

## STUDY REGARDING ENERGY CONSUMPTION AFTER „NO-TILLAGE” TECHNOLOGY

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**Abstract:** *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 labor force expenses, machines, and fuel and, at the same time, as a means to cultivate more. Energy expenses in mechanized agriculture cover both the energy consumed for the production and maintenance of the agricultural equipment and the energy necessary to exploit them. 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%. 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. Developing unconventional tillage systems combined harmoniously with other technology elements should be regarded not as a trend, but as a necessity that could solve a series of problems: preventing degradation and recovering the degraded soil structure, preventing and diminishing erosion, diminishing energy consumption, and optimizing production processes. In this paper we present a synthesis of some trial results concerning the dynamics of the direct sowing unit. Researches were carried in the experimental and production fields at the Didactic Station from Banat's University of Agricultural Sciences and Veterinary Medicine (Timiș county). The object of the trial was the unit formed of the no tillage machine Massey Ferguson MF 354 TSB and the tractor U-650 M. We made 12 measurements for 6 speed regimes with 2 trials for each engine nominal rotation (1800 rot/min).*

**Key words:** *direct sowing, dynamics of the unit, forces and moments*

### INTRODUCTION

Power consumption in exploiting the equipment is twice as big as that necessary for their manufacturing. Mechanical work of the soil through traditional methods is more and more questioned because of the high-energy consumption and of continuous degradation of the soil in its arable layer by erosion and excessive setting.

Direct sowing 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.

In this paper we present a synthesis of experimental results of a study on power consumptions in different variants of working the soil compared to the direct drill method on the maize crop.

### MATERIAL AND METHODS

Researches were carried in the experimental and production fields at the Didactic Station from Banat's University of Agricultural Sciences and Veterinary Medicine (Timiș

county).

Trials were set on a vertic chernozem strongly gleyed, 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 object of the trial was the unit formed of the no tillage machine Massey Ferguson MF 354 TSB and the tractor U-650 M.

The direct sowing machine Massey Ferguson MF 354 TSB is designed for hoeing plant (maize, sunflower, soy, beans, and peanuts) precision sowing on not worked land together with applying solid mineral fertilisers or herbicides. The trial device for the study under working conditions of the dynamics and energy of the direct sowing unit is presented in figure 1.



Fig. 1. Trial device for the study of the dynamics and energy of the direct sowing unit

The model we used is equipped with 4 working sections equipped with opening organs of the double-disc type, capable of working at a row distance between 70-96 cm.

Measurement apparatuses were as follows:

- torsion moment translators (to determine the plug-in moment)
- force translators for the traction power and for the compression force, both with tension-meter timbres

Signal-conditioning apparatuses consisted of:

- amplifying modules
- data acquisition plaque
- laptop 486
- n-SOFT processing software

We made 12 measurements for 6 speed regimes with 2 trials for each engine nominal turation (1800 rot/min).

Arrangement of measuring equipment on the tractor is shown in figure 2.



Figure 2. Measurement equipment ordered tractor

### RESULTS AND DISCUSSIONS

In the case of the unit we studied, the sizes that we monitored during the trial research and that have a dynamic and energy impact on the direct sowing work are as follows:

- the tensile force between the tractor and the direct sowing machine;
- the pressure force between the linking coupling tractor – direct sowing machine;
- the torsion moment transmitted to the machine through the power plug axis.

The signals recorded and saved in the computer memory in files of the ASCII type were processed and rendered by the data acquisition system under the form of time-related graphs. These oscillogrammes were processed, eliminating transitory working regimes and separating the variation of each size measured. For each of the two trials we designed variation graphs of the parameters studied at different speed regimes.

Table 1 presents the values recorded upon the trials of the unit made up of a tractor U-650 M – no tillage machine Massey Ferguson MF 354 TSB and Figure 3 shows the evolution of the mean values of the dynamic parameters we studied.

### CONCLUSIONS

Dynamics of the working system tractor – no tillage machine can be studied on the basis of the dynamic models equivalent of the real physical systems for real working and movement conditions.

