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MECHANISATION OF MEDIUM SOIL PLOUGHING ON FLAT TERRAIN 30 CM DEEP IN THE SOIL

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Abstract

This paper presents the mechanisation technology of medium soil ploughing 30 cm deep in the soil given that the ploughing area is 100 ha (1000 m x 1000 m) and that the ploughing aggregate is made up of a Deutz Fahr 150 tractor and a LemkenEuropal – 4 reversible born plough. After choosing the movement direction, we identify the turning areas at the ends of the plot. At the beginning, the turning area is market by poles, and then we plough 6-8 cm deep. These marks point to the transport and working position of the plough. The turning areas are worked after the plot is ploughed.

Key words: *mechanisation, technology, exploitation Deutz Fahr*

INTRODUCTION

Plowing work is the oldest work that was applied to the soil and at the same time the most important work.
Ploughs fall into the category of agricultural machinery for soil and are designed to perform plowing, work through which is achieved the detachment of the ground in windrows, shredding and overthrow their depth being determined from the plowed soil layer, creating the conditions necessary for proper plant development .
They are also used for loosening soil (one of the most significant effects are achieved by plowing) and incorporation of crop residues in soil and organic fertilizer or chemicals.
Plowing is done by a loosening of the soil, the soil is incorporated in everything that exists on the surface and in depth structured remove surface soil; it is also used in weeds, diseases and pests control, and soil aeration is also done.
Plowing is assigned some drawbacks: it promotes soil erosion by water on sloping land, destroys soil structure when executed in adverse conditions of moisture and extra work is costly due to the large volume of soil that mobilizes him. [9]
In this context, the objective of the paper was to present the mechanisation technology of medium soil ploughing 30 cm deep in the soil given that the ploughing area is 100 ha (1,000 m x 1,000 m) and that the ploughing aggregate is made up of a Deutz Fahr 150 tractor and a LemkenEuropal – 4 reversible born plough.

MATERIALS AND METHODS

Exploitation parameters of the Deutz Fahr 150 tractor

The technical features of a Deutz Fahr 150 tractor (Figure 1) are:
Weight – 5700 daN
Power – 150 HP (112 kW)
Engine 100.6 – WT (displacement 6 l)
Nominal engine speed – 2300 rot/min
Maximum couple - 57 daNm
Tank capacity 230 l
Spins power outlet 1,000 rot/min.
Completely synthesised gearbox (redactor+inversor), 16 speeds ahead:
1-4L SR=0.36-0.82 km/h
1-4L=1.54-3.51 km/h
1-4N=4.6-10.54 km/h
1-4V=13.82-31.63 km/and 12 speeds back:
1-4L=1.54-3.51 km/h
1-4N=4.61-10.55 km/h
1-4 V=13.82-31.64 km/h

Technical features of the LemkenEuropal – 4 plough

The LemkenEuropal – 4 plough is a reversible born plough.

Its technical features are:

Weight – 4600 N

Body number – 4 double bodies

Working width – 1.2 m (30 cm/body)

Study on based energy.

Ploughing with a reversible plough is done after shuttle routes, with furrows oriented towards the same side of the plot. Ploughing depth is 30 cm.

The resistance force of a ploughing plough is:

$$R_{plug} = K_0 \cdot a \cdot b \cdot n = 5 \cdot 10^3 \cdot 0.3 \cdot 0.3 \cdot 4 = 1{,}800 \text{ daN},$$

where:

K_0 - specific soil resistance to ploughing on medium soil [daN/cm^2];

a - ploughing depth [cm];

b - working width of a body [cm];

n - number of bodies.

Working speed

By comparing the plough resistance to ploughing R_{plug} with the thrust F_t the tractor can develop, we choose the 2nd quick gear speed ($8.2\ km/h = 2.3\ m/s$) to plough.

Taking into account the sliding of the running gears ($\delta = 0.15\ \%$), the working speed is:

$$v_l = v_t(1-\delta) = 2.3(1-0.15) = 2\ m/s = 7.2\ km/h$$

Working capacity of the ploughing aggregate

The hourly real working capacity is calculated with the formula:

$$W_h^r = 0.1 \cdot B_l \cdot v_l \cdot K_s = 0.1 \cdot 1.2 \cdot 7.2 \cdot 0.8 = 0.75\ ha/h$$

The shift real working capacity is calculated with the formula:

$$W_{sch}^r = W_h^r \cdot T_s = 0.75 \cdot 8 = 6\ ha/sch.$$

RESULTS AND DISCUSSIONS

Calculus and making up the ploughing aggregates.

The technological exploitation chart of the ploughing aggregate (tractor Deutz Fahr 150 + born reversible plough LemkenEuropal – 4) contains the indices: working conditions (land features), cultivation requirements, aggregate features and aggregate preparation, land preparation, working organisation and quality control.

The working regime is established by taking into account engine and tractor load.

The chart also contains the most important organisation indices of the technological process (movement cycle duration, area ploughed, fuel consumption per ha).

