HARVESTING GRAIN MAIZE WITH A CASE-IH 7088 SELF-PROPELLES COMBINE

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Abstract. *Grain maize harvesting self-propelled combines have two main sub-ensembles: cob collector and thrasher.The cob collector detaches the cobs from the stem, carrying the leafless cobs to the thrasher, and chopping the stems. The chopped stems can be collected in the tow or they can be spread to be incorporated in the soil.The thrasher thrashes the cobs, separates the grains from impurities, and carries the grains to the bunker. The objective of this study were shortening the harvesting period and increasing work productivity. To reach these goal and to rationally operate the combines, we need to prepare the field for harvesting, to choose the way the combine will move in the field, to ensure transportation means, etc. harvesting grain maize was done on an area of 100 ha with a CASE IH 7088+CS8 harvesting combine. The plot was divided so that useless moves of the combine in the field be minimal and the number of rows be a multiple of four. The combine movement pattern is in linear routes with double U turns without overlapping loops. The working capacity of grain maize harvesting combines is given by the amount of maize or by the harvested area per time unit corresponding to cultivation technology requirements in t/h or ha/h, and also on working conditions. The combine working speed is chosen depending on maize yield per ha and on the thrasher flow, to avoid the combine being overloaded. For the work aimed at, the CASE-IH 7088 + CS-8 self-propelled harvesting combine harvested maize along eight rows at a working width of 5.6 m. The combine was equipped with a Diesel engine of 325 HP with an hourly productivity of24 t/h for a feeding flow of the thrasher of 18 kg/s. for a production of 6 t/ha, fuel consumption was 11.2 l/ha (1.9 l/t) and totals costs with grain maize harvesting were 79.5 RON/ha, i.e. 13.3 RON/t. To produce more per area unit with low costs, we need to strictly observe the cultivation technology by using very complex aggregates with higher productivity.*

Keywords*: mechanisation technology, self-propelled combine, harvesting, maize*

INTRODUCTION

Studies regarding the mechanisation technology for grain maize harvesting with a CASE-IH 7088 self-propelled harvesting combine in Sântana, Arad County, Romania, on 100 ha. The farm has 6 CASE tractors, 3 ploughs, 2 combinators, 3 sowing machines, 1 CASE IH 7088 + CS 8 combine, 1 mower, 2 rakes, and 2 balers.

The technological process of the cob collector is as follows: the maize plants go through the detachment plates to the rolls rotating anti-clockwise one towards the other pulling the stems downwards.

The detaching plates detach the maize cobs from the stems and the cobs are taken by claw chains and carried to the transversal spiral trough.

MATERIAL AND METHOD

Grain maize harvesting process is as follows:

The combine advances in the field and the detaching sectors in the cob collector detach the cobs from the stems.

The detached cobs are carried to the thrasher and the stem are chopped and spread over the soil. Thrashing produces two fractions:

-The first fraction, which does not go beyond the counter-beater of the thrasher, is directed by the post-beater to the separation system and contains fragments of cobs and stems, husks and grains. The grains are recovered from the separation system and directed to the cleaning system, while the other components go to the rear of the thrasher and fall on the stump.

-The second fraction is directed by the cleaning system and passes through the counter-beater of the thrasher containing good grains, cob and stem fragments, as well as other vegetal and mineral fragments. The cleaning system separate the good grains from the other impurities through sieving and ventilating. The good grains are overtaken by the grain spiral and grain elevator and carried to the bunker.

The spirals take the cobs to the rubber plate and are then introduced into the main elevator and carried inside the combine. Cob detachment from the stems by the plates above the rolls ensue minimum damage to the cobs. The distance between the plates is chosen so that they pass freely and avoid touching the rolls.

The CASE-IH self-propelled harvesting combine has a CS-8 cob collector for eight row, and is equipped with a Diesel engine with a nominal power of 325 HP. Below are the exploitation indices depending on the engine features:

- Nominal power: $P_n =$ 242 kW = 325 HP;
- Engine nominal speed: n_m = 2000 rot/min (ω_m = 210 rad/s);
- Nominal engine momentum: M_e = 96 daNm;
- Hourly fuel consumption: G_h = 46 kg/h = 54 l/h;
- Specific fuel consumption: g_s = 215 g/HPh.

The CASE-IH 7088 combine is characterised by the following parameters:

- Working width: $B_l = 8 \times 0.7 = 5.6$ m;
- Thrasher feeding flow: q = 18 kg/s.

Combine real working capacity is:

$$W_h^r = \frac{3600 \cdot q \cdot K_s}{m_b \cdot \left(1+\delta_p\right)} = \frac{3600 \cdot 18 \cdot 0{,}75}{6000\left(1+1\right)} = 4 \text{ ha/h = 24 t/h}$$

Working capacity per shift is:

$$W_{sch}^r = W_h^r \cdot T_s = 4 \cdot 8 = 32 \text{ ha/shift =192 t/shift.}$$

RESULTS AND DISCUSSION

Calculus of operating indices

Harvesting area: 100 ha.

