THE EFFECT OF DIFFERENT SOIL TILLAGE CONSERVATIVE SYSTEMS ON SOIL PHYSICAL CHARACTERISTICS

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In the context of the present intensive agriculture, the optimization of farming procedures require the implementation of new strategies that allow the most effective use of lands and also the reduction of gas emissions into the atmosphere, in order to reduce the negative impact of the soil tillage system on the environment [9, 4, 1).The energetic impact of annual cultures on the environment may be reduced by a rational rotation and minimal soil tillage system [1, 9]. The study was carried out from August 2007 to August 2008 in on experimental field belonging to the Department of Soil Management, and initiated in the Student Research Station Ezareni of the University of Agricultural Sciences and Veterinary Medicine of Iasi – Experimental Farm. In this paper are evaluated the effects of tillage systems on soil physical properties.

***Key words**: soil tillage, physical properties, winter wheat*

Besides direct effects, soil tillage is responsible for long term residual effects induces into soil, which act on its physical and physic-mechanical characteristics, by modifying them [7].

No-tillage systems (NT) are becoming increasingly attractive to farmers because they clearly reduce production costs and because they provide feasible soil management with fewer disturbances to soil agroecosystems comparing to conventional tillage systems (CT).

Some researchers [10, 6] observed no significant effect of tillage methods (no-tillage and plow till) on bulk density (BD) and total porosity, but [5] found that CT increased the total porosity of soil, but the macropores (effective pores) decreased in number, stability and continuity compared with no-till soil. This discrepancy could be due to the differences in crop species, soil properties, climatic characteristics and their complex interactions [12].

MATERIAL AND METHOD

The experiments were carried out at the Didactic Station of the „Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine of Iasi, Ezareni Farm, during farming year 2007-2008.

The experimental site is located on a chambic chernozem (SRTS-2003, or haplic chernozems after WRB-SR, 1998), with a clay-loamy texture, 6.8 pH units, 3.7 % humus content and a medium level of fertilization. The soil has high clay content (38-43%) and is difficult to till when soil moisture is close to the wilting point (12.2%). The experimental site has an annual average temperature of 9.40ºC and precipitation of 587 mm.

The experimental design was a “divided plots design” with three replications.

The experiment is of multiple factor type (A x B x C) where Factor A – soil tillage system, Factor B – crop rotation and Factor C – fertilization system.

Factor A. Tillage systems

a_1 - conventional tillage system (CTS) (plowing at 20 cm depth, followed by a single pass of the mixing machine)

a_2 – minimal tillage system (MTS) (soil loosening without turning the furrow with the chisel, followed by a single pass of a complex aggregate formed by a rotary harrow with vertical rotors, field roller and field cultivators with disks and settling wheel)

a_3 – no-tillage system (NTS) (direct cultivation on the stubble field with a complex aggregate)

Factor B. Cultivated plant

a_1 – rape

a_2 – winter wheat

Factor C. Fertilization system

a_1 – chemical fertilization

Rape	Winter Wheat
V_1 – non-fertilized	V_1 – non-fertilized
V_2 - $N_{64}P_{50}K_{40}$	V_2 - $N_{32}P_{32}$
V_3 - $N_{96}P_{80}K_{60}$	V_3 - $N_{64}P_{64}$

a_2 – organic fertilization

Rape	Winter Wheat
V_1 – non-fertilized	V_1 – non-fertilized
V_2 – 20 t/ha	V_2 – 20 t/ha
V_3 – 30 t/ha	V_3 – 30 t/ha

a_3 – organic and chemical fertilization

Rape	Winter Wheat
V_1 – non-fertilized	V_1 – non-fertilized
V_2 – 20 t/ha + $N_{96}P_{80}K_{60}$	V_2 – 20t/ha + $N_{96}P_{96}$
V_3 – 30 t/ha + $N_{64}P_{50}K_{40}$	V_3 – 30 t/ha + $N_{64}P_{64}$

This paper presents the results obtained in rape growing as concerns the influence of the tillage method on some soil physical characteristics. Soil samples were taken from the fields just after the sowing, during the vegetation season and right after the harvesting, in order to determine soil bulk density (BD) and total porosity (TP).

Soil bulk density (BD) was determined on an oven-dry basis by the core method. We have also calculated degree of total porosity (TP) and efficient porosity (EP) [13] as the ratio of bulk density and particle density.

Determinations were carried out at three depths (0-10, 10-20 and 20-30 cm). Statistical processing of data was done by means of the analysis of variance.

RESULTS AND DISCUSSIONS

The dynamics of soil physical properties such as bulk density or total porosity, and other porosity classes (inactive porosity, aeration porosity, and useful porosity) and the way they are influenced by tillage systems are related in this paper. Soil bulk density is probably the most frequently measured soil quality parameter in tillage experiments [12].

Bulk density is inversely related to soil porosity and is an indicator of the capacity for air and water transport in the soil. Excessive bulk density increases penetration resistance, reduces aeration and may limit root growth. One of the goals of tillage is to alleviate soil compaction by reducing bulk density.

At sowing (layer 0-10 cm), they were between 1.17 g/cm^3 (NT) and 1.22 g/cm^3 (RT) (Tab. 1). In all tillage systems, BD increased with the degree of depth (in layer 10-20, reaching values comprised between 1.21 g/cm^3 (CT) and 1.28 g/cm^3 (NT and RT), and in layer 20-30 cm minimum values being registered in the case of NT (1.33 g/cm^3), followed by values registered in the case of CT and RT.

