# STUDIES ON SUPERFICIAL TILLAGE WITH AGGREGATES OF 45 HP, 65HP, 70 HP TRACTORS AND PLOUGHS WITH 2, 3 AND 4 PLOUGH BODIES

# STUDII PRIVIND EXECUTAREA ARĂTURILOR SUPERFICIALE CU AGREGATE FORMATE DIN TRACTOARE DE 45 CP, 65CP, 70 CP, ŞI PLUGURI PURTATE CU DOUĂ TRUPIȚE, CU TREI TRUPIȚE ŞI CU PATRU TRUPIȚE

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***Abstract:*** *Field crop cultivation on wide areas needs superficial tillage 15-20 cm deep in the soil to ensure optimal conditions for sowing and seed germination. From an agro-technological point of view, superficial tillage stores water in the soil and controls weeds, thus ensuring optimal development conditions. Though simple apparently, it should be paid proper attention to get proper quality indices with minimal costs and low fuel consumption.*

***Rezumat:*** *Cultura plantelor de câmp pe suprafeţe mari necesită efectuarea unor arături superficiale la adâncimi de 15-20 cm care să asigure condiţii optime pentru semănat şi germinarea seminţelor. Arătura superficială din punct de vedere agrotehnic păstrează apa în sol şi combate buruienile, asigurând condiţii optime de dezvoltare. Deşi lucrarea pare simplă, trebuie să i se acorde o atenţie deosebită pentru obţinerea unor indici calitativi corespunzători, cu cheltuieli minime şi cu un consum redus de combustibil.*

***Key words****: soil breaking up degree, soil aeration degree, tillage quality, working width;*
***Cuvinte cheie****: grad de mărunţire, grad de afânare, consum de combustibil, adâncime de lucru;*

## INTRODUCTION

Aggregates used to do the superficial tillage are made up of 45, 65, 70 HP and of ploughs with 2, 3 and 4 plough bodies.

The main quality indices of tillage are:

- observing working depth depending on the crop, soil, working conditions, and pre-emergent crop;
- observing plough working width, that influences both tillage quality (soil upsetting and proper row ending) and fuel consumption;
- soil breaking up degree and aggregate working speed;
- soil aeration degree which is a tillage quality indicator;
- plant debris incorporation degree.

The main technical features of ploughs are presented in Table 1.

In order to make the tillage works using the ploughs presented in Table 1 we made the following adjustments:

- adjusting the horizontality of the plough frame longitudinally and transversally, acting on the vertical pullers of the suspension mechanism;
- adjusting plough total working width;
- adjusting first plough body working width;
- adjusting working depth;

- adjusting working depth of the disc knife as well as its position towards the plough body.

*Table 1.*

Technical features of the plough

| Technical features | U.M. | Plough types | | |
|---|---|---|---|---|
| | | **PP-2-30M** | **PP-3-30** | **PP-4-30** |
| Number of plough bodies | Pieces | 2 | 3 | 4 |
| Working width | | | | |
| per plough body | cm | 24-36 | 30 | 30 |
| total | cm | 48, 60, 72 | 90 | 120 |
| Working depth | cm | 15 | 15 | 15 |
| | cm | 20 | 20 | 20 |
| Distance between plough bodies | cm | 750 | 750 | 675 |
| Plough weight | kg | 310 | 415 | 430 |
| Size features | | | | |
| length | mm | 1700 | 2600 | 3050 |
| width | mm | 1290 | 1450 | 1650 |
| height | mm | 1075 | 1150 | 1210 |
| Tractors in the aggregate | CP | 45 | 65 | 70 |

Figure 1 Plough PP-4-30

**RESULTS AND DISCUSSION**

Aggregates we used (tractor + ploughs) were tried on the field of the Didactic Station in Timişoara, in the following working conditions:

- soil type: veric chernozem strongly salinised and alkalinised (below 100 cm) semi-carbonates extremely deep on parental materials bi stratified medium fine. The soil profile has the following horizons: Ap-Ap-Amk-A/cyk-CykG-CyGo-GcaGo-CcaGo-CcaGr;
- specific tillage resistance 0.5-0.6 daN/cm$^2$;
- soil moisture in the (undecipherable) layer 10.5-12.8%;
- previous crop – wheat.

Quality indices resulted from the trials are shown in Table 2.

*Table 2*

Quality indices resulted from the trials

| Aggregate | Medium working depth [cm] | Working depth variation index [%] | Average working width [cm] | Working width variation index [%] | Breaking index [%] | Aeration index [%] | Plant debris incorporation degree [%] |
|---|---|---|---|---|---|---|---|
| Tractor U445 + PP-2-30 | 15.3 | 5.14 | 69.5 | 5.9 | 75 | 23 | 81 |
| | 20.2 | 4.73 | 68 | 5.3 | 71 | 24 | 84 |
| Tractor U650 + PP-3-30 | 15.2 | 4.71 | 93 | 4.4 | 80.1 | 21 | 83 |
| | 20.7 | 4.68 | 92 | 4.1 | 77.1 | 25 | 88 |
| Tractor SAME 70+ PP-4-30 | 15.5 | 4.4 | 1.21 | 4.5 | 81.9 | 24 | 87 |
| | 21.1 | 4.21 | 1.22 | 4.2 | 78.9 | 25 | 91.5 |

Working energy indices of the studied aggregates are presented in Table 3.

