FUEL CONSUMPTION IN MINIMUM TILLAGE VARIANTS COMPARED TO CLASSICAL MAIZE CULTIVATION SYSTEM AT THE DIDACTIC STATION IN TIMISOARA (ROMANIA)

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Abstract*: 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. Minimum tillage method is a concept that has been adopted quicker than maize hybrid adoption 50 years ago. 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 labour force, machines and fuel and as a means to cultivate more, as well. 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 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. 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. 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%. One of the important factors characterising cultivation with a small number of soil works is fuel consumption. This is why we made, between 2006 and 2008, at the Didactic Station in Timisoara, measurements of the fuel consumption in different variants of soil works. The experimental field was set at the Didactic Station in Timisoara on a vertic chernozem strongly gleyzied with the following profile: Ap - Ap - Amk - A/Cyk - CykGo - CCaGo - CcaG - $CcaG_0$ - CcaGr. For the experiments, we used as a source of power the tractor U-650 and the tractor Case 180 CP and for sowing, in the variants V_1-V_6 we sued the sowing machine SPC 8. The highest fuel consumption was in the classical soil work variant – plough + disc harrow, where we used 111.10 l/ha, minimum tillage being done with a consumption of 92.19 l/ha in the variant V_2 (disc harrow with 2 passages), i.e. 82.90% compared to the control and 98.10 l/ha, i.e. 88.30%, in the variant V_5 (chisel + combined rotary harrow) compared to the control.*

Key words**:** *classical tillage, minimal tillage, fuel consumption;*

INTRODUCTION

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.

Minimum tillage method is a concept that has been adopted quicker than maize hybrid adoption 50 years ago.

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 labour force, machines and fuel and as a means to cultivate more, as well.

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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.

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One of the important factors characterising cultivation with a small number of soil works is fuel consumption. This is why we made, between 2006 and 2008, at the Didactic Station in Timisoara, measurements of the fuel consumption in different variants of soil works.

MATERIAL AND METHODS

The experimental field was set at the Didactic Station in Timisoara on a vertic chernozem strongly gleyied with the following profile: Ap - Ap - Amk - A/Cyk - CykGo - CCaGo - CcaG - $CcaG_0$ - CcaGr. For the experiments, we used as a source of power the tractor U-650 and the tractor Case 180 CP and for sowing, in the variants V_1-V_6 we sued the sowing machine SPC 8, with the following variants:

V_1 – Control – Ploughing with a mould plough + discing with a disc harrow;
V_2 – discing with heavy disc harrow – 2 passages;
V_3 – harrowing with a combined rotary harrow – 2 passages;
V_4 – harrowing with a heavy disc harrow + harrowing with a combined rotary harrow;
V_5 – chisel + harrowing with a combined rotary harrow;
V_6 – cultivator + harrowing with a combined rotary harrow.

Table 1.

Features of the machines used

Machine	Work width (m)	Work depth (cm)	Necessary power (CP)	Working capacity (ha/h)
Plough PP-4(3)-30	0.9–1.2	20–22	65	0.32–0.52
Disc harrow GD-3,2	3.2	6–12	65	1.3–2.1
Heavy disc harrow GD-6,4	6.4	8–12	180	2.4–3.1
Combined rotary harrow GRC-2,5	2.5	8–18	80	1.5–2.1
Total work cultivator CPT-4	4	8-12	80	1.8-2.2
Chisel	90	18-20	80	4.5
Sowing machine SPC-8M	5.6	2–8	65	0.5–1.8

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.

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 54,500 plants per ha (16 kg/ha).

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.

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

RESULTS AND DISCUSSIONS

The evolution of the mean fuel consumption during the experimental period 2006-2008 at the Didactic Station in Timisoara is shown in Table 2.

Table 2.

Mean fuel consumption (l/ha) in grain maize depending on the soil working system at the Didactic Station in Timişoara (2006-2008)

<table>
<tr><td colspan="2" rowspan="3">Fuel consumption per technological operation (l/ha)</td><td colspan="6">Soil working variant</td></tr>
<tr><td>V_1</td><td>V_2</td><td>V_3</td><td>V_4</td><td>V_5</td><td>V_6</td></tr>
<tr><td>Plough + Disc harrow</td><td>Disc harrow x2</td><td>Combined rotary harrow</td><td>Disc harrow + Combined rotary harrow</td><td>Chisel + Combined rotary harrow</td><td>Cultivator + Combined rotary harrow</td></tr>
<tr><td colspan="2">Basic soil work</td><td>29.50</td><td rowspan="2">35.50</td><td rowspan="2">39.00</td><td rowspan="2">38.00</td><td rowspan="2">41.50</td><td rowspan="2">40.00</td></tr>
<tr><td colspan="2">Preparation of germination bed + Herbicide application</td><td>25.00</td></tr>
<tr><td colspan="2">Sowing + fertilisation</td><td>8.45</td><td>8.45</td><td>8.45</td><td>8.45</td><td>8.45</td><td>8.55</td></tr>
<tr><td colspan="2">Crop maintenance (tillage and application of herbicide)</td><td>13.25</td><td>13.25</td><td>13.25</td><td>13.25</td><td>13.25</td><td>13.20</td></tr>
<tr><td colspan="2">Harvesting</td><td>23.45</td><td>23.45</td><td>23.45</td><td>23.45</td><td>23.45</td><td>23.45</td></tr>
<tr><td colspan="2">Other consumptions</td><td>11.45</td><td>11.45</td><td>11.45</td><td>11.45</td><td>11.45</td><td>11.45</td></tr>
<tr><td rowspan="2">TOTAL</td><td>l/ha</td><td>111.10</td><td>92.10</td><td>95.60</td><td>94.60</td><td>98.10</td><td>96.65</td></tr>
<tr><td>%</td><td>100 (Mt)</td><td>82.90</td><td>86.05</td><td>85.15</td><td>88.30</td><td>87.86</td></tr>
</table>

CONCLUSIONS

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.

Analysing data resulted from measurements we can see the advantages such as shown in Table 1: soil works are within proper agro-technical times, there is substantial reduction of fuel consumption in minimum tillage compared to the classical system which also reduces the value of expenses for the soil works since crop setting to harvesting.

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.

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