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 (reductor+inversor), 16 speeds ahead:
1-4L SR=0.36-0.82 km/h
1-4L=1.54-3.51 km/h
1-4N=4.69-10.54 km/h
1-4V=13.82-31.63 km/h and 12 speeds back:
1-4L=1.54-3.51 km/h
1-4N=4.61-10.55 km/h
1-4L=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:
\[ R_{plug} = K_0 \cdot a \cdot b \cdot n = 5 \cdot 10^3 \cdot 0.3 \cdot 0.3 \cdot 4 = 1,800 \text{dN}, \]
where:
- \( K_0 \) - specific soil resistance to ploughing on medium soil [dN/cm²];
- \( a \) - 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.

Working capacity
The hourly real working capacity is calculated with the formula:
\[ W_h = 0.1 \cdot B_{1} \cdot v_{1} \cdot K_{s} = 0.1 \cdot 1.2 \cdot 7.2 \cdot 0.8 = 0.75 \text{ha/h}, \]
The shift real working capacity is calculated with the formula:
\[ W_{sch} = W_h \cdot T_s = 0.75 \cdot 8 = 6 \text{ha/sch} . \]

RESULTS AND DISCUSSIONS

Calculating 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).

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

<table>
<thead>
<tr>
<th>Base index</th>
<th>Technological features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land features</td>
<td>Area to be ploughed 100 ha</td>
</tr>
<tr>
<td>Plot length</td>
<td>1,000 m</td>
</tr>
<tr>
<td>Land relief</td>
<td>flat</td>
</tr>
<tr>
<td>Specific resistance</td>
<td>( K_0 = 5,000 \text{dN/m}^2 )</td>
</tr>
<tr>
<td>Technical requirements</td>
<td>Ploughing depth 30 cm</td>
</tr>
<tr>
<td>Degree of plant waste incorporation</td>
<td>over 90%</td>
</tr>
<tr>
<td>Features of the aggregate and preparation</td>
<td>Working width 1.2 m</td>
</tr>
<tr>
<td>Adjustment of working depth</td>
<td>5 m</td>
</tr>
<tr>
<td>Adjustment of plough horizonality</td>
<td></td>
</tr>
<tr>
<td>Land preparation</td>
<td>Width of turning radius 15 m</td>
</tr>
<tr>
<td>Number of plots</td>
<td>4</td>
</tr>
<tr>
<td>Marking control line with control furrow</td>
<td></td>
</tr>
<tr>
<td>Work organisation</td>
<td>Hourly working capacity 0.75 ha/h</td>
</tr>
<tr>
<td>Shift working capacity</td>
<td>6 ha/shift</td>
</tr>
<tr>
<td>Fuel consumption</td>
<td>26 l/ha</td>
</tr>
<tr>
<td>Movement pattern</td>
<td>shuttle route</td>
</tr>
<tr>
<td>Quality control</td>
<td>Measurement of working depth Abatement: ( \pm 1 \text{cm} )</td>
</tr>
<tr>
<td>Control of plant debris incorporation</td>
<td>90%</td>
</tr>
</tbody>
</table>

Fuel consumption per ha \( C_{ha} \) is calculated

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depending on the hourly consumption \( C'_h \) and on the hourly real working capacity \( W'_h \):
\[
C_c = \frac{C'_h}{W'_h} = 35 \cdot 0.75 = 26 \text{ l/ha}
\]
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:
\[
C_S = C_m \cdot S = 2.66 \cdot 9 = 24 \text{ RON/ha}.
\]

Fuel expenses \( C_c \) are established depending on the fuel consumption \( G_{fa} \) (l/working unit) and on fuel cost \( p_i \) (RON/l):
\[
C_c = G_{ha} \cdot p_i = 26 \cdot 5 = 130 \text{ RON/ha}
\]

Expenses for the amortisation of the aggregate \( C_A \) are:
\[
C_{tractor} = \frac{V_i - V_r}{W_{sch} \cdot n_s \cdot n_z \cdot D} = \frac{45,000}{3 \cdot 250 \cdot 10} = 6 \text{ RON/ha}
\]
\[
C_{plug} = \frac{V_i - V_r}{W_{sch} \cdot n_s \cdot n_z \cdot D} = \frac{7,000}{3 \cdot 250 \cdot 8} = 1.2 \text{ RON/ha}
\]
\[
C_A = 6 + 1.2 = 7.2 \text{ RON/ha}.
\]

For the tractor, expenses for technical assistance are calculated with the formula:
\[
C_{dtractor} = \frac{V_i \cdot G_{ha}}{C_n} = \frac{45,000 \cdot 26}{96,000} = 12.3 \text{ RON/ha}
\]

For the plough, technical assistance expenses are calculated with the formula:
\[
C_{dplug} = \frac{V_i}{W_n} = \frac{7,000}{2,000} = 3.5 \text{ RON/ha}
\]

\[
V_i - \text{inventory value (RON)}
\]
\[
W_n - \text{work volume per service (ha)}.
\]

Expenses for technical assistance of the aggregate are:
\[
C_{dt} = 12.3 + 3.5 = 15.8 \text{ RON/ha}.
\]

Direct expenses per ploughed ha are:
\[
C_d = C_S + C_c + C_A + C_{dt} = 24 + 130 + 7.2 + 15.8 = 177 \text{ RON/ha}.
\]

<table>
<thead>
<tr>
<th>Economic indices</th>
<th>RON/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct expenses, of which</td>
<td></td>
</tr>
<tr>
<td>- retributions</td>
<td>( C_S )</td>
</tr>
<tr>
<td>- fuel</td>
<td>( C_c )</td>
</tr>
<tr>
<td>- reduction in value</td>
<td>( C_A )</td>
</tr>
<tr>
<td>- technical assistance</td>
<td>( C_{dt} )</td>
</tr>
<tr>
<td>Auxiliary expenses</td>
<td>( C_{ac} )</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>( C_T )</td>
</tr>
</tbody>
</table>

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.

\[
C_{ac} = 0.2 \cdot 177 = 35 \text{ RON/ha}.
\]

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 ($8.2 \text{ km/h} = 2.3 \text{ m/s}$) to plough.

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