THE USING OF SOME TILLAGE VARIANTS IN ORDER TO REDUCE THE FUEL CONSUMPTION WITH THE SUNFLOWER CROP IN IRRIGATION CONDITIONS

FOLOSIREA UNOR VARIANTE TEHNOLOGICE LA LUCRĂRILE DE BAZĂ ALE SOLULUI ÎN VEDEREA REDUCERII CONSUMULUI DE COMBUSTIBIL LA CULTURA DE FLOAREA SOARELUI ÎN CONDIȚII DE IRIGARE

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Abstract: *The researches carried out in the Caracal Plain do confirm the presence of positive relation between the tillage, the sunflower yield and the energy consumption no matter the irrigation regime and climatically condition of the year. There have been made determinations on the fuel consumption (l/ha), the machinery productivity (ha/hour) to the tillage, the seed yield at 11% moisture, energy consumption (Mcal/kg of product). The results of fuel consumption with the three in average after measuring and timing within the researched period show differences between them.*

Rezumat: *În cercetările desfăşurate în Câmpia Caracalului confirmă prezența relației pozitive dintre lucrările solului, producţia de floarea soarelui şi consumul de energie, indiferent de condițiile climatice ale anului. Au fost făcute determinări ale consumului de combustibil (l/ha), productivitatea maşinilor agricole (ha/oră) la lucrările solului, producția de semințe la 11% umiditate şi consumul de energie (Mcal/kg de produs). Rezultatele consumului de combustibil în medie pe trei repetiții după măsurare în perioada cercetată arată diferențe între ele.*

Key words**:** *tillage, irrigation, fertilizers, fuel consumption*
Cuvinte cheie: *lucrările solului, irigare, îngrăşăminte, consum de combustibil*

INTRODUCTION

The soil tillage is one of the most important measures of cropping technology no matter wide or narrow row in order to prepare the seedbed. The classic system of tillage that is being practiced always includes the ploughing with the mouldboard plough which inverse the soil layer.

At the mid XX century there has appeared the necessity to reduce the number of tillage in order to avoid the problems of the classic system yet to preserve and ameliorate the soil productivity potential. In this manner, there were begun to use new soil tillage systems especially in order to preserve the soil having several variants: discing, chisel, paraplough, mulch layer, direct drilling, etc.

The technological researched variants follow the maintaining and improving the agricultural system, the increasing of the effective soil fertility and the achievement of equal or higher yield that the classical ones that involves the mouldboard plough.

The yield differences between the alternative systems and the classic one can be explained by choosing the most suitable technological variant in certain pedoclimatical condition (Guş, P. et al., 1995; Jităreanu, G., 1995; Sin, Gh., et al. 1995) and within a crop rotation, the tillage are rotated, too (Picu I., et al., 2005.).

MATERIAL AND METHOD

As The experiment was set up in the fall of 2000 year at the SCDA Caracal and there were researched the efficiency of the minimal tillage system in order to reduce the inputs, the increasing of the productivity, the ensuring of high and stable yields in the chemical fertilization and differential irrigation condition.

The soil was a typical chernozem from the Caracal Plain, not carbonate, with well evident profile, with a low to average humus content (3.18%), low supplied with nitrogen (0.13% total N), average to well supplied with phosphorus (43.8 ppm soluble phosphorus) and very well supplied with potash (233.7 ppm soluble potash) and the C/N ratio is 16.53.

As regard the hydric features, within the shallow layer, the wilting coefficient is 12.3%, the field capacity is 24.5% and the hydraulic conductivity is 9.2 mm/hour, and these values slowly increase into the subarable horizon.

As crop structure, there were used three crops: wheat, corn and sunflower.

The researching unit had three replications and the following factors:

The A factor – the level of water supplying (optimal irrigation, limited irrigation, rainfed)

The B factor – the soil tillage (mouldboard ploughing at 22-25 cm + harrowing, chiselling at 22-25 cm + harrowing, chiselling at 8-10 cm + harrowing).

The C factor – the fertilization with N_0, N_{40}, N_{80}, N_{120} on a constant background of P_{80}.

The vegetal debris of the previous crop there were chopped and spread evenly on the soil surface.

The determinations that were made within the vegetation period were:

- the fuel consumption (l/ha) and the machinery productivity (ha/hour) at the time of performing the soil tillage
- the yield production at the 11% moisture.

RESULTS AND DISCUSSIONS

The fuel consumption in function of the soil tillage system within the 2002 – 2005 period.

The obtained results on the fuel consumption with the three tillage show differences between them (table 1).

