THE MODIFICATION OF MACROSTRUCTURAL HYDROSTABILITY DEGREE CAUSED BY DIFFERENT TILLAGE SYSTEMS AT WINTER WHEAT

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Several management systems can improve soil productivity. By studying aggregate stability it is possible to quantify whether or not the management is ameliorating the natural soil properties and the land capability for agriculture. Knowing the soil structure, as an essential element of soil fertility, has a great importance because it influences not only the physical conditions aeration and food regime but also the accessibility of nutrient for plant, degradation of organically material in soil and microbiological activity.

The experience was carried out in the East of Romania, in the Experimental Farm of Agricultural University of Iaşi (47°07` N, 27°30` E), on a chambic chernozem with a clay-loamy texture and 3,4% humus, during 2006-2007.The experiment was in a "divided plots design" with three replications. Plots were 60 m^2 surface, seeded with winter wheat, in a rotation soy-bean, winter wheat, maize. Each set of plots received yearly the following treatments:

Tillage systems - conventional, ploughed at 20 and 30 cm and, unconventional: disk harrow, chisel + rotary harrow, paraplow.

Fertilizers - with two levels: $N_{80}P_{80}$ and unfertilized.

The samples for soil stability analysis were taken on the depth of 0-10 cm, 10-20 cm and 20-30 cm, at seeding, on vegetations stages and at the harvesting time, air dried, gently crushed and sieved with a RETSCH AS300 sieving machine to obtain aggregates of 1-2 mm diameter. A modification of the wet-sieving method of Kemper and Rosenau (1986) was used to determine the stability of the air-dried soil aggregates in water. Four grams of 1-mm to 2-mm air-dried aggregates were placed in a 0.25 mesh/cm basket and placed in a wet sieving instrument.

The macrostructural hydrostability degree it is evaluated in percents of stabile aggregates bigger then 0.25 mm diameter, from the total mass of soil analyzed. This study on the effect of different tillage practices over a period of 1 year on the clay-loamy soil of Moldovian Plateau - Romania, shows that it resulted in changes of macrostructural hydrostability degree. According to the interpretation scale, only the Disk harrow variant had a hydric stability degree that characterize a soil "partially structured" (<78%); all other 4 variants had the velleity to surpass the 80% limit, being considered as a resistant soil to erosion process with a good aero-hydric regime; the tendency of the macrostructural hydrostability indicator was to grow from seeding to harvesting period.

Keywords*: tillage, soil structure, water stability.*

Several management systems can improve soil productivity. By studying aggregate stability it is possible to quantify whether or not the management is ameliorating the natural soil properties and the land capability for agriculture.

Knowing the soil structure, as an essential element of soil fertility, has a great importance [5] because it influences not only the physical conditions aeration and food regime but also the accessibility of nutrient for plant, degradation of organically material in soil and microbiological activity [12].

Soil structure and aggregation are strongly influenced by processes such as tillage, cropping system, and climate [14, 2, 3, 6, 7]. Soil structure is hard to characterize because it fluctuates in time and space [13]. Factor affecting aggregate stability can be grouped as abiotic (clay minerals, sesquioxides, exchangeable cations), biotic (soil organic matter, activities of plant roots, soil fauna, and microorganisms), and environmental (soil temperature and moisture) [11].

Determination of the state of soil aggregation and the stability of soil aggregates has been performed using various indices, but no universal prescription could be offered on which of these alternative indices is preferred [16].

Several methods have been proposed to determine soil aggregate size distribution and stability [10]. The suitability of these methods depends on the purpose of the study. The most widely used approaches are based on the wet-sieving method [9, 10].

MATERIAL AND METHODS

The experience was carried out in the East of Romania, in the Experimental Farm of Agricultural University of Iaşi (47°07` N, 27°30` E), on a chambic chernozeom with a clay-loamy texture and 3,4% humus, during 2006-2007.

The purpose of this study was to evaluate the influence of the conventional and unconventional tillage systems on the macrostructural hydrostability degree in the areal of Moldovian Plateau.

The experiment was in a “divided plots design” with three replications. Plots were 60 m^2 surface, seeded with winter wheat, in a rotation soy-bean, winter wheat, maize. Each set of plots received yearly the following treatments:

- Tillage systems: - conventional, ploughed at 20 and 30 cm
  - unconventional: disk harrow, chisel + rotary harrow, paraplow.
- Fertilizers - with two levels: $N_{80}P_{80}$ and unfertilized.

All other agronomic practices were kept as normal and uniform for all treatments.

The samples for soil stability analysis were taken on the depth of 0-10 cm, 10-20 cm and 20-30 cm, at seeding, on vegetations stages and at the harvesting time, air dried, gently crushed and sieved with a RETSCH AS300 sieving machine to obtain aggregates of 1-2 mm diameter. A modification of the wet-sieving method of Kemper and Rosenau (1986) was used to determine the stability of the air-dried soil aggregates in water. Four grams of 1-mm to 2-mm air-dried aggregates were placed in a 0.25 mesh/cm basket and placed in a wet sieving instrument (EIJKELKAMP- Wet Sieving Apparatus). Aggregates were dunked (1.3 cm, 35 times/min) in a can of distilled water for 3 minutes. After that the cans were placed in a drying oven at 105° C until the water

evaporated. The soil cans with unstable soil were then weighed. Aggregates of 1-2 mm are considered to be the most effective in reducing evaporation.

