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THE INFLUENCE OF TILLAGE SYSTEMS ON HYDRIC STABILITY OF STRUCTURAL AGGREGATES, IN WINTER WHEAT CROP DURING 2006-2007

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Abstract

The experience was carried out in the Eastern part of Romania, in the Didactic Station of the USAMV Iasi, Ezareni Farm, during 2006-2007, on a cambic chernozem with a clay loamy texture, 7 pH units and 2.7% humus content, middle provided in N and P_2O_5 and agreeably in K_2O. The purpose of this review was to evaluate the influence of tillage systems on soil structure. Tillage systems modify some of the structure proprieties of soil such as aggregate stability and size distribution.

Morphologically, the structure according with the genetic of the soil, is different from a level to another, significant difference appear in arable layer as consequence of tillage applied. Structural stability indices are empirical and comparisons among treatments, soil properties, and/or processes have significance only when similar procedure are used.

INTRODUCTION

An agricultural soil with poor quality, may not possess all of the attributes required for good agricultural production, or it may be prone to environmental degradation [9]. Due to the extreme complexity of the soil environment, agricultural soil quality is often segmented into soil physical quality, soil chemical quality, soil biological quality, these components interacting. Numerous researchers [1, 2, 5, 6, 7, 8] notice the favourable function of tillage systems in increasing soil fertility (increasing the humus content). Soil physical quality is important for the entire crop rooting zone which is approximately the top 1m of the soil profile. The top 10 cm of soil is particulary important because it controls many critical agronomic and environmental processes such as seed germination, aggregation tillage impacts, surface crusting, aeration, infiltration [4].

MATERIAL AND METHODS

The experience was carried out in the East part of Romania, in the Didactic Station of the USAMV Iasi, Ezareni Farm, during 2006-2007, on a cambic chernozem with a clay loamy texture, 7 pH units and 2.7% humus content, middle provided in N and P_2O_5 and agreeably in K_2O. Experiments were set up in split plots design, AxBxC type, and plots covered surface was 18 m^2. Factor A - is indicated by the tillage system, factor B - cultivated plant and factor C - chemical fertilizer dose. Conventional tillage system was ploughed at 30 cm and unconventional tillage systems were: disk harrow, chisel and paraplow.

Tillage systems:

-Conventional: V_1-plough

-Unconventional: V_2-paraplow+vertical rotary harrow (VRH)

V_3-paraplow+horizontal rotary harrow (HRH)

V_4-chisel

V_5-disk harrow

The preparation of seedbed was effectuated with shallow tillage; ploughed at 30 cm treatment received one pass with seedbed cultivator Lemmkeen; paraplow treatment received one pass with vertical rotary harrow; paraplow and chisel treatment received one pass with horizontal rotary harrow and for disk harrow treatment we have used Lemmkeen cultivator. The samples were collected from 0-10 cm, 10-20 cm and 20-30 cm depth, for distribution and stability of macrostructural, the procedure of Tiulin- Erikson was used.

RESULTS AND DISCUSSION

The influence of tillage systems on hydric stability of structural aggregates

Following the variation of different categories of hydrostabil aggregates, we observed that the percentage of aggregate with diameter between 1-5 mm is smaller at the surface and becomes bigger in the layer 0-30 cm, while the percentage of aggregate with diameter between 1-0.5 cm and between 0.5-0.25 cm is smaller.

From emergence to harvesting is certifiable an increment in percentage of aggregate with diameter higher than 5 mm and between 1-5 mm and a diminution of aggregates with diameter between 1-0.5 mm and between 0.5-0.25 mm. In chisel treatment are dominant the aggregate with diameter between 1-5 mm and >5 mm, in entire soil profile (40.7%) and in each growing stage (63.7%).