The area to be ploughed is 1000 m x 1000 m (100 ha).

Working the land with the LemkenEuropal - 4 plough is done by moving the aggregates along linear routes (shuttle routes).

Preparing the land

This requires the following:

Checking and removing the causes that prevent the machines from working;

Identifying return areas and choosing the most efficient moving methods;

Dividing the land into plots and marking the line of the first turn.

Table 1. Exploitation indices of the tractor – plough aggregate Deutz Fahr 150 + LemkenEuropal – 4

Basic indices	Technological features	
Land features	Area to be ploughed	100 ha
	Plot length	1,000 m
	Land relief	flat
	Specific resistance	K0 = 5,000 daN/m^2
Technical requirements	Ploughing depth	30 cm
	Degree of plant waste incorporation	over 90%
Features of the aggregate and preparation	Working width	1.2 m
	Turning radius	5 m
	Adjustment of working depth	
	Adjustment of plough horizontality	
Land preparation	Width of turning radius	15 m
	Number of plots	4
	Marking control line with control furrow	
Work organisation	Hourly working capacity	0.75 ha/h
	Shift working capacity	6 ha/shift
	Fuel consumption	26 l/ha
	Movement pattern	shuttle route
Quality control	Measurement of working depth	Abatement: ±1 cm
	Control of plant debris incorporation	90%

Fuel consumption per ha C_{ha} is calculated depending on the hourly consumption C_h^r and on the hourly real working capacity W_h^r:

$C_c = C_h^r / W_h^r = 35 : 0.75 = 26\ l/ha$

To plough 100 ha in 4 days, we need 4 ploughing aggregates.

Exploitation indices of the tractor – plough aggregate are shown in Table 1.

The technological mechanisation chart for ploughing contains the ploughing expenses per ha.

Expenses per ha are:

$C_S = C_m \cdot S = 2.66 \cdot 9 = 24$ RON/ha.

Fuel expenses C_c are established depending on the fuel consumption G_{ha} (l/working unit) and on fuel cost p_l (RON/l):

$C_c = G_{ha} \cdot p_i = 26 \cdot 5 = 130$ RON/ha

Expenses for the amortisation of the aggregate C_A are:

$$C_{Atractor} = \frac{V_i - V_r}{W_{sch}^r \cdot n_s \cdot n_z \cdot D} = \frac{45,000}{3 \cdot 250 \cdot 10} = 6$$
RON/ha

$$C_{Aplug} = \frac{V_i - V_r}{W_{sch}^r \cdot n_s \cdot n_z \cdot D} = \frac{7,000}{3 \cdot 250 \cdot 8} = 1.2$$
RON/ha

$C_A = 6 + 1.2 = 7.2$ RON/ha.

For the tractor, expenses for technical assistance are calculated with the formula:

$$C_{dttractor} = \frac{V_i \cdot G_{ha}}{C_n} = \frac{45,000 \cdot 26}{96,000} = 12.3$$
RON/ha

where:

V_i - inventory value (RON)
G_n - fuel consumption per service (l)
C_{ha} - fuel consumption per ha (l).

For the plough, technical assistance expenses are calculated with the formula:

$$C_{dtplug} = \frac{V_i}{W_n} = \frac{7,000}{2,000} = 3.5 \text{ RON/ha}$$

where:

V_i - inventory value (RON)
W_n - work volume per service (ha).

Expenses for technical assistance of the aggregate are:

$C_{dt} = 12.3 + 3.5 = 15.8$ RON/ha.

Direct expenses per ploughed ha are:

$C_d = C_S + C_c + C_A + C_{dt} = 24 + 130 + 7.2 + 15.8 = 177$ RON/ha.

Table 2. Technological chart of ploughing mechanisation (expenses per ha)

Economic indices		**RON/ha**
Direct expenses, of which	C_d	**177**
- retributions	C_S	24.0
- fuel	C_c	130.0
-reduction in value	C_A	7.2
-technical assistance	C_{dt}	15.8
Auxiliary expenses	C_{ac}	**35**
TOTAL	C_T	**212**

Auxiliary expenses C_{ac} are expenses for main and auxiliary materials, for the storage and maintenance of the tractors and of agricultural machines. They are shown as percentage (15-20%) of direct expenses.

$C_{ac} = 0.2 \cdot 177 = 35$ RON/ha.

The total costs per ploughed ha are:

$$C_T = C_d + C_{ac} = 177 + 35 = 212$$

RON/ha.

Calculated technological indices are synthesised in the technological mechanisation chart of ploughing (Table 2).

CONCLUSIONS

Ploughing with a reversible plough is done after shuttle routes, with furrows oriented towards the same side of the plot.

Ploughing depth is 30 cm.

By comparing the plough resistance to ploughing R_{plug} with the thrust F_t the tractor can develop, we choose the 2nd quick gear speed ($8.2\,km/h = 2.3\,m/s$) to plough.

To plough 100 ha in 4 days, we need 4 ploughing aggregates.

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