The mouldboard plough tillage at the depth of 22-25 cm plus harrowing has recorded the highest fuel consumption (29.6 l/ha) and the lowest productivity (0.22 ha/hour).

Table 1

The fuel consumption (l/ha) and the productivity of the machinery (ha/hour)

No.	Tillage	The fuel consumption l/ha	Productivity ha/hour	Obs.
01	Mouldboard ploughing 22 – 25 cm + harrowing	26.9	0.22	-
02	Chisel 22 - 25 cm + harrowing	23.6	0.70	-
03	Chisel 8 - 10 cm + harrowing	14.6	0.91	Instability of the machinery

The performing of the chisel tillage at the same depth plus harrowing has a 23.6 l/ha fuel consumption and a 0.70 ha/hour productivity, 0.48 ha/hour higher.

The using of the chisel plus harrowing has made a 14.6 l/ha fuel consumption (the lowest) and the highest productivity, of 0.91 ha/hour, yet, during the operation there was manifested a certain instability of the machinery.

The influence of the tillage system on the seed yield

The obtained yields were different in the experimentation years as influenced by the meteorological conditions, the irrigation regime, the soil tillage and the fertilizer doses.

After the analysis on each irrigation regime the effect of the soil tillage as influenced by the fertilizer doses, the differences were evident.

In optimal irrigation condition (50% of AWC), when the tillage was made with the usual plough plus harrow, the variant that was not fertilized with nitrogen has given the lowest yields, from 1,686 to 2,315 kg/ha (table 2 a). As nitrogen doses were applied, the sunflower yield increased along with them and with the cropping years, the differences being well assured in comparison with the control variant.

Table 2

The influence of the tillage system on different nitrogen doses on the sunflower yield in optimal irrigation condition (50% from the AWC) - kg/ha

Dose of N	2003	2004	2005	Average
a. Ploughing at 22 – 25 cm + harrowing				
N_0	1893	1686	2315	1965
N_{40}	2233^{xxx}	2328^{xxx}	3249^{xxx}	2603^{xx}
N_{80}	2710^{xxx}	2809^{xxx}	3745^{xxx}	3086^{xxx}
N_{120}	3023^{xxx}	3118^{xxx}	4333^{xxx}	3491^{xxx}
b. Chisel at 22 – 25 cm + harrowing				
N_0	2073	2003	2111	2062
N_{40}	2460^{xxx}	2728^{xxx}	2900^{xxx}	2696^{xxx}
N_{80}	2833^{xxx}	2846^{xxx}	3637^{xxx}	3105^{xxx}
N_{120}	3080^{xxx}	3374^{xxx}	4200^{xxx}	3551^{xxx}
c. Chisel at 8 – 10 cm + harrowing				
N_0	1807	1291	2323	1807
N_{40}	2297^{xxx}	2044^{xxx}	3595^{xxx}	2645^{xxx}
N_{80}	2550^{xxx}	2632^{xxx}	3777^{xxx}	2986^{xxx}
N_{120}	2903^{xxx}	2950^{xxx}	4058^{xxx}	2204^{xxx}
DL 5% =	41	89	58	370
DL 1% =	56	122	79	561
DL 0.1% =	76	166	108	901

The using of the chisel at the 22-25 cm depth plus harrowing has conducted to the obtaining of superior yields in comparison with the classic one at the most fertilization levels and in almost all years the differences being very significant (Table 2 b).

When the chisel tillage was made at the 8-10 cm depth plus harrowing, the sunflower yield was lower than the previous variant yet higher than the control variant (table 2 c).

The using of the limited irrigation (1/2 of the optimal one) on all three tillage the yields were lower yet they had the same aspect of the differences between the tillage systems and nitrogen fertilization levels.

In the case of normal ploughing at 22-25 cm plus harrowing, the average yields were 1,751 to 2,897 kg/ha having differences on years and nitrogen doses (table 3 a).

The chisel tillage at the same depth plus harrowing was superior in all researching years and nitrogen dose levels as regard the sunflower yields.

