional and unsusceptible for conservative, due to the preservation of plant debris at the soil surface.

Key words: soil degradation, aridization, minimum tillage, soil properties

INTRODUCTION

The system of soil work based on its protection, reduced work and direct sowing, has been widely used on large areas in recent decades, priority to combat drought by accumulating and conserving larger amounts of water in the soil, by reducing fuel consumption and increasing productivity by reducing soil work ensuring a significant increase in profit (Charles, 2010; Benoit, 1989; Barriuso, 1994; Ball, 1994; Lupu, 1992; Rusu, 2004).

Extensive research has demonstrated that Conservative agriculture (improves the physico-chemical and biological properties of soil that are crucial to supporting soil health and increasing the agroecosystem's resistance to global change (Stavi et al., 2016; Cociu et al., 2017; Claassen et al., 2018).Conservative agriculture is a major opportunity that can be applied to achieve several objectives: reducing environmental degradation, combating aridization/desertification phenomena, restoring biodiversity, reducing climate change, being widely recognized as a viable concept for the practice of sustainable agriculture. It is appreciated, that only in this way can agriculture contribute in the long term to the improvement and conservation of various environmental resources, including biodiversity (Burtan Lavinia et al., 2016).

1)The influence of AC on the physical and hydrophysical properties of soil

By applying the minimum system of soil works, the apparent density values (Da g/cm3) become higher over time compared to those characteristic of the soil worked according to classical technology (Blache et al., 1986). Instead, the harpan is no longer formed, improving air circulation, water infiltration and deep development of the root system. Conservation work has a positive effect on the structure of the soil and its water stability (Griffith et al., 1993). Total porosity and volume of macropores have lower values in the case of minimal work, but compared to the classical system, these values are more favorable because vertical continuity of pores is ensured as a result, soil airing, drainage and root growth are ensured (Lal, 2000; Lal et al., 2000). As for soil compaction, especially on heavy soils, where the main indicators of compaction, including resistance to penetration, increase over time. An average level of compaction has been found to have positive effects on production, especially in years of lower rainfall (Carter, 1994). Through the use of these works, a reduction in the amount of infiltrated water has been observed, but this effect is countered by the presence of biopores, especially those due to the activity of earthworms (Kemper et al., 1987). The presence of mulch on the soil surface reduces water loss through evaporation and contributes to a more efficient use of water from precipitation or irrigation (Jităreanu et al., 2020).

2)The influence of AC on the chemical properties of soil

In the soil worked through the minimal works system (conservative) it was observed that the pH and organic carbon change rapidly. Organic carbon in the soil worked by this system increases in the superficial layer (0-3 cm) and thus also increases the C/N ratio. This phenomenon is mainly due to organic debris left at the surface of the soil and the decrease in biological activity, by reducing the number and depth of the works, the pH of the soil is reduced (Dick, 1992; Blevins, 1991), because most processes and technologies cause acidification of the soil. In the plowed layer, acidification dissipates throughout the loose layer and manifests itself after a period of 3-5 years, depending on the buffering capacity of the soil. In conservation work, acidification is determined by the decomposition of plant debris on the surface of the soil and the application of fertilizers in the superficial layer and manifests itself in the layer on the surface (0-3 cm). Blevins (1991) showed that the PH difference between the classical system and the one with minimal works was 1-1.5 pH units in the 0-5 cm layer and 0.5 pH units in the 5-15 cm layer.

MATERIALS AND METHODS

A study was conducted in the case of experiments on soil Works located at Padina, Mehedinti county (Romania), latitude: N 44.47224, longitude: E 023. 05446.

The soil type representative of the unit is Preluvosol redhead (SRTS, 2012).

In the experimental fields (soil works in conventional and conservative system), two main soil profiles were performed and characterized in terms of morphology and physicochemical characteristics, according to the Working Methodology of ICPA Bucharest (MESP, vol. I-III, 1987).

The preparation of the land in conventional (classical) system was carried out through the following works: plowing, discuit, sowing, application of phytosanitary treatments and harvesting, barley culture, variety/hybrid Tepee, in non-irrigated field. In the conservative agricultural technology (minimum tillage), scarification, leveling, sowing and harvesting were carried out on the corn crop, variety/hybrid DKC 4728, in non-irrigated field.

