THE INFLUENCE OF DIFFERENT CONVENTIONAL AND CONSERVATIVE TILLAGE SYSTEMS ON QUALITATIVE INDICATORS OF THE SEEDBED FOR WINTER OIL SEED RAPE

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Abstract

Rapeseed crop has a very important role in world economy, being the third largest source of vegetable oil after palm and soybeans. It is very sensitive to soil compaction, because root growth, water and nutrient absorption are achieved with difficulty. The seedbed preparation ensures the lumps shredding, weed control, land leveling, introduction of fertilizers in soil and, essentially, creating a layer of loose soil, favorable for seed germination. The last tillage done before sowing has direct effects on the quality and quantity of the yield. The tillage activities by their nature must modify soil properties towards biological plant requirements without damaging its physical condition. The qualitative indices determined for the seedbed preparation are average depth of soil mobilization (D_a), soil crumbling degree (D_{sc}), soil loosening degree (D_{sl}), soil leveling degree (D_{ls}) and weed control degree (D_{wc}). The paper present the effect of soil tillage on seedbed qualitative indices for the rapeseed crop. The experiments were carried out at the Research and Development Agricultural Station, Secuieni, Neamt County, between 2012 and 2014. The results show that different tillage systems influenced the quality of the seedbed, with higher values for the conventional Plough+Combigerm variant and lower for the minimum tillage one, Disc+Vibromix.

Key words: soil, seedbed, tillage, qualitative indices

Rapeseed crop has a very important role in world economy, being the third largest source of vegetable oil after palm and soybeans. It is very sensitive to soil compaction, because root growth, water and nutrient absorption are achieved with difficulty (Chiriac *et al*., 2013).

The tillage activities by their nature must modify soil properties towards biological plant requirements without damaging its physical statement (Jităreanu *et al*., 2008). The qualitative indices of the equipment used for the seedbed preparation include both indexes of the technological process and compliance of the agrobiological requirements of the plants (Meca *et al.*, 2010).

Soil tillage aim to achieve a loose layer in which the plants are able to find optimal conditions for growth and development. In a loose soil the roots develop more and can penetrate more easily, especially in the early stages of vegetation. It is necessary that the seedbed preparation to have good quality, because it's the las tillage done before sowing and the potential quality deviations cannot be corrected by other works (Farcaş, 2001; Şandru, 2002). *The qualitative indices of the soil tillage* represent a complex of characteristics measurable or determinable using measuring equipment, which can characterize a work process. The qualitative indices of the seedbed preparation characterize the degree of agronomical requirements which are satisfied at the moment of sowing (Constantinescu, 2010). For seedbed preparation, the main qualitative indices are: *average depth of soil mobilization (D_a), soil crumbling degree (D_{sc}), soil loosening degree (D_{sl}), soil leveling degree (D_{ls}) and weed control degree (D_{wc}).*

MATERIAL AND METHOD

This paper presents the effect of soil tillage on the qualitative indices of the seedbed for the rapeseed crop. The experiments were carried out between 2012-2014, at the Research and Development Agricultural Station, Secuieni, Neamt County. The terrain of the experience has a slope of 10-12 %, the soil was a cambic chernozem (Cz cb), with low acid pH of 6.29, humus content of 2.55-3.1 %, medium content of N and high stock of P_2O_5 and K_2O. The experimental design had 84 harvest plots, 21 for each crop (wheat, rapeseed, maize and soybean). The total experimental area was 20280m^2. The experience was placed by the method of "subdivided plots", in three repetitions, with two factors, AxB type. Within the experimental factor A, it was considered the basic tillage (BT) and the seedbed preparation (SBP). The tillage variants were: Plow+Combigerm, Plow+Vibromix (CV), heavy

harrow disc (HDH) 3.85+Vibromix, heavy harrow disc (HDH) 3.85 + vertical rotary harrow (VRH), Chisel + Vibromix, Chisel + vertical rotary harrow (VRH) and Scarificator + Venta. The experimental factor B was represented by the cultivated plant: winter wheat, winter oilseed rape, maize and soybean.

Regarding the climatic conditions, the agricultural year 2012-2013 was a warm one, with an annual average of 9.1 ^{o}C, above the normal of 8.7 ^{o}C. The dry summer of 2012 caused great problems for the shredding of the previous crop residues. Obtaining an optimal seedbed for sowing rapeseed was difficult to achieve, taking into account that the temperature deviation for September was +3^{0}C and for October and November +1.7 ^{0}C, compared to the multiannual average. Regarding the rainfall, the autumn of 2012 started with a deficit, with -11.4 mm deviation for September and -12.3 mm for October. In those circumstances, the basic tillage was carried out late, in hard conditions.

In 2013-2014, regarding the precipitations, October was very dry, the deviation from normal being -20.4 mm, and November was rainy, with a deviation of +10.7 mm.

RESULTS AND DISCUSSIONS

a). Average depth of soil mobilization of the equipment used for soil tillage (D_a)

Rapeseed is incorporated into the soil at 2-3 cm depth, and the seedbed must be very well prepared, without plant debris or weeds. If this activity is carried out in unfavorable conditions, such a too loose and uneven ground, it is recommended that the drill coulters to be adjusted so the seeds get at the same depth in the superficial soil layer.

The data regarding the average depth of soil mobilization for the equipment used for seedbed preparation, for the two experimental years are presented in (*table 1*).

All the variants under unconventional tillage had D_a values below the control, the differences being very significant and distinctly significant.

Table 1

Average depth of soil mobilization of the equipment used for seedbed preparation for the rapeseed crop (2012-2014)

Variant	D_a (cm)				Significance
	2012-2013	2013-2014	Average	%	
Plow + Combigerm	3.34	4.23	4.09	103.70	
Plow + Vibromix	3.18	4.12	3.65	100.00	control
HDH 3.85+ Vibromix	1.23	2.46	1.85	50.55	ooo
HDH 3.85 + VRH	1.49	2.84	2.17	59.32	ooo
CHISEL + Vibromix	1.87	2.98	2.43	66.44	ooo
CHISEL + VRH	2.20	3.25	2.73	74.66	ooo
Scarificator + Venta	2.62	3.76	3.19	87.40	oo
		DL5%	0.28		
		DL1%	0.42		
		DL0.1%	0.67		

Maximum working depth (4.09 cm) was recorded for the complex equipment Combigerm, with basic tillage made with the reversible plow at 30 cm depth. The difference compared to the control for this variant was positive, but statistically unassured.

The unevenness of the equipment working depth for this crop is justified by the high influence of the basic tillage, the unevenness of the ground and its slope.

In order to ensure a good germination and plant emergence, it was done a work with rollers, both before and after sowing.

b). Soil crumbling degree (D_{sc})

Table 2 present as percentage the values of the soil crumbling degree, for the rapeseed crop, in the two experimental years, the average values and the statistical analysis resulted from the study regarding the influence of the equipment used for seedbed preparation on soil crumbling degree compared to the control.

It is noticed that the variant which was plough and then prepared using the Combigerm complex equipment, recorded the highest values of the D_{cs}, both in every experimental year and also as average (85.96 %), showing a positive, significant difference compared to the control variant.

The lowest values were recorded for the variants where was used the HDH 3.85 and chisel + Vibromix, being distinctly significant and significant.

c). Soil loosening degree (D_{sl})

The values as percentage of the soil loosening degree in the experimental years, for the rapeseed crop, are presented in *table 3*.

Negative, distinctly significant differences were recorded for the HDH 3.85+VRH and chisel+VRH compared to control - plow+Vibromix. The other experimental variants had D_{sl} values very close to control, statistically unassured.

Table 2

Influence of the equipment used for seedbed preparation on the crumbling soil degree for the rapeseed crop (2012-2014)

Variant	Dcs %				Significance
	2012-2013	2013-2014	Average	%	
Plow + Combigerm	83.73	88.19	85.96	101.39	
Plow + Vibromix	81.69	87.87	84.78	100.00	control
HDH 3.85 + Vibromix	73.72	83.21	78.47	92.55	oo
HDH 3.85 +VRH	76.12	85.38	80.75	95.25	o
Chisel + Vibromix	77.68	85.49	81.59	96.23	o
Chisel + VRH	78.63	87.32	82.98	97.87	
Scarificator + Venta	79.16	87.53	83.35	98.31	
		DL5%	3.15		
		DL1%	4.15		
		DL0.1%	7.5		

Table 3

Influence of equipment for seedbed preparation on soil loosening degree for the rapeseed crop (2012-2014)

