STUDY CONCERNING THE PREPARATION OF THE SEEDBED USING COMBINERS

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ABSTRACT

Combiners from domestic production in use are not equipped with additional components for grinding and leveling and not achieved the work of the soil with the same qualitative indices that those of known companies in the world.

New mechanization technology using combiners includes soil work by removing the stubble height and preparation of the seedbed on fresh tillages or on no-till fields, on which it is established summer-autumn crops.

The constructive solutions made by the big companies producing agricultural machinery included in the construction combiners the following: a leveling blade located in front of a helical steamroller, three fields of active components, a second helical steamroller, followed by the second leveling blade and a row of elastic talons.

INTRODUCTION

The plants sown in a proper seed stock develop better than plants to which the seedbed is seated on the globs of ground which hinder the ingress of water to the roots of plants (Hera C., 1999).

At present, in our country, the preparation of the seedbed on summer-autumn tillage is achieved (in most cases) with slight discs harrows (for tractors of 65 HP), with specialized combiners, or with heavy harrows intended for the great powers tractors (Cojocaru I. și colab, 2000).

Preparing the seedbed with slight discs harrows lead to a high fuel consumption, to increase the employment and the duration of the working campaign and also for the execution of a incorrectly seedbed, in conditions with low humidity of the soil.

In this context, the aim is to promote set combiners with vibration active components and additional grinding components intended for the great powers tractors, for perfecting and improving the technology of preparation of the seed stock on fresh tillages on which are established summer-autumn crops (Alexandru T., 2010; Bădescu M. și colab., 2005 ; Ciulu Gh. și Gh. Bârcă, 2002).

Spring, frozen tillages cannot be processed with discs, because in the process of working, soil processed overturns (the wet part rises on the top) and lost of a large amount of water by evaporation. In this case is indicated soil processing only with combinesrs, because in their work process is not occur the overturning of the ground (Alexandru T. și M. Glodeanu, 2009; Glodeanu M. și colab., 2015; Glodeanu M. și colab., 2001).

MATERIAL AND METHODS

- **Presentation of the combiner used at experimentations**

KONGSKILDE company from Denmark has achieved a range of set combiners (in four work variants), with different constructive solutions compared with the majority of set combiners carried out in the world.

The construction of these set combiners is as follows: a steamroller with rods, equipped with five independent rotors located in front of the leveling blade (which is made up of five sections to follow the soil profile on the transverse direction), followed by four rows of active organs (behind of these being located helical harrows with rods) (fig. 1).

Fig.1. a) Set combiner achieved by KONGSKILDE company; b) The layout of the active components.

The active components of the type raising claws are mounted on elastic mounts, in the form of S, which allows a vibration of components. The combiner has a work width of 6 m. The limitation of the working depth is achieved by rods helical harrows which are operated by means of the adjustable tie-rods.

- **Test method**

In the tests were determined or calculated in accordance with the procedures in force, following indices (Alexandru T. și M. Glodeanu, 2009; Ciulu Gh. și Gh. Bârcă, 2002; Glodeanu M. și colab., 2015):

a) ***Qualitative indexes of work:***

1) <u>Average working depth (a_m)</u> in cm. It is calculated with the following relation:

$$a_m = \frac{\sum_{1}^{n} a_i}{n} \quad [\text{cm}] \tag{1}$$

where: a_i is the working depth, measured cm;

n - number of measurements performed.

2) <u>Average width (B_m)</u> in cm, with aid of relation:

$$B_m = \frac{\sum_{1}^{n} B_i}{n} \quad [\text{ m }] \tag{2}$$

where: B_i is the working width, measured in m;

n - number of measurements performed.

3) <u>The shredding soil degree (G_{ms})</u> in%.

The main indicator of the work quality is the shredding degree of soil. For determinations was delimited a soil sample with size of 1m x 1m (using metric frame). From the sample were separated soil fractions with size of less than 50 mm, from the lumps with size larger than 50 mm.

Shredding soil degree is the proportion by weight of soil fractions with a satisfactory shredding, respectively lumps with the size of maximum 50 mm (reported to the total weight of the soil sample) It is calculated using the following equation:

$$G_m = \frac{\sum_{1}^{n} \frac{M_{ci}}{M_{ti}}}{n} \cdot 100[\%] \tag{3}$$

where: M_{ci} is the measured weight of the lumps of soil with maximum conventional size less of 50 mm, from the soil sample [kg];

M_{ti} – the measured weight of the whole soil samples taken [kg].

Weighings have been performed with a portable scale, with a permissible relative error of 1%.

4) The destruction of plant debris degree, in in %. It is calculated using the relation :

$$G_V = \frac{\sum_{1}^{n} \frac{G_{ti} - G_{Si}}{G_{ti}}}{n} x100 [\%] \quad (4)$$

where: G_{si} is the measured weight of remained plant mass on the soil surface, from the sample taken after switching equipment, in g;

G_{ti} - total weight of plant mass from the ground surface measured before switching equipment, in g.

n - number of measurements performed;

5) Soil loosening degree in %. Is determined with relation:

$$G_{as} = \frac{\sum_{1}^{n} \frac{h_1 - h_2}{h_2}}{n} \cdot 100 [\%] \quad (5)$$

where: h_1 is the distance to the ground before disking, in cm;

h_2 - the distance to the ground after disking, in cm.

b) ***Energy indices:***

1) Effective working speed (V_e) in km / h. It was calculated using the relation:

$$V_e = \frac{3{,}6s}{t} \; [\text{km/h}] \quad (6)$$

where: s is the covered linear space, in m;

t - travel time of the covered space, in s;

2) Fuel consumption per hectare (q) in l / ha. It was calculated with the relation:

$$q = \frac{Q}{W_{ef}} \; [\text{l/ha}] \quad (7)$$

where: Q - is the hourly fuel consumption in l/h;

W_{ef} - hourly work capacity at effective time, in ha/h.