Contrary is disk harrow treatment where the percentage of 1-5 mm ranged from 17.4% to 44.4%. The uses of rotary harrow treatment in seedbed preparation lead the aggregate diameter smaller than 1.00 mm forming the hydrosolubil aggregate. In unconventional tillage system, in 0-10 cm depth, the percentage of aggregate <1mm is higher compared with the conventional variant (9.6%). On vegetation stage in all three depths the values of hydric stability are recording increments in all of the tillage system. At harvesting in disk harrow treatment only the aggregate with diameter between 1-5 mm (44.4%) are modified. In 20-30 cm layer from emergence to harvesting the proportion is favourable for aggregate with 1-5 mm size.

In plough treatment at 30 cm depth, the aggregate with diameter between 0.25-0.5 mm and 0.5-1 mm are present in a higher percentage than in other variants. With the increments in depth (20-30 cm layer) the paraplow (68.9-68.3%) and chisel variant oversie the value of plough variant (65.1%).

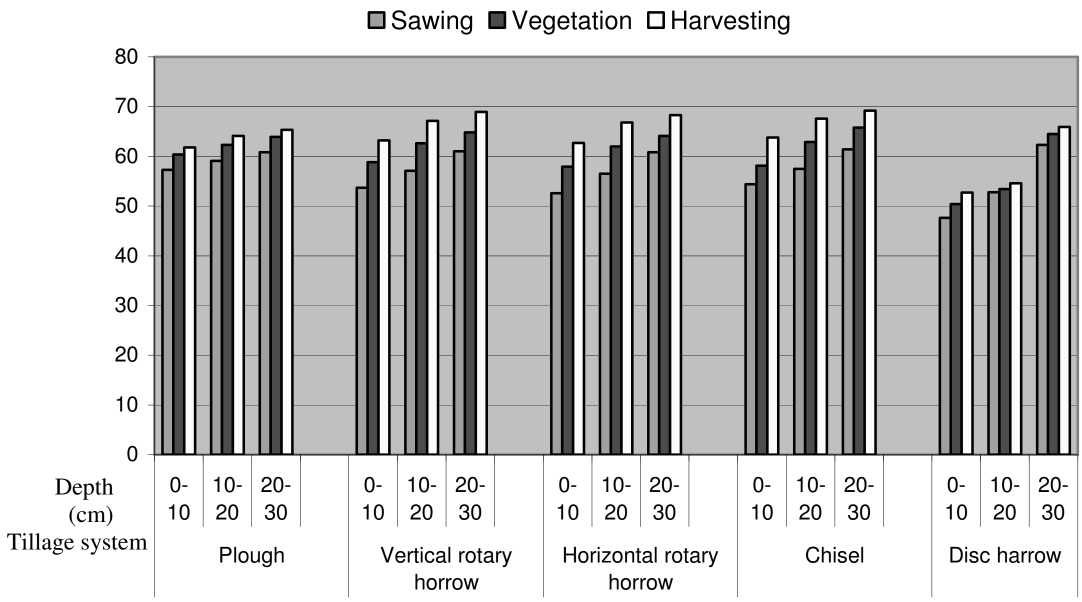

Fig. 1. Hydric stability of structurale aggregates in winter wheat crop during 2006-2007

The hydric stability of structural aggregates in all vegetation stages or tillage variants are increasing with depths. In 0-10 cm layer the values were 47.6-57.3% at emergence, 50.4-59.4% on vegetation and 52.7-63.8% at harvesting. The same phenomena has been observed on 10-20 cm layer where the values of hydric stability are increasing from 52.8 to 59.1% at emergence and from 54.6 to 67.6% at harvesting. On 20-30 cm depth the values were smaller, between 60.8-62.3% at emergence and between 65.3-69.2% at harvesting. In superficial layer 0-10 cm, the structure suffer an pronounced degradation by reason of mechanical action, in preparing the seedbed by direct and negative influence of rain and environmental factors. All these effects are attenuating with the depth.

