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Research on the relation-tillage-fuel production from maize in terms of Didactic Station Timisoara

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Abstract Mechanized soil tillage though classical methods becomes more and more doubtful due to a high energy intake and to a continuous soil degradation because of the excessive setting.

It is well known that the classical system of processing the soil (tillage with an earth board plough) has, besides its extraordinary contributions to social progress, seriously prejudiced the environment and its vital resource – soil – leading to a steady diminution of its fertility.

The disadvantages attributed to the classical soil work system, an intensive system that includes compulsory earth board plough tillage, resulted in the appearance and rapid spread of the concept of soil conservation. Romanian literature shows that in the conventional system, soil works need 35-60% of the fuel necessary to set and maintain a crop. Research and the expansion of minimum tillage systems have become important since the necessity to reduce production costs and the risks of soil degradation, setting, and erosion.

Research data show the fact that in order to obtain an increase of agricultural production of 1% we need a fuel consumption of 2.5%.

In this paper we present a synthesis of the results obtained experimentally concerning fuel consumption in different minimum tillage variants compared to the classical system.

Key words

tillage, direct drill, fuel consumption, production, maize

The concept of soil conservation comprises a set of activities, measures, and technologies that compete in maintaining soil's fertility without sensibly diminishing yields and with important production cost cuts.

The new technologies of mechanizing soil works in the conservative system comprise several processing methods: minimum tillage, mulch tillage, ridge tillage, and no-tillage or direct drill [2].

Taking into account the necessity to eliminate the conventional system's disadvantages, the elaboration of some alternative soil working technologies to assure the preservation and maintenance of its productive capacity, and also the decrease of energy intake, represents now a necessity in order to develop and strengthen a durable agriculture.

Maize cultivation in our country using technological methods specific to the unconventional soil working system has a series of technical and economic advantages. Reducing fuel consumption means smaller production expenses which makes agricultural production process more efficient economically.

Direct drill is the most important method of saving power and of preserving the soil's production capacity. Due to the small ratio between production costs and sale price of agricultural products, more and more farmers appeal to different minimum tillage and no-till methods as means of diminishing work force, agricultural machines and fuel expenses and cultivating more [1].

Due to the small ratio between production costs and delivery prices of agricultural produce, more and more farmers appeal to different methods of minimum tillage and no-till as a means to reduce expenses with labor force, machines and fuel and as a means to cultivate more, as well.

Research in the last ten years have pointed out the fact that applying variants of the non-conventional soil working systems leads to important reductions of the fuel consumption both on area unit and per production unit.

Material and Method

Data included in this paper are based on the experimental and production results obtained at the Didactic Station from Banat's University of

Agricultural Sciences and Veterinary Medicine (Timiş county).

Researches were performed on a plot named Body I consisted of an area of 268 ha limited in the North by the brook Beregsău, in the South by the inner land from Timişoara, and in the East and West by the national roads DN 69 Timişoara – Arad, respectively Timişoara – Sânnicolau Mare.

The climate is specific to the Banat's Plain, more open to western winds and to the influence of the Mediterranean and Atlantic currents, which makes it moister.

Experimental plots were set on a strongly gleyied vertic chernozem, salinizate and alkalized in depth (under 100 cm), extremely profound demi-carbonated on double-layer parental materials, medium fine, medium clayey argyle/medium clayey argyle.

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

Climatic condition were characterized by annual average temperatures between 11°C and 12.7°C, and while rainfall ranged between 395 mm and 592.5 mm.

In the experimental setting we tested the following variants:

V_1 (control): tillage with a plough + harrowing with a disk harrow.

V_2: harrowing with a disk harrow (two times).

V_3: harrowing with a combined rotating harrow

V_4: harrowing with a disk harrow + combined rotating harrow;

V_5: harrowing with a disk harrow + vibrocultor

V_6: direct drill.

The soil was set after harvesting the wheat. The experimental method determined the fuel consumption for each soil working variant V_1-V_6 and the results were compared with the results obtained in variant V_1. Experimental variants were tested in three replications each of which occupied an area S = 15 x 20 = 300 m^2.

For field measurements, we used the fuel consumption device FLOWTRONIC – 217 attached to the engine fuel feeding device (Fig.1.).

Fig. 1. The device FLOWTRONIC 217 for determining fuel consumption placed on the tractor U-650M

Fuel consumption is determined with the relation:

$$C_{ha} = \frac{\lambda_c \cdot C_h^n}{W_h^r} \text{ [kg / ha] , where:}$$

C_{ha} – fuel consumption per ha;

C_h^n – fuel consumption per hour of the tractor's engine in a nominal functioning regime in kg/h;

λ_c – correction coefficient taking into account the incomplete load of the engine during the functioning, the fuel consumption during fowl functioning and stationing of the aggregate while the engine is functioning.

In the experimental field, we sowed the maize hybrid Florencia from Pioneer, a semi-late hybrid of the maturity class FAO 450-550, the sowing norm being 55.000 per ha (16,8 kg/ha).

Results and Discussions

Fuel intake is directly related to the mechanical work performed by each agricultural aggregate and depends upon the aggregate's hourly intake in various working regimes and upon the its operating period.

Tillage system differentiates the fuel consumption depending on aggregate, working depth, resistance to traction and the number of necessary works.

The analysis of the influence of fuel intake in maize crop (table 1 and fig 1.) shows the differences between the experimental variants.