The ANOVA procedure was used to evaluate the significance and the treatment means were separated by the least significance difference (LSD) test.

RESULTS AND DISCUSSIONS

The macrostructural hydrostability degree it is evaluated in percents of stabile aggregates bigger then 0.25 mm diameter, from the total mass of soil analyzed. The evaluation of soil structure and the interpretation it is done following the further scale [7]:

>98% - very well structured	Soils that are resistant to erosion process with
78-98 % - well structured	a good aero-hydric regime.
50-78% - partially structured	Soils with a weak resistance to erosion process
39-50% - weak structured	and with viciously aero-hydric regime; are
<39% - very weak structured	necessary preventive actions for restructuring.

The macrostructural hydrostability degree for all five tillage treatments showed an increasing trend from sowing to harvesting period (*tab. 1*). Thus, at the sowing time, we had the biggest average value at the Chiesel + rotary harrow variant (77.08%) and the smallest one at Disk harrow treatment (69.44%), a normal value as a matter a fact. At the same period on the layer 0-10 cm the variant Plough - 30 cm had the biggest value, by reason of bringing the stable aggregates from 30 cm depth simultaneously with tillage operation. On the next two layers 10-20, 20-30 cm the values had the tendency easily to decrease. Contrary, at the Disk harrow variant the tendency is to increase from 71.43% at 0-10 cm layer at 80.10% on 20-30 cm layer at the growing period, and from 72.30% to 84.80% at harvesting.

Tabel 1

The evolution of macrostructural hydrostability degree (%) at winter wheat (2006-2007)

No.	Variant		Sowing 2006	Growing period 2007	Harvesting 2007
1	Disk harrow	0 - 10 cm	69.58	71.43	72.30
2		10 - 20 cm	63.92	70.45	75.50
3		20 - 30 cm	74.83	80.10	84.80
Average			**69.44**	**73.99**	**77.53**
	Paraplow	0 - 10 cm	75.42	79.90	85.10
5		10 - 20 cm	71.58	74.50	77.90
6		20 - 30 cm	74.92	81.67	85.60
Average			**73.97**	**78.69**	**82.89**
7	Chisel + rotary harrow	0 - 10 cm	79.92	82.67	85.40
8		10 - 20 cm	76.25	78.39	81.60
9		20 - 30 cm	75.08	77.45	80.91
Average			**77.08**	**79.50**	**82.64**
10	Plough 20 cm	0 - 10 cm	71.50	76.90	86.32
11		10 - 20 cm	72.17	73.68	76.34
12		20 - 30 cm	77.50	79.67	80.61
Average			**73.72**	**76.75**	**81.08**

No.	Variant		Sowing 2006	Growing period 2007	Harvesting 2007
13	Plough 30 cm	0 - 10 cm	77.50	79.83	80.59
14		10 - 20 cm	71.92	75.67	82.82
15		20 - 30 cm	73.58	75.80	77.65
Average			**74.33**	**77.10**	**80.35**

The stability of fine aggregates depends on the amount and the stability of organic cementing agents [1] point out that aggregates of >0.25 mm were 60% greater in no tillage than in conventional tillage at a depth of 0-5 cm, but showed no difference at a depth of 12.5-20 cm. However, the effect of tillage system on macrostructural hydrostability degree reveal a negative statistically significant difference at the Disk harrow variant compared with control treatment.

Table 2

Macrostructural hydrostability degree (%) at winter wheat (2006-2007) - averages values on treatment, depth and growing levels

Treatment	Macrostructural hydrostability degree - average (%)	Comparison with control variant (%)	Differences with control variant (%)	Significations
Chisel	79.7	103.10	2.4	**xx**
Paraplow	78.5	101.55	1.2	
Plough 30 cm	77.3	100.00	0.0	
Average	**77.3**	**100.00**	-	Control variant
Plough 20 cm	77.2	99.87	- 0.1	
Disk harrow	73.7	95.34	-3.6	**ooo**

(The control variant it is the average value of the indicator for all five treatments)

LSD 5%= 1.4% LSD 1%= 2.1% LSD 0.1%= 3.1%

Also, the Chisel variant is statistically insured, being with 2.4% bigger than control treatment (*tab. 2*).

CONCLUSIONS

This study on the effect of different tillage practices over a period of 1 year on the clay-loamy soil of Moldovian Plateau - Romania, shows that it resulted in changes of macrostructural hydrostability degree.

- According to the interpretation scale, only the Disk harrow variant had a hydric stability degree that characterize a soil "partially structured" (<78%);
- All other 4 variants had the velleity to surpass the 80% limit, being considered as a resistant soil to erosion process with a good aero-hydric regime;
- The tendency of the macrostructural hydrostability indicator was to grow from seeding to harvesting period.

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