Soil sampling

Soil samples were collected on the depths of 5-10 cm; 25-30 cm and 45-50 cm). The analyses and determinations carried out are in accordance with the methodology and STAS in force (SRTS, 2003).

Organic matter (humus) (%) was determined volumetric by wet oxidation method after Walkley black modified Gogoasa;

Potentiometrically determined pH, with combined glass and calomel electrode, in aqueous suspension at the soil/water ratio of 1/ 2,5; Total Nitrogen (Nt%) by Kjeldahl method; Mobile Phosphorus and Potassium in extract in ammonium lactate acetate (Egner-Riehm-Domingo).

For the physical characterization of the soil samples collected in order to determine the mechanical characteristics of the soil, the granulometric analysis was performed, at least seven fractions without oxidation of organic matter (sieving and sedimentation method).

The apparent density (Dawi) was determined by the pycnometric method, it is expressed in g/cm3.

Total porosity (PT) is expressed in % by Volume (%v / v) and was determined using the formula:

$$\mathbf{PT} = \left(\mathbf{1} - \frac{\mathbf{DA}}{\mathbf{D}}\right) \cdot \mathbf{100}$$

in which: the numerical values of the apparent density were obtained from soil samples taken in metal cylinders with known volume (100 or 200 cm^3), and for the soil density was used the numerical value 2.68 g/cm^3.

Determination of the water content (wi) method of drying in the etuve at 105^0C;

Shrinkage index (IC): Methods of Physical Soil Analysis (2009);

The aeration porosity (PA) was determined using the formula: PA = PT - CC • DA, it is expressed in % by Volume (%v/v).

The saturated hydraulic conductivity (Ksat mm / h) was determined in the laboratory based on the Darcy law on undisturbed soil samples taken in metal cylinders. The standard penetration resistance (RD) was determined in the laboratory, using the dynamic penetrometer, at a soil moisture of 50% of the total water capacity; it is expressed in kgf/cm3.

Permeability for water (ksat mm/ha) by constant water gradient method.

RESULTS AND DISCUSSIONS

In the experimental fields where conventional (classical) and conservative (minimum tillage) agricultural technologies were applied, the results obtained, from the physicochemical point of view:

The texture on the depth of 5-10 cm is medium clay, on the next two depths (25-30 cm and 45-50 cm), it is clay clay, on both experimental fields.

The apparent density (Dawi g/cm^3) on the depth of 5-10 cm, 1.04 g/cm^3 is extremely low and a value of 1.37 g / cm^3 is medium in minimum tillage.

On the next depth 25-30 cm it is medium with a value of 1.39 g/cm^3 and 1.54 g/cm^3 being considered large, and on the last depth (45-50 cm) it is large with values of 1.47 g/cm^3 and 1.58 g/cm^3 in both technologies.

The apparent density was significantly affected by the soil works systems, with the lowest values for the conventional system on the depth of 5-10 cm, and on the depth of 25-30 cm, the highest values being recorded in minimum tillage. This difference is given by the higher clay content. There were no significant differences on the depth of 45-50 cm. The penetration resistance (RP Kgf/cm^2) in the first depth is very small (9 Kgf/cm^2) and at minimum tillage a recorded value of 47 Kgf/cm^2, being medium, and on the next two depths is medium 30 respectively 47 Kgf/cm^2 in both systems of soil works. On the last harvest depth (45-50 cm), the penetration resistance with the value of 47 Kgf/cm^2 is medium in conventional system, and high (71 Kgf/cm^2) in minimum tillage.

Resistance to penetration on 5-10 cm provides normal growth of plant roots in classical and partial limitation in minimum tillage. In the two systems of soil works partial plant growth limitations occur on the last depths due to the clay content.

The shrinkage index (IC) is moderately susceptible (0.0282; 0.0127 and 0.0107) on the three harvesting depths in the experimental field in conventional system and unsusceptible in minimum tillage (0.0070; 0.0088 and 0.0097). The degree of susceptibility of reddish Preluvosol for the two systems of works is moderately susceptible for conventional and unsusceptible for conservative, due to the preservation of plant debris at the soil surface.