Table 1

Influence of tillage system on fuel intake in maize crop (l/ha)

Fuel consumption for technological operation (l/ha)		Tillage system					
		V1 Plough + Disk harrow	V2 Disk harrow x 2	V3 Combined rotating harrow	V4 Disk harrow+ Combined rotating harrow	V5 Disk harrow+ Vibrocultor	V6 Direct drill
Basic work		29,50	35,50	39,00	38,00	41,50	-
Germinative bed preparation		25,00					
Drill		8,25	8,25	8,25	8,25	8,25	45,80
Maintenance, fertilization		13,00	13,00	13,00	13,00	13,00	
Chemical control upon weeds		23,50	23,50	23,50	23,50	23,50	23,50
Harvesting		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

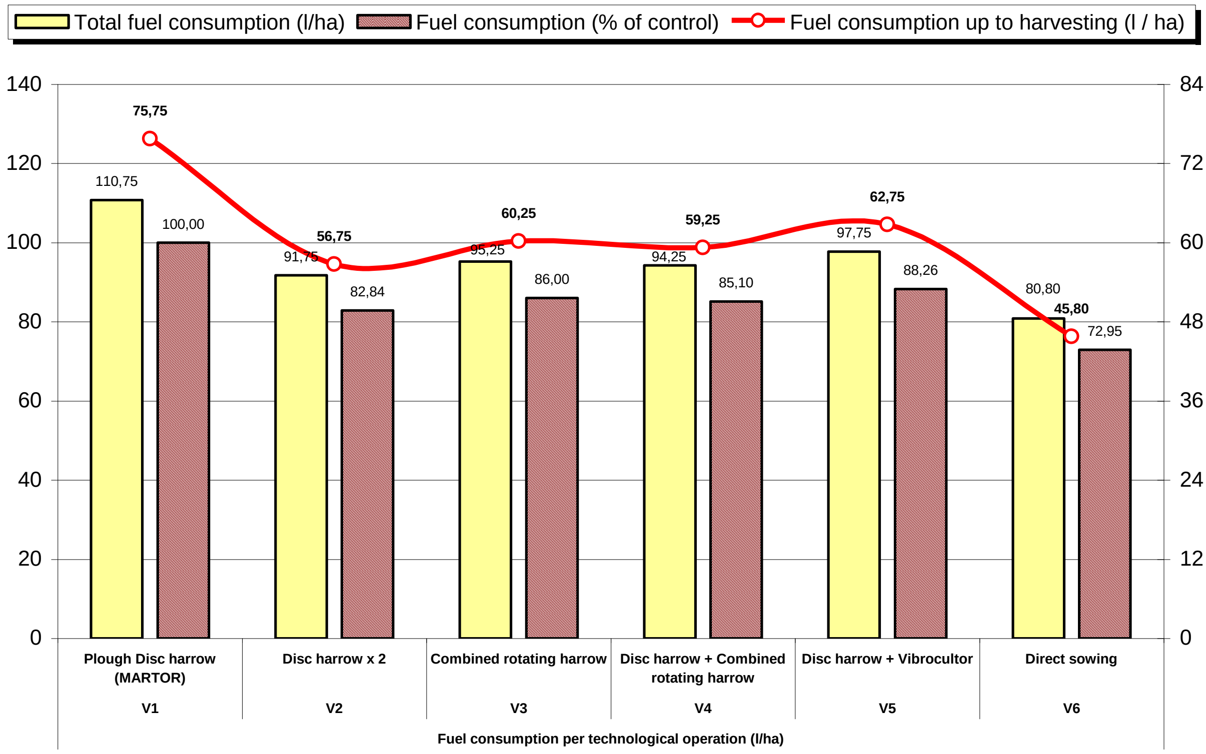

Fig.2. Influence of tillage system on fuel intake in maize crop (l/ha)

The bigger fuel consumption was recorded within the classical variants with earth board plough, namely 110,75 l/ha (table 1). A fuel intake of 91,75-97,75 l/ha was recorded within the variants with minimum tillage, and it was 80,8 l/ha in the case of direct drill.

Fuel consumption, analyzed according to the main production obtained, is presented in Table 2.

Table 2

Influence of tillage system on fuel consumption in maize yield (l/t)

Nr.crt.	Technological variant/specification	Tillage system					
		V_1 Plough + Disk harrow	V_2 Disk harrow x 2	V_3 Combined rotating harrow	V_4 Disk harrow+ Combined rotating harrow	V_5 Disk harrow+ Vibrocultor	V_6 Direct drill
1	Production t/ha	8,75	8,15	8,23	8,33	8,42	7,98
2	Fuel intake l/t	12,66	11,26	11,57	11,31	11,61	10,13
3	Fuel intake %	100,00	82,84	86,00	85,10	88,26	72,96

Determinations performed show that fuel consumption decreases with 1,40-2,53 l/t in minimum tillage and direct drill variants, compared to 12,66 l/t consumed in the classical technology.

Conclusions and Recommendations

1. The maintenance and preservation of soil physical features through the promotion of unconventional tillage, with satisfactory yields and taking into account the significant fuel intake reductions represent a useful solution and a viable alternative, too, for the classical system due to its numerous advantages.

2. The unconventional tillage system influences maize production. It is more profitable to obtain yields lower with 90-95% in the unconventional system compared to the classical ones due to the dramatic reduction of fuel intake.

3. Grain maize yields have values between 8150-8750 kg/ha in the minimal tillage variants and 7980 kg/ha in the case of direct drill. Compared to the classical system (8750 kg/ha), yields are lower (91,20% in no tillage variant)

4. Fuel intake per total technology has the biggest values in both crops under the classical system. In maize crop, fuel savings are between 13,0-19,01 l/ha in the minimum tillage variants and 30,4 l/ha in the case of direct drill.

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