During the vegetation period, the BD has increased in all three variants and at all depths (Fig. 1). In CT the situation was interesting, BD increased much that on RT and RT, special of 10-20 cm (1.31 g/cm^3) (*fig. 1*).

At harvesting, the BD have the lowest mean values at the variants NT (1.36 g/cm^3) and plough at 20 cm (1.37 g/cm^3), followed by the variant RT (1.40 g/cm^3) (tab. 1).

Our results are in good agreement with those of [5] and [10] who reported that bulk density of soil under CT was, at the beginning, lower than NT in 0–75 cm depth, and inversely after the harvesting.

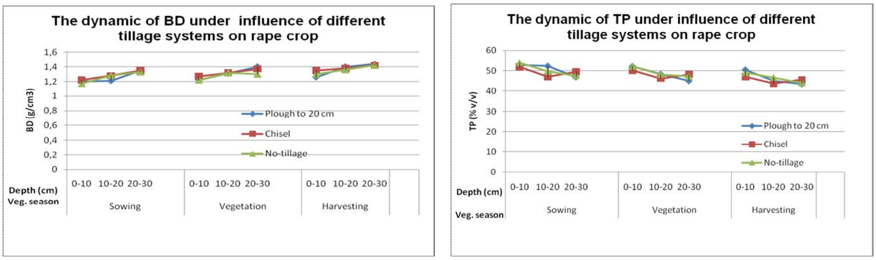

Figure 1 **The dynamic of BD and TP under influence of different tillage systems on rape crop**

In NT, soil bulk density in the 0–10 cm depth was lower than CT and RT, probably because of combined influence of greater wheel traffic, decrease in OC concentration and reduction in soil aggregation. Our results are in agreement with [11] researches. In contrast, our results are not in agreement with the findings of [8].

The values of total porosity (TP) decrease from sowing to harvesting in all three tillage systems variants. Also, the values of total porosity decrease with the depth, in CT and NT systems, but in RT the lowest value for this indicator was in the 10-20 cm depth (Fig. 1). Also, there was a trend for total porosity to be slightly more in NT for 0–10 cm depth.

Table 1

Influence of tillage systems on some soil physical properties

Soil tillage system	Veg. season	Depht (cm)	BD ($g \cdot cm^{-3}$)	TP (% $v \cdot v^{-1}$)
Plough to 20 cm	Sowing	0-10	1,20	52,76
		10-20	1,21	52,23
		20-30	1,35	$46,85^{o}$
		Mean value	1,25	50,61
	Vegetation	0-10	1,22	52,10
		10-20	1,31	$48,29^{ooo}$
		20-30	1,40	45,01
		Mean value	1,31	48,47
	Harvesting	0-10	1,26	50,39
		10-20	1,40	44,88
		20-30	1,44	$43,44^{ooo}$
		Mean value	1,37	46,24
Mean value			1,31	48,44
Chisel	Sowing	0-10	1,22	51,84
		10-20	1,35	49,48
		20-30	1,28	$46,98^{o}$
		Mean value	1,28	49,43
	Vegetation	0-10	1,27	$50,00^{o}$
		10-20	1,37	48,16
		20-30	1,32	$46,19^{oo}$
		Mean value	1,32	48,12
	Harvesting	0-10	1,35	46,98
		10-20	1,43	$45,54^{ooo}$
		20-30	1,38	$43,57^{ooo}$
		Mean value	1,39	45,36
Mean value			1,33	47,64
No-tillage	Sowing	0-10	1,17	53,94
		10-20	1,28	49,61
		20-30	1,33	47,51
		Mean value	1,26	37,02
	Vegetation	0-10	1,22	52,10
		10-20	1,32	48,16
		20-30	1,30	47,11
		Mean value	1,28	49,12
	Harvesting	0-10	1,30	48,95
		10-20	1,36	$46,59^{o}$
		20-30	1,42	43,96
		Mean value	1,36	46,50
Mean value			1,31	48,66

Control variant (C.V.) – mean value for all variants

$LSD_{5\%}$ = 0,3 $g \cdot cm^{-3}$ $LSD_{5\%}$ = 1,3 % $v \cdot v^{-1}$

$LSD_{1\%}$ = 0,4 $g \cdot cm^{-3}$ $LSD_{1\%}$ = 1,7 % $v \cdot v^{-1}$

$LSD_{0,1\%}$ = 0,5 $g \cdot cm^{-3}$ $LSD_{0,1\%}$ = 2,3 % $v \cdot v^{-1}$

CONCLUSIONS

In this study the effects of those three soil tillage systems on the physical properties were evaluated. Soil management practices determined significantly changes on the basic soil properties. We conclude that the effect of till with chisel, compared to CT or NT, was more pronounced with changes in bulk density. The NT system resulted in lower bulk density and higher total porosity than CT, special for 0-10 cm depth. Lower bulk density and higher total porosity in NT for 0-10 cm depth was attributed to the increase in the OC concentration. Bulk density and porosity showed significantly negative correlations.

In the scope of the increasing concern for soil conservation, RT agriculture is growing more important in today´s agriculture in Western Europe although the crop rotations are somewhat particular because of the large share o erosion sensitive root crops.

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