*Table 3.*

Working energy indices

| Aggregate | Average working depth [cm] | Average working speed [km/h] | Traction resistance force [daN] | Fuel consumption per hour [c/h] | Fuel consumption per ha [l/ha] | Working capacity per hour Wh [ha/h] |
|---|---|---|---|---|---|---|
| Tractor U445 + PP-2-30 | 15.3 | 4.02 | 585 | 3.97 | 17.1 | 0.21 |
| | 20.2 | 3.82 | 795 | 4.24 | 19.2 | 0.23 |
| Tractor U650 + PP-3-30 | 15.2 | 4.28 | 796 | 5.89 | 16.2 | 0.39 |
| | 20.7 | 4.14 | 1079 | 6.21 | 18.9 | 0.36 |
| Tractor SAME 70+ PP-4-30 | 15.5 | 4.85 | 1026 | 7.95 | 15.1 | 0.59 |
| | 21.1 | 4.52 | 1396 | 8.26 | 17.2 | 0.60 |


Figure 2. Plough PP-3-30

Analysis of the data presented in Tables 2 and 3 show the following:

- working aggregates under study show a proper stability during the working process which also results from the low values of the working depth and working width variation indices;
- the plough PP-2-30 in aggregate with the tractor U-445 achieve, at a working depth of about 15.3-20.2 cm, a soil breaking rate of 71-75%, a soil aeration rate varying between 23 and 24%, and a plant debris incorporation rate between 81 and 84%;
- the plough PP-3-30 in aggregate with the tractor U-650M achieve, at a working depth of about 15.2-20.7 cm, a soil breaking rate of 77.1-80.1%, a soil aeration rate varying between 21 and 25%, and a plant debris incorporation rate between 83 and 88%;
- the plough PP-4-30 in aggregate with the tractor SAME 70 CP achieve, at a working depth of about 15.5-21.1 cm, a soil breaking rate of 78.9-81.9, a soil aeration rate varying between 24 and 25%, and a plant debris incorporation rate between 87 and 91.5%.

Figure 3 Plough PP-2-30

As a result of the trials in the field we could notice, depending on the increasing variation of the working depth, a slight increase of the plant debris incorporation rate with an almost constant soil breaking rate and soil aeration rate.

Working quality indices after the trials with the aggregates presented above meet agro-technical requirements.

We can see that in all the aggregates under study for small variations of the working speed there is a decrease of the fuel consumption per ha and an increase of the aggregate working capacity.

Working time use coefficients in the three aggregates are shown in Table 4.

*Table 4.*

Working time use coefficients

| Coefficient | Aggregate | | |
|---|---|---|---|
| | U-445 + PP-2-30 | U-650 + PP-3-30 | SAME 70 + PP-4-30 |
| Operating time use coefficient | 0.90 | 0.92 | 0.95 |
| Total operating time use coefficient | 0.89 | 0.90 | 0.94 |
| Production time use coefficient | 0.87 | 0.90 | 0.93 |
| Shift time use coefficient | 0.79 | 0.81 | 0.83 |
| Technological service coefficient | 1.00 | 1.00 | 1.00 |
| Technical care coefficient | 0.98 | 0.99 | 0.99 |
| Technological safety and equipment component coefficient | 1.00 | 1.00 | 1.00 |
| Technical safety coefficient | 0.99 | 0.99 | 0.99 |
| Exploitation safety coefficient | 0.99 | 0.99 | 0.98 |

Working capacity of the aggregates and fuel consumption per ha are shown in Table 5.

*Table 5.*

Working capacity and fuel consumption

| Index | UM | Aggregate | | |
|---|---|---|---|---|
| | | U-445 + PP-2-30 | U-650 + PP-3-30 | SAME 70 + PP-4-30 |
| Working capacity of the effective time | ha/h | 0.220 | 0.365 | 0.58 |
| Working capacity during shift | ha/h | 0.169 | 0.298 | 0.418 |
| Fuel consumption | ha/h | 22.52 | 20.80 | 18.51 |

## CONCLUSIONS

Analysing data presented in Table 4 shows that shift time use coefficient had increasing values and that the plough types we monitored are easy to maintain and exploit, and have a high operating duration in exploitation.

As for the fuel consumption per ha (Tables 3 and 5) in the aggregates formed of low power tractors is higher than in high power tractors, while the working capacity increases with the tractor power increase. This points out the fact that, to make superficial tillage works, it is advisable to use higher power tractors in aggregate with larger working width ploughs, i.e. ploughs with more working organs, which leads to a higher working capacity and lower fuel consumption.

## BIBLIOGRAPHY

1.CĂPROIU ŞTEFAN şi colab., Maşini agricole de lucrat solul, semănat şi întreţinerea culturilor. Ed. Didactică şi Pedagogică Bucureşti 1972.

2.ŞANDRU A.N., şi colab. Exploatarea utilajelor agricole. Ed. Didactică şi Pedagogică Bucureşti 1983.

3.TONEA CORNELIA, Maşini agricole şi horticole. Ed. Agroprint Timişoara; 2003

4.TONEA CORNELIA, ILEA RADU, DRĂGOI GHEORGHE, POPA DANIEL LĂZUREANU DAN, Studii privind încărcarea optimă a motoarelor de tractor. Cercetări Ştiinţifice – Horticultură 2004, ISSN 1453-1402.