RESEARCH CONCERNING ENERGY CONSUMPTION DURING SOIL WORKS

CERCETĂRI PRIVIND CONSUMURILE ENERGETICE SUB INFLUENȚA LUCRĂRILOR SOLULUI

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Abstract: *Energy consumption during equipment exploitation is twice as high as the one necessary for its manufacturing. Research data show that for an increase of agricultural production of 1% we need an increase of the energy consumption under the form of fuel of 2,5%*
In this paper we present a synthesis of some trial results concerning energy consumption in different soil work variants compared to the direct sowing in maize crops.

Rezumat*: Consumul energetic pentru exploatarea utilajelor este de două ori mai mare decât cel necesar pentru fabricarea lor. Datele desprinse din cercetare indică faptul că unei creşteri a producţiei agricole de 1% îi este necesară o creştere a consumului de energie sub formă de combustibil de 2,5%.*
Lucrarea de faţă prezintă o sinteză a rezultatelor obţinute pe cale experimentală privind consumurile energetice pe diferite variante de lucrări ale solului comparativ cu metoda de semănat direct în mirişte la cultura de porumb.

Key words*: working system, energy consumptions*
Cuvinte cheie*: sistem de lucrare, consumuri energetice*

INTRODUCTION

Direct sowing is the most important method of saving energy and of preserving soil's yielding capacity. Because of the low ratio between production costs and delivery prices for agricultural produce, more and more farmers appeal to minimal soil work methods (minimum tillage) and to methods in which there is no soil work (no-till) as means of reducing labour force expenses, machines, and fuel and, at the same time, as a means to cultivate more.

Data presented in this paper are based on both trial and production results obtained at the Didactic Station of the Agricultural and Veterinary University of the Banat in Timişoara (Timiş County).

MATERIALS AND METHOD

Trials were organised in the soil and climate conditions of the Banat's Plain on the lands of the Didactic Station of the Agricultural and Veterinary University of the Banat in Timişoara between 2003 and 2005.

Trials were set on a vertic chernozem strongly gleyied, deeply salinised and alkalinised (below 100 m) and extremely deeply semi-carbonated on parental bi-layered, medium fine, medium clay-loamy/medium clay-loamy materials.

The soil profile has the following horizon succession: Ap - Ap - Amk - A/Cyk -CykG - CyGo - CcaGo - $CcaG_0$ - CcaGr.

Climate conditions between 2003 and 2005 were characterised by mean annual temperatures between 11,0°C and 12,7°C and precipitations during the same period of time had values between 395 mm and 592.5 mm.

In the trial setting, we tested the following variants:

V_1 (control): Ploughing with a mould plough + Harrowing with a disc harrow

V_2: Harrowing with a disc harrow – two times
V_3: Harrowing with a combined rotating harrow
V_4: Harrowing with a disc harrow + Harrowing with a combined rotating harrow
V_5: Harrowing with a disc harrow + Working the soil with a vibrocultor
V_6: Direct sowing

Fuel consumption is directly related to the mechanical work done by each of the agricultural units and it depends on the hourly consumption of the unit at different working regimes and on the duration of functioning of these regimes. The soil working system differentiates the fuel consumption depending on the unit used, on the depth of the works, on the resistance to traction, and on the number of works necessary.

The analysis of the impact of fuel consumption on maize crop (Table 1) shows differences between the trial variants we used.

Table 1

Impact of soil work system on fuel consumption in maize crops (l/ha)

Fuel consumption per technological operation (l/ha)		Soil work variant					
		V_1	V_2	V_3	V_4	V_5	V_6
		Plough Disc harrow	Disc harrow x 2	Combined rotating harrow	Disc harrow + Combined rotating harrow	Disc harrow + Vibrocultor	Direct sowing
Basic work		29,50	35,50	39,00	38,00	41,50	45,80
Preparing the germination bed + Applying herbicides		25,00					
Sowing + Fertilising		8,25	8,25	8,25	8,25	8,25	
Maintaining the crop (fertilising and applying herbicides)		13,00	13,00	13,00	13,00	13,00	
Harvesting		23,50	23,50	23,50	23,50	23,50	23,50
Other consumptions		11,50	11,50	11,50	11,50	11,50	11,50
TOTAL	l/ha	110,75	91,75	95,25	94,25	97,75	80,80
	%	100 (Mt)	82,84	86,00	85,10	88,26	72,95

Figure 1 shows the share of fuel consumption per agricultural work in the trial variants. The highest fuel consumption was in the classical soil work system variant – plough + disc harrow x 2 times, in which we used 110,7 l/ha (Table 1), direct sowing needing a consumption of 80,80 l/ha, representing 72,95 % compared to the control variant.

