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Raising Productivity Of Harvesting Using The Combing Method.

IN Semov*, ON Kukharev, and MA Fedin.

Department of Technical Sciences (Penza SAU)

ABSTRACT

The article deals with the problem connected with using combing methods in harvesting grain crops, grass seeds. The authors describe method of the experiment on determining optimal construction and regime parameters of modernized rotor of combing reaper and present the results of testing.
Keywords: combing reaper, harvesting, losses, rotor, comb with tangential channel, testing results.

Corresponding author

INTRODUCTION

The introduