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INFLUENCE OF MINIMUM TILLAGE ON SOIL PHYSICAL PROPERTIES AND ON WINTER WHEAT YIELD AND QUALITY IN WESTERN ROMANIA

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ABSTRACT
Research was carried out between October 1, 2011 and September 31, 2012 and focused on the following aspects:
- influence of minimum tillage on soil physical properties in the experimental field located in the village of Sag, where we examined 4 different tillage variants on 4 different plots (1 plot = 1 ha).

- First plot at the **Monastery (V1)**
  2X disc harrow 6.4, hollers, cutting and sowing with Kverneland Drill
- Second plot at the **Dam (V2)**
  Subsoiling to a depth of 65 cm with Maschio Gaspardo, Artiglio 250, direct seeding with Terramix Grower
- Third plot at the **Farm left plot (V3)**
  2X disc harrow 6.4, Terradisk 500, sowing with SUP 29,
- The fourth plot at the **Farm right plot (V4)**
  2X disc harrow 6.4, Terradisk 500, seeding with Kverneland Drill

Keywords: minimum tillage, winter wheat, soil moisture, production, quality.

INTRODUCTION

The soil tillage performed with tractors and various types of tillage equipment has harmful effects on soil characteristics, such as degradation of soil structure, compaction of surface and depth, low humus content, reduced biological activity which ultimately lead to lower natural fertility of the soil (GUŞ ET AL., 2003).
The economical efficiency of a culture is in strong connection with the way of performance and the quality of the tillage systems (DUMITRU ET AL., 1999). The tillage systems determine firstly changes of the physical characteristics which influence the chemical and the biological features of soil.
Modernization of agriculture in the last decades has come with a number of harmful effects on soil physical properties and on the environment (CANARACHE, 1990). We use increasing levels of fertilizers, especially the chemical ones, because we want to increase the amount of production and reduction of cultivated area (DERPSCH , 2001).
The product quality was also followed with great attention and therefore only varieties which resist to the climatic conditions specific for the cultivated area has been grown (MATEESCU, 2003).
The conservation and maintenance of natural fertility of the soil was and it is promoted by researchers and specialists with the current requirements of sustainable agriculture.
It is not surprising that all the countries are looking for extensive research in agronomical, technological, design and especially tillage techniques in the hope of finding new ways of saving energy and money (ŞARPE, 2001).

MATERIAL AND METHOD

Table 1 shows the 4 types of minimum tillage used in Sag area in all 4 plots (1 plot = 1 ha). The most important components of conservative technological systems, as in the case of conventional tillage, are the tillage variants and the seed input method (ŢOPA AND JITAREANU, 2007).

To this end, soil samples were taken from all 4 plots, where soil profiles were made at an average depth of 50 cm, to determine and compare soil texture, soil structure, soil moisture, soil porosity, degree of compaction, etc.

After we have collected 4 soil samples from every 10 cm to a depth of 50 cm on all 4 plots, we determined the specific weight of the wet soil samples. Then the samples were incubated for 10 hours at 102 °C and were weighed again using digital balance. To obtain accurate results, we used digital balance to measure the soil moisture directly in the field as we can see in *Table 7.*

We have performed measurements on straw weight (10 repetitions/plot), length and number of grains/straw.

Table 1. Soil tillage work on the experimental plots of the Sag locality

Work performed	Monastery (V1)	Dam (V2)	Farm Left Plot (V3)	Farm Right Plot (V4)
Seedbed preparation 2011	2X disc Harrow 6.4, rollers, cutting, sowing with Kverneland Drills	Subsoiling to a depth of 65 cm with Maschio Gaspardo, Artiglio 250 Direct seeding with TERRAMIX Grower	2X disc harrow 6.4, TERRADISK 500 Sowing with SUP 29	2X disc harrow 6.4, TERRADISK 500 Seeding with Kverneland Drill
Forecrop 2010	Sunflower	Wheat	Wheat	Wheat

RESULTS

As it can be seen in the following tables, according to the tillage method, we have production and quality differences, considering that all four plots were cultivated with the same variety of winter wheat, variety 'Alex Basis'.

Table 1 shows the 4 types of minimum tillage used in Sag area.

Table 2. Number of plants raised per square meter 2011-2012

Variant of soil work	Number of raised plants/m^2	Relative values (%)	Differences plants/m^2	Significance of differences
V_2 –	560	104,09	+22	***
V_4 -	550	102,23	+12	***
V_1 –	540	100,37	+2	-
Average $\bar{x}$	538	100,00	Mt.	-
V_3 -	502	93,39	-36	000

Dl 5% = 5,12 plants/m^2 ; Dl 1% = 7,93 plants/m^2; Dl 0,1% = 10,03 plants/m^2

If we look at *Table 2*, at the plot Dam (V2), we have obtained the best results.
Table 3 shows that at the plot Monastery (V1) the average wheat grain weight is the highest with a value of 1.25 g and the minimum average wheat grain weight is at the Farm Left Plot (V3) with a value of 1.14 g.