The necessary energy for the sowing and maintaining of a maize crop is about 20.000-23.000 MJ/ha and the energy produced upon the harvesting of 1 ha cultivate with maize by the addition of the main production and of the secondary production is between 190.000 and 250.000 MJ. The impact of the soil working system is reflected in the energy efficiency which has values between 0,8816 and 0,8878.

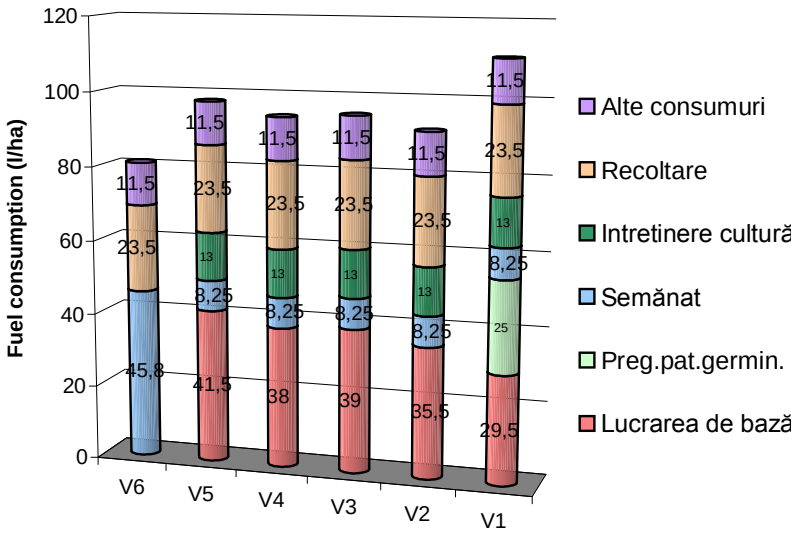

Fig. 1. Fuel consumption per technological stage

Table 2

Impact of working typical chernozem on energy efficiency in grain maize crops

Variant		Energy (MJ/ha)			Energy efficiency (%)	Energy yield	Energy ratio
		Consumed	%	Produced			
V1	Plough + Disc harrow	22.885	100,0	193.220	0,8816	8,44	0,1184
V2	Disc harrow x 2	21.400	93,51	185.320	0,8845	8,66	0,1155
V3	Combined rotating harrow	21.700	94,82	186.745	0,8838	8,61	0,1162
V4	Disc harrow + Combined rotating harrow	21.945	95,89	189.175	0,8840	8,62	0,1160
V5	Disc harrow + Vibrocultor	21.380	93,42	190.590	0,8878	8,91	0,1122
V6	Direct sowing	19.420	84,86	174.200	0,8885	8,97	0,1115

Energy yield shows that for 1 MJ invested in all the working variants compared to the control variant we can get increases of the energy efficiency between 8,61 and 8,91, maximum efficiency 8,97 being in the direct sowing system variant (Table 2).

CONCLUSIONS

1. The unconventional soil working system has an impact on maize production. Lower productions (90-95%) in the unconventional system compared to the classical system are considered more profitable due to the significant diminution of the fuel consumption.

2. Grain maize production has values between 8.450 kg/ha in minimal work variants and 8.400 kg/ha in direct sowing. Compared to the classical system, productions are lesser (94,13-97,12%).

3. Fuel consumption per total technology has the highest values in both classical system crops. In maize crops, fuel savings are between 31,3 and 36,1 l/ha in minimal work variants and 30,4 l/ha in direct sowing.

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