Table 1

The influence of tillage systems on hydric stability of structurale aggregates in winter wheat crop (%)

Depth (cm)	Tillage	Growing stage											
		Emergence				Vegetation				Harvesting			
		>5	5-1	1-0.25	Total	>5	5-1	1-0.25	Total	>5	5-1	1-0.25	Total
0-10	Plough	9.9	34.8	12.6	57.3	10.3	35.7	13.4	59.4	13.1	37.3	11.4	61.8
	Paraplow +F.v	11.3	28.2	14.2	53.7	12.5	32.4	13.9	58.8	15.9	35.8	11.5	63.2
	Paraplow +F.o	11.3	27.1	14.2	52.6	15.2	28.1	14.6	57.9	16.7	35.9	10.1	62.7
	Chisel l	12.3	28.4	13.7	54.4	16.7	28.9	12.5	58.1	18.7	34.1	11	63.8
	Disk	2.7	17.4	27.5	47.6	5.9	24.4	20.1	50.4	6.2	29.2	17.3	52.7
10-20	Plough	13.4	35.3	10.4	59.1	14.9	38.4	9	62.3	15.2	39.9	9	64.1
	Paraplow +F.v	13.1	33.3	10.7	57.1	15.5	38.7	8.4	62.6	19.7	40.1	7.3	67.1
	Paraplow +F.o	12.8	32.5	11.2	56.5	16.4	38.1	7.6	62.1	18.8	40.8	7.2	66.8
	Chisel	13.8	29.3	14.4	57.5	17.9	39.3	5.7	62.9	20.3	41.4	5.9	67.6
	Disk	3.1	25.9	23.8	52.8	6.7	27.6	19.1	53.4	9.5	33.1	12	54.6
20-30	Plought	13.9	36.3	10.6	60.8	16.3	39.3	8.3	63.9	19.8	40.1	5.4	65.3
	Paraplow +F.v	17.4	35.8	7.9	61.1	17.4	41.4	6	64.8	20.4	43.8	4.7	68.9
	Paraplow +F.o	17.9	34.9	8	60.8	18.1	41.7	4.3	64.1	20.3	42.3	5.7	68.3
	Chisel	18.5	33.1	9.8	61.4	18.6	43.9	3.3	65.8	21.3	42.4	5.5	69.2
	Disk	17.3	39.2	5.8	62.3	17.2	44.8	2.5	64.5	19.2	44.4	2.3	65.9

Table 2

Hydric stability in winter wheat crop - average values on treatment, depth and growing stages

Treatment	Hydric stability		Differences (%)	Statistical signification
	Percentage (%)	% comparasion with control variant		
Chisel	62.2	100.97	0.6	
Paraplow + VRH	61.9	100.49	0.3	
Plought 30 cm	61.6	100.00	0.0	Control variant
Paraplow + HRH	61.3	99.51	-0.3	
Disk harrow	56.0	90.91	-5.6	oo
$LSD_{5\%}$ = 2.6 %	$LSD_{1\%}$ = 3.8%	$LSD_{0.1\%}$ = 5.7%		

It was demostrated a season variation in all depths, the values of hydric stability becaming bigger from emergence to harvest, in all tillage systems. In plough treatment (0-10 cm) the values of hydric stability are smallest 61.8% comparated with paraplow treatment (62.7-63.2%) and chisel treatment (63.8%). At this depth the disk harrow treatment has the smallest value 52.7%. The effect of tillage system on hydric stability (table 2), reveal a negative statistically significant difference at disk harrow variant compared with control, where the values are statistically assured, there are also differences between V_4 and V_2 compared with V_1 where the values are statistically unassured.

CONCLUSIONS

1. Variants vertical and horizontal rotary harrow produce a degradation of soil structure on 0-10 cm depth, where the percentage of aggregate is 14.2%.
2. In chisel variant the values of hydric stability 69.2% are aproximately equaly with the paraplow variant 68.3-68.9% and higher than plough 65.3% and disk harrow variant 65.9%.
3. The tillage system has influence on the quality of soil structure by the changes in hydric stability of structural aggregates, indifferent of growing stage and profile depth.
4. Untill harvesting, the hydric stability increased in all the depths, with a maximum in 20-30 cm layer in chisel variant, followed by paraplow variant.

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