Table 3

The influence of the tillage system on different nitrogen doses on the sunflower yield in limited irrigation condition (1/2 of the optimal irrigation) - kg/ha

Dose of N	2003	2004	2005	Average
a. Ploughing at 22 – 25 cm + harrowing				
N_0	1543	1458	2252	1751
N_{40}	1853^{x}	2033^{xxx}	3156^{xxx}	2347^{x}
N_{80}	2050^{xx}	2550^{xxx}	3786^{xxx}	2795^{xx}
N_{120}	2150^{xxx}	2567^{xxx}	3973^{xxx}	2897^{xx}
b. Chisel at 22 – 25 cm + harrowing				
N_0	1660	1781	2264	1902
N_{40}	1843	2255^{xxx}	3328^{xxx}	2475^{x}
N_{80}	2103^{xx}	2520^{xxx}	3873^{xxx}	2832^{xx}
N_{120}	2267^{xxx}	2977^{xxx}	4029^{xxx}	3091^{xx}
c. Chisel at 8 – 10 cm + harrowing				
N_0	1520	1284	2409	1738
N_{40}	1980	2048^{xxx}	3408^{xxx}	2479^{x}
N_{80}	1980	2420^{xxx}	3609^{xxx}	2670^{x}
N_{120}	1583	2468^{xxx}	3963^{xxx}	2671^{x}

DL 5% =	287	57	53	573
DL 1% =	394	78	73	869
DL 0.1% =	536	107	100	1396

The soil tillage with the same tool but at 8-10 cm depth plus harrowing has determined the obtaining of similar yields with the ploughing ones in all researching years (table 3 c).

The cropping in rainfed condition has determined the lowest yields for each tillage and smaller differences between tools.

The normal ploughing has given yields that have increased on the all 3 years period yet on the nitrogen fertilizer dose levels, the average values being of 1,305 to 2,522 kg/ha (table 4 a).

The chisel tillage at the same depth has determined the obtaining of very close yields to the plough one, between 1,434 and 2,355 kg/ha (table 4 b).

By shallow tillage using the chisel there have been achieved approximately equal yields with the previous tillage, of 1,410 – 2,297 kg/ha (table 4 c).

CONCLUSIONS

1. The fuel consumption has differed in function of the tool used for tillage, the highest one being recorded with the usual plough followed by chisel at the same depth but the distance between the active tool of 35 cm and the tillage with the same tool at the same distance between the active tool but at the 8-10 cm depth.

2. Regarding the machinery productivity, it increased from the usual plough to chisel at the 8-10 cm depth.

3. The sunflower yield was different with the irrigation regime and within it, with the tillage and the nitrogen doses.

Table 4

The influence of the tillage system on different nitrogen doses on the sunflower yield in rainfed condition - kg/ha

Dose of N	2003	2004	2005	Average
a. Ploughing at 22 – 25 cm + harrowing				
N_0	673	974	2268	1305
N_{40}	853^{xxx}	1756^{xxx}	3174^{xxx}	1928^{x}
N_{80}	983^{xxx}	2234^{xxx}	3258^{xxx}	2158^{x}
N_{120}	1087^{xxx}	2447^{xxx}	4031^{xxx}	2522^{xx}
b. Chisel at 22 – 25 cm + harrowing				
N_0	793	1315	2195	1434
N_{40}	883^{xxx}	1859^{xxx}	3002^{xxx}	1915^{x}
N_{80}	1080^{xxx}	1996^{xxx}	3374^{xxx}	2150^{x}
N_{120}	1150^{xxx}	2224^{xxx}	3691^{xxx}	2355^{xx}
c. Chisel at 8 – 10 cm + harrowing				
N_0	713	810	2707	1410
N_{40}	800^{xxx}	1572^{xxx}	3020^{xxx}	1797
N_{80}	973^{xxx}	2124^{xxx}	3402^{xxx}	2166^{x}
N_{120}	1080^{xxx}	2324^{xxx}	3488^{xxx}	2297^{xx}
DL 5% =	35	61	58	526
DL 1% =	48	84	80	797
DL 0.1% =	65	114	113	1281

4. In optimal irrigation condition, 50% of AWC, the highest productions were given by the chisel at 35 cm between the active tools and 22-25 cm depth with all 4 fertilization levels, followed by the usual plough at the same depth and then by the shallow tillage with the chisel at 8-10 cm.

5. The applying of reduced irrigation regime (1/2 of the optimal regime) has maintained the same effect and order of the tillage tools.

6. In rainfed conditions there were recorded the lowest yields in comparison with the other two irrigation regimes having very close values to the usual plough variant and the chisel one at the 8-10 cm depth.

7. As regard the fertilization, the nitrogen doses that were applied on constant phosphorus background have conducted to the obtaining of yield outputs that have increased along with the increasing of the nitrogen dose higher differences being recorded in optimal irrigation and chisel at 22-25 cm depth.

8. The capitalisation of the mineral fertilizers was lower in the rainfed conditions with this crop.

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