Plot number: n_p = 4 plots.

Plot length: *l = 250 m*

Turning area width: *E=33,6 m* (48 rows).

Working movement length: L_1= L-2*E=930 m

Mean useless movement length L_g is calculated with the relation: L_g = 3*R+0,5 l=3*10+100=130 m.

Working speed is calculated with the relation:

$$v_l = \frac{10000 \cdot q}{m_b\left(1+\delta_p\right)\cdot B_l} = \frac{10000 \cdot 18}{6000(1+1)\cdot 5{,}6} = 2{,}7\ m/s = 9{,}6\ km/h.$$

If working speed equals useless moving speed, a cycle will take:

$$T_c = \frac{L_l \cdot n_l}{v_l} + \frac{L_g \cdot n_g}{v_g} = \frac{(943+130)\cdot 2}{2{,}7} = 795\,sec.$$

Theoretical area per cycle is calculated with the relation: $W_c = \frac{L_l \cdot n_l \cdot B_l}{10^4} = \frac{930 \cdot 2 \cdot 5{,}6}{10000} = 1{,}04\ ha/ciclu$.

Hourly theoretical working capacity is: $W_h = 3600 \cdot \frac{W_c}{T_c} = 3600 \cdot \frac{1{,}04}{795} = 4{,}71\,ha/h$.

Fuel consumption per ha C_{ha} is calculated with the relation:W.

Calculus of economic indices

The number of h/combine is: $C_a = \frac{T_s}{W_{sch}^r} = \frac{8}{32} = 0{,}25$ combine-h/ha.

The coefficient C_m is: $C_m = C_a \cdot m = 0{,}25$ man-h/ha.

Production costs

Direct costs C_d are calculated with the relation: $C_d = C_S + C_c + C_A + C_{dt}$

Wages costs are: $C_S = C_m \cdot S = 0{,}25 \cdot 11{,}4 = 2{,}9$ RON/ha.

Fuel costs C_c are: $C_c = G_{ha} \cdot p_i = 11{,}4 \cdot 4 = 45{,}6$ RON/ha = 7.6 RON/t.

Aggregate amortisation costs C_A are: $C_A = \frac{V_i - V_r}{W_{sch}^r \cdot n_s \cdot n_z \cdot D} = \frac{180000}{32 \cdot 90 \cdot 10} = 6{,}3$ RON/ha = 1.1 RON/t.

Aggregate technical assistance costs C_{dt} are: $C_{dt} = \frac{V_i \cdot G_{ha}}{C_n} = \frac{180000 \cdot 11{,}4}{180000} = 11{,}4$ RON/ha = 1.9 RON/t.

Direct costs per worked ha are: $C_d = C_s + C_c + C_A + C_{dt}$ = 2.9+45,6+6,3+11,4=66,2 RON/ha.

Direct costs per t of grain are: C_d = 66: 6= 11RON/t.

Auxiliary costs C_{ca} = 0,2*66=13,3 RON/ha = 2.2 RON/t.

Total costs per worked ha are: $C_T = C_d + C_{ac}$ = 66,2+13,3=79,5RON/ha = 13.2 RON/t.

CONCLUSIONS

Taking into account that maize harvesting mechanised works have advanced considerably lately at world level, the most important aspect concerns the choice of optimal operating regimes allowing productivity and quality increase and costs reduction. Analysis of literature points out concerns of scientific research regarding the improvement of self-propelled grain maize harvesting combines and cob collectors to meet increasing requirements in work quality and quantity. Besides choosing the most economic variants of mechanisation technology in harvesting grain maize, other important ways of reducing costs are to be recommended, such as: periodical technical maintenance, observing optimum feeding flow of the thrasher by correlating the working speed with field yield, avoiding useless movements of the combine during the day from one plot to another, unloading the bunker while working, ensuring daily working norm for each combine, adjusting the equipment depending on the maize cultivar being harvested, etc. To get high yields per area unit with low costs, we need to strictly observe cultivation technologies by using complex aggregates with high yielding capacity.

BIBLIOGRAPHY.

1.ANIŞOARA DUMA COPCEA, R. ILEA, I. CRÎSTA, 2017, Studies regarding grain loss in straw cereals, Research Journal of Agricultural Science, 49 (1). https://www.rjas.ro/paper_details/2440

2. CANARACHE A., 1997 - Însuşirile fizice ale solurilor agricole din Banat, Lcr. şt. Ale S.N.R.S.S. Timişoara.

3. ILEA R., 2013 Exploatarea agregatelor agricole, Timișoara.

4. MIHUȚ CASIANA – Fizica solurilor agricole Agricultural EdituraAgroprint, Timișoara 2014.

5.* * * *Reviste de "Mecanizarea agriculturii"colecţia 2000 - 2012.*