The water permeability (ksat mm/h) in conventional is 52.14 mm/h is medium on the first depth, and in minimum tillage it records a value of 6.59 mm / h, being considered very low. On the depths (25-30 cm and 45-50 cm) in conventional are values between 5.37 mm/h – 3.05 mm/h, falling into the very low and excessively low appreciation class. On the same depths in minimum tillage, the appreciation class is excessively small (1.22 mm/h – 2.32 mm/h).

The water permeability on the depth of 5-10 cm has a very good water infiltration rate and on the following depths increases the danger of puddling and water leakage due to the clay content.

The total porosity (% v/v) is excessively high with a value of 60.6% in conventional and 48.2% in minimum tillage at first harvest depth. In the conventional experimental field, the total porosity on the second and third depths (47.7 % - 44.7%) is medium respectively small. In the system minimum tillage is very small (41.8% - 40.4%) on the last two depths.The soil is excessively loose (high aeration) in conventional (5-10 cm), on the same depth in minimum tillage, the soil is strong to moderately loose (moderate aeration). The soil reaction (pH) in conventional on the three harvesting depths is moderately acidic (5.40-5.41) and weakly acidic (6.15) respectively weakly acidic (5.81; 6.08; 6.38) in minimum tillage. Reddish preluvosol is by definition an acidic soil. Humus content (%) in conventional recorded values (1,97%; 1,31%; 0,89 %) and conservative (2,15%; 1,19%; 0,89 %) being considered small, very small and extremely small. The total nitrogen content (Nt %) in both soil works systems is small (0.116% - 0.110%) on the first harvest depth, respectively very small (0,088% - 0,073 / 0,072-0,056%) on the last depths of harvesting soil samples. The low content of humus and total nitrogen in both systems of soil works on the depth of 5-10 cm is due to intensive agricultural technologies for a long time.

The mobile phosphorus content (P_{AL} mg / kg) in the two soil works systems is high (72 mg/kg – 50 mg/kg) on the depth of 5-10 cm. In the conventional system of depths 25-30 cm and 45-50 cm is medium respectively small (30 mg/kg – 18 mg/kg), the minimum tillage is small (9.4 mg/kg – 13 mg/kg) in the last harvesting depths.

The mobile potassium content (K_{AL} mg/kg) is high (219 mg/kg) on the first depth in conventional and middle (152 mg/kg) for minimum tillage. With a small content for the two systems of soil works with values of (72 mg/kg – 66 mg/kg / conventional and 82 mg/kg – 84 mg/kg / minimum tillage) on the depths of 25-30 cm and 45-50 cm. The phosphorus and potassium content of reddish Preluvosol is high on the depth of 5-10 cm in both systems decreasing with depth from middle to low.

The degree of saturation in bases (v %) at reddish Preluvosol falls within the oligomezobasic domain. By definition according to (SRTS, 2012) Preluvosols must have the degree of saturation in bases (V%) above 53%.

CONCLUSIONS

The two soil works systems were placed on the same soil type in the Padina area, having a medium clay texture on the depth of 5-10 cm and clay clay for the depths of 25-30 cm and 45-50 cm.

The apparent density was significantly affected by the soil works systems, with the lowest values for the conventional system on the depth of 5-10 cm, and on the depth of 25-30 cm, the highest values being recorded in minimum tillage. This difference is given by the higher clay content.

The water permeability on the depth of 5-10 cm has a very good water infiltration rate and on the following depths increases the danger of puddling and water leakage due to the clay content.

Resistance to penetration on 5-10 cm provides normal growth of plant roots in classical and partial limitation in minimum tillage. In the two systems of soil works partial plant growth limitations occur on the last depths due to the clay content.

The degree of susceptibility of reddish Preluvosol for the two systems of works is moderately susceptible for conventional and unsusceptible for conservative, due to the preservation of plant debris at the soil surface.

Considering, the first year of experimentation of the two systems of soil works, we can draw a first conclusion, that due to the clay/clay loam texture, which is defining for the implementation of the conservative system (minimum tillage), this is a limiting factor.

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