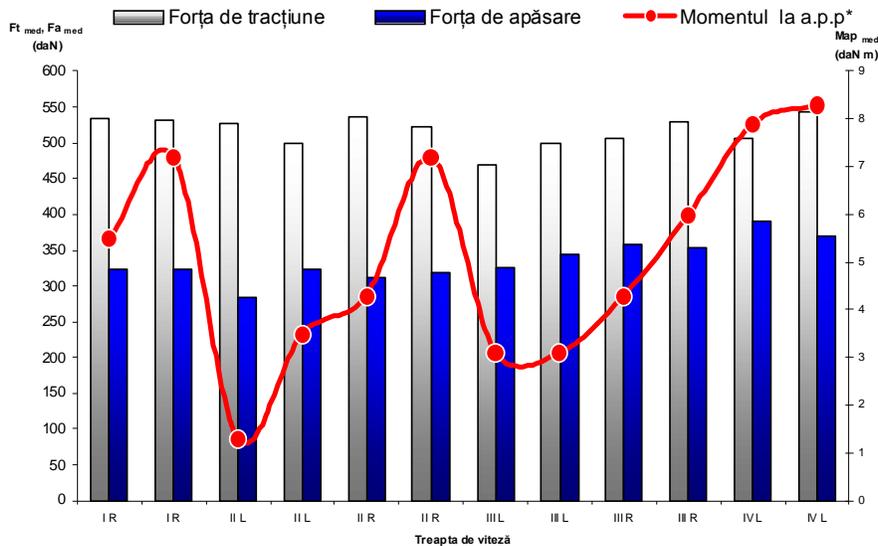
- on the basis of the processing and analysis of the data obtained within the trial research, we could develop a series of conclusions, the most important of which being as follows:

- the mean tensile force  $F_{t_{med}}$  has values between 469,1 daN at the level III L (trial 2) and 543,0 daN at the level IV L (trial 2);
- the mean pressure force  $F_{a_{med}}$  increases from 285,0 daN at level II L (trial 1) to the maximum level 391,0 daN at the level IV L (trial 1);

Table 1

Results concerning the traction trials of the direct sowing unit tractor U-650 M + no tillage machine Massey-Ferguson MF 534

| No. | Number of the trial | Speed level | Traction force (daN) |       |       | Pressure force (daN) |       |       | Resistance moment to the power plug axis (daNm) |      |     |
|-----|---------------------|-------------|----------------------|-------|-------|----------------------|-------|-------|---|------|-----|
|     |                     |             | Min                  | Max   | Med   | Min                  | Max   | Med   | Min   | Max  | Med |
| 1   | 1                   | I R         | 316,8                | 716,6 | 533,2 | 242,2                | 413,8 | 322,5 | 1,4   | 9,2  | 5,5 |
| 2   | 2                   | I R         | 325,9                | 738,3 | 531,7 | 223,4                | 391,7 | 324,3 | 0,7   | 13,3 | 7,2 |
| 3   | 1                   | II L        | 273,0                | 693,8 | 527,6 | 229,8                | 367,4 | 285,0 | -0,3  | 3,1  | 1,3 |
| 4   | 2                   | II L        | 320,2                | 643,7 | 498,4 | 267,2                | 412,6 | 322,5 | 0,1   | 6,3  | 3,5 |
| 5   | 1                   | II R        | 242,7                | 812,6 | 537,0 | 186,7                | 424,2 | 311,4 | 0   | 8,4  | 4,3 |
| 6   | 2                   | II R        | 284,1                | 766,9 | 521,5 | 230,2                | 415,8 | 319,0 | 0,36  | 13,9 | 7,2 |
| 7   | 1                   | III L       | 261,9                | 679,6 | 469,1 | 192,5                | 467,0 | 326,4 | -4,7  | 13,8 | 3,1 |
| 8   | 2                   | III L       | 305,4                | 721,1 | 498,4 | 276,5                | 437,4 | 343,1 | -1,5  | 14,3 | 3,1 |
| 9   | 1                   | III R       | 115,3                | 901,3 | 507,3 | 192,2                | 514,2 | 357,4 | -3,2  | 13,4 | 4,3 |
| 10  | 2                   | III R       | 110,1                | 1027  | 529,7 | 146,9                | 508,0 | 353,9 | -2,9  | 16,0 | 6,0 |
| 11  | 1                   | IV L        | 117,6                | 876,2 | 505,3 | 305,8                | 526,9 | 391,0 | -0,3  | 17,2 | 7,9 |
| 12  | 2                   | IV L        | 211,7                | 782,7 | 543,0 | 288,7                | 467,6 | 370,3 | -3,9  | 22,1 | 8,3 |



\* app – power take off

Fig. 3. Mean values of the trials of the unit made up of the direct sowing unit tractor U-650 M + no tillage machine Massey-Ferguson MF 534

- the moment resistant to the power plug axis  $Map_{med}$  is between 1,3 daNm at the level II L (trial 1) and 8,3 daNm at the level IV L (trial 2);
- the values of the moment resistant to the power plug axis are low no matter the speed level used since only the ventilator of the direct sowing machine is operated hydrostatically from the tractor's power plug and the necessary energy is low.

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