Variant	Dsl %				Significance
	2012-2013	2013-2014	Average	%	
Plow + Combigerm	24.71	27.92	26.32	102.64	
Plow + Vibromix	24.30	26.98	25.64	100.00	control
HDH 3.85 + Vibromix	20.83	24.59	22.71	88.57	ooo
HDH 3.85 + VRH	22.48	25.41	23.95	93.39	oo
CHISEL + Vibromix	21.75	25.02	23.39	91.21	ooo
CHISEL + VRH	22.53	26.09	24.31	94.81	oo
Scarificator + Venta	24.15	26.87	25.51	99.49	
		DL5%	0.71		
		DL1%	1.08		
		DL0.1%	1.74		

d). Soil leveling degree (D_{ls})

The statistical analysis of the average values for the soil leveling degree, are shown in *table 4*. It was noticed that the seedbed preparation using the Vibromix and VRH on a soil that was previous worked with disc harrow and chisel had a bad influence on the parameter taken into study (D_{ls}), with negative, distinctly significant and significant differences compared to the control.

The value of the soil leveling degree was minimal for the variant prepared using a Vibromix, after a previous work with HDH,3.85, and maximum for the Combigerm complex equipment.

e). Weed control degree (D_{wc})

Regarding the weed control degree, after the seedbed preparation for the rapeseed crop, the values are presented in *table 5*.

The analysis of the data reveals that all the values of the D_{wc} were above 95%, which is the lower limit for this index at an optimal seedbed, in order to have good conditions for plant development.

The minimal value of D_{wc} (95.98%), was recorded in the variant were the seedbed preparation was made using the HDH 3.85+Vibromix, the difference compared to the control being very significant.

Table 4

Influence of seedbed preparation equipment on soil leveling degree for the rapeseed crop (2012-2014)

Variant	Dls %				Significance
	2012-2013	2013-2014	Average	%	
Plow + Combigerm	71.06	75.86	73.46	104.63	
Plow + Vibromix	66.72	73.70	70.21	100.00	control
HDH 3.85+ Vibromix	53.75	66.28	60.02	85.48	oo
HDH 3.85+ VRH	58.10	68.30	63.20	90.02	oo
CHISEL + Vibromix	60.25	67.11	63.68	90.70	o
CHISEL + VRH	63.31	69.89	66.60	94.86	
Scarificator + Venta	63.90	72.92	68.41	97.44	
		DL5%	4.52		
		DL1%	6.85		
		DL0.1%	11.00		

Almost the same values were obtained for the variant worked with Chisel+Vibromix. The differences of the D_{wc} values for the variants worked with VRH were negative, distinctly significant and significant, compared to the control.

The highest value, recorded for the ploughed variant and prepared with the Plow+Combigerm complex equipment was 98.75%, being statistically unassured.

Table 5.

Influence of seedbed preparation equipment on weed control degree for the rapeseed crop (2012-2014)

Variant	Dwc %				Significance
	2012-2013	2013-2014	Average	%	
Plow + Combigerm	98.75	99.12	98.94	100.40	
Plow + Vibromix	98.43	98.66	98.55	100.00	control
HDH 3.85+ Vibromix	95.67	96.28	95.98	97.39	ooo
HDH 3.85+ VRH	97.32	97.89	97.61	99.05	oo
CHISEL+ Vibromix	96.63	97.23	96.93	98.36	ooo
CHISEL + VRH	97.54	98.56	98.05	99.50	o
Scarificator + Venta	98.25	98.74	98.50	99.95	
		DL5%	0.43		
		DL1%	0.65		
		DL0.1%	1.04		

CONCLUSIONS

All the unconventional tillage variants had D_a values below the control, the differences being very significant and distinctly significant. For the rapeseed seedbed preparation, the maximum working depth (4.09 cm) was recorded for the complex equipment Combigerm, with basic tillage done with the reversible plow at 30 cm depth. The highest values for the soil crumbling degree were recorded for the Plow+Combigerm, in every experimental year and as average (85.96 %), showing a positive significant difference compared to the classical tillage, Plow+Vibromix (control). Regarding the soil loosening degree, the values for the minimum tillage variant, where the seedbed preparation was made using the Vibromix, were highlighted, being minimal (20.83% and 21.75%), with negative very significant differences compared to the control. The soil leveling degree had minimal value for the variant worked with the HDH 3.85+Vibromix, and the maximum was recorded for the Plow+Combigerm variant. The analysis of the results proves that all the values of the weed control degree were above 95 %, which is the lowest limit of this index, for a well done seedbed, in order to have optimal conditions for normal plant development.

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