3) Hourly work capacity at the effective time (W_{ef}), in ha / h. It was calculated with the relationship:

$$\boldsymbol{W_{ef}} = 0{,}1\boldsymbol{B_m v} \; [\text{ha/h}] \quad (8)$$

where: B_m is the average working width, in m;

v – real working speed in km/h.

RESULTS AND DISCUSIONS

Tests under laboratory and field conditions-operation were carried out in aggregate with tractor JOHN DEERE 6030 (180 HP) and KONGSKILDE combiner**,** during April 2017 - October 2017, in accordance with specific test procedures (fig. 2).

Field tests - lab were performed in the following conditions:

- Soil type: Brown cernosiom degraded

- Previous culture: wheat

Spring tests were performed at a soil moisture of:

- 0 – 10 cm – 16...18 %;
- 10 – 20 cm – 15...17 %;
- 20 – 30 cm – 14...16 %.

Fig. 2. Aspects during working with KONGSKILDE combiner.

The main qualitative indices of work achieved are presented in table 1.

Table 1

Qualitative indices of work achieved at field-lab tests

Characteristic	Value	
Work width[m]	6,00	6,00
Work speed [km/h]	**12,72**	**13,85**
Wheel spin [%]	7,5	9,2
Hourly fuel consumption [l/h]	**18,25**	**21,36**
Specific fuel consumption [l/ha]	**4,82**	**5,21**
Work depth [cm]	10,2	9,7
Uniformity of the work depth [%]	82,2	86,6
Shredding soil degree [%]	**93,2**	**86,6**
Leveling degree [%]	89	88
Work capacity [ha/h]	7,6	8,2

Analyzing the data base from table 1 results the following:
- that the achieved work índices meet the requirements imposed to the preparation of the seed stock;
- the value of the shredding soil degree is over 85%;
- the value of the leveling degree is over 88%;
- achieved exploitation indices shown that the fuel consumption per unit of surface has values between 4,82…5,21 l/ha.

To put in evidence the advantages of combiners using were achieved comparative tests between the technologies of the preparation of the seedbed. All the works have been carried out with the U-650 tractor, using GDU-3,4 discs harrow.

The results of comparative tests are presented in table 2.

Table 2

Productivity and consumption indices obtained at tests

Working variant	Specific consumption				Shredding soil degree
	Labour		Fuel		
	Hours men/ha	%	l/ha	%	
plowing+work with harrow - 2 passes	3,15	100	43,86	100	**98,7**
plowing+work with harrow - 1 pass	2,94	**93,3**	38,5	**87,8**	**84,1**
plowing +combiner - 2 passes	2,82	**89,5**	37,6	**85,7**	**99,2**

From the above data base it can be ascertained that:

- the work of preparation of the seedbed with discs harrows (2 passes) is not comparable from the point of view of the quality with the work with combiner (a single pas); in these conditions is achieved a reduction of the fuel consumption with 14,3%;
- lower qualitative indices links are obtained at the preparing of the seed stock through a work with the harrow; in this case the fuel consumption has dropped with 12,2%, compare with the variant with two passes; also in this case the fuel consumption is with 2,1% higher than in the case of processing the soil using the combiner.

➢ The influence of the seedbed preparing method on the maize crop

The results of tests carried out in three variants of technology, for the crop of maize (for a plants density of 59000 – hybrid OLT) are presented in table 3.

From the point of view of production the diference between the plowing+working with harrow (2 passes) and plowing+combiner is 6,2%, the production being with15,23% lower in addition to the case of preparing through a single work with the harrow.

Specific fuel consumption per unit of the product has the lower value in the case of soil preparation through only one work with the harrow, being with 40,9% smaller than the work with the harrow through two passes.

In the case of the variants of preparing the seedbed with discs harrow and combiner it is found that we have an increase of production per hectare of 536 kg/ha, in conditions of an reduction of fuel consumption by 14,8% (for the second variant).

Table 3

The influence of the seedbed preparing method on the maize crop

Variant of preparing the seedbed	Average production		Specific fuel consumption for the work of mobilization	
	q/ha	%	l/t	%
Plowing+work with harrow- 2 passes	86,0	100	12,18	100
Plowing+combiner- 2 passes	91,36	106,2	10,38	85,2
Plowing+work with harrow-1 pass	72,85	84,71	7,32	60,1

CONCLUSIONS

From the analysis of data obtained in the tests resulted the following conclusions:

- combiners are are agricultural machinery suitable for the preparation of the seedbed, because during their work process does not produce overturning of the the ground;

- the constructive solutions made by the big companies producing agricultural machinery included in the construction combiners the following: a leveling blade located in front of a helical steamroller, three fields of active components, a second helical steamroller, followed by the second leveling blade and a row of elastic talons;

- the tests achieved in three variants for the preparation of the seedbad show that:

- performed qualitative indices of work meet the requirements imposed to the preparation of the seedbed;
- shredding degree has values over 85%, and the leveling degree is over 88%:
- Appropiate qualitative indices are obtained at the work of preparation of the seed stock with the harrow (two passes), with a fuel consumption less than 27,7 %;
- the achieved qualitative indices shown that the fuel consumption per surface unit has values between 4,82…5,21 l/ha;
- At the soil preparation through a single pas with the combiner is achieved a reduction of fuel consumption with 26,1%;
- The method of preparing the seedbed using combiners is more efficiently from the point of view of fuel consumption (24,8% compare with plowing+work with harrow through two passes) and also from the production point of view, which is higher by 6,2%.

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