Table 3. Influence of soil tillage on wheat grain straw weight in 2011-2012

Variant of soil work	Grain weight (g)/straw	Relative values (%)	Differences (g)	Significance of differences
V_1 –	1.25	105.04	+0.06	-
V_2 –	1.24	104.20	+0.05	-
V_3 -	1.14	95.80	-0.05	-
V_4 -	1.11	93.28	-0.08	-
Average $\bar{x}$	1.19	100.00	Mt.	-

Dl 5% = 0,12 g/straw ; Dl 1% = 0,24 g/straw ; Dl 0,1% = 0,42 g/straw

In *Table 4* we can see the influence of soil tillage on wheat straw weight and we can observe that the best results were obtained at the Monastery plot (V1) with an average of 1.66 g after 10 repetitions. The minimum value is obtained at the Farm Left Plot (V3) with an average weight of 1.10 g after 10 repetitions.
Table 5 shows the influence of soil tillage on wheat quality with the following parameters:
- humidity (%) with values between 12.5 % and 14 %,
- hectolitre weight (kg/hl) with values between 76.5 (kg/hl) and 79.8 (kg/hl).

In *Table 5* we present qualitative evidence to the culture of wheat on the 4 plots, results obtained with the device GRANOMAT.

Table 4. Influence of soil tillage on wheat straw weight in 2011-2012

Repetition	Wheat straw weight (g)			
	Monastery (V1)	Dam (V2)	Farm Left Plot (V3)	Farm Right Plot (V4)
1	2.04	1.40	0.84	1.33
2	1.78	1.58	0.99	1.60
3	2.17	1.03	1.25	1.07
4	2.00	2.06	1.25	1.29
5	1.56	1.20	1.44	1.24
6	1.25	1.12	1.25	1.43
7	1.76	1.60	1.19	1.95
8	1.97	2.19	0.94	1.25
9	0.69	1.45	0.99	1.17
10	1.44	1.75	0.93	1.17
Average	**1.67**	**1.54**	**1.11**	**1.35**

Table 5. Influence of soil tillage on wheat quality in 2011-2012

Quality parameters	Monastery (V1)	Dam (V2)	Farm Left Plot (V3)	Farm Right Plot (V4)
Humidity (%)	13.9	12.5	14.0	13.5
Hectolitre weight (kg/hl)	76.5	79.9	77.5	77.7
Temperature (°C)	26.5	26.7	26.2	25.4

In *Table 6* we have presented the qualitative evidence to the culture of wheat on the 4 plots, results obtained with the device OMEGA ANALIZER in 2011-2012 with protein content values between 10.5% and 13.1%, gluten content with values between 12% and 21%, and Zeleny index with values between 17 ml and 41 ml.

Table 6. Influence of soil tillage on wheat quality in 2011-2012

Quality parameters	Monastery (V1)	Dam (V2)	Farm Left Plot (V3)	Farm Right Plot (V4)
Protein content (%)	12.5	13.1	10.7	10.5
Humidity (%)	13.6	12.1	13.5	13.6
Gluten content (%)	20.0	21.0	13.0	12.0
Sedimentation value (Zeleny index)(ml)	41.0	38.0	17.0	17.0

In *Table 7* we presented the humidity values taken directly in field with the electronic balance at 01.10.2011 which has a major influence on the quality and quantity of winter wheat.

Table 7. Soil humidity registered on the 1. October 2011 in the depth of 0-50 cm

Depth profile	Soil moisture (%)			
	Monastery (V1)	Dam (V2)	Farm Left Plot (V3)	Farm Right Plot (V4)
0-10 cm	21	15	10	21
10-20 cm	25	18	16	22
20-30 cm	28	22	21	25
30-40 cm	31	25	27	29
40-50 cm	32	33	30	35

Table 8 presents the production of winter wheat in 2011-2012 on all 4 plots.

Table 8. Production of winter wheat in 2011-2012 (q/ha)

Variant of soil work	Production (q/ha)	Relative production (%)	Production difference (q/ha)	Significance of differences
V_2	48.80	105.67	+2.62	*
V_1	46.60	100.91	+0.42	-
V_3	45.50	98.53	-0.68	-
V_4	43.80	94.85	-2.38	0
Average $\bar{x}$	46.18	100.00	Mt.	-

Dl 5% = 2,28 q/ha ; Dl 1% = 3,16 q/ha ; Dl 0,1% = 4,35 q/ha

CONCLUSIONS

The reduction of the soil structure and the physical characteristics are the first changes induced by the tillage systems. The minimum tillage systems, through the reduction of the soil tillage and by the increase of the quantity of organic matter left in the soil or on its surface contribute essentially to the renewal of the soil structure (BUDOI, 1997).

The total porosity offers significant information about many soil characteristics. High values of the total porosity show a higher capacity of water storage, high permeability and good airing, but sometimes reduced values of the lifting power (STĂNILĂ, 2000).

The porosity variations, induced at the conventional and unconventional works for the soil preparation are not uniform on the profile and more they do not influence all pore categories (CARCIU, 2003)

Considering the amount of rainfalls in 2011, with an average of 768.90 mm, we can tell that it was a favorable year for wheat crop.

The soil porosity can be damaged seriously due to the improper application of the soil tillage systems. The soil humidity taken directly in field with the electronic balance has a major influence on the quality and quantity of winter wheat.

Our results show that at the Plot Dam (V2) where we have made the subsoiling to a depth of 65 cm, we had the best wheat yield of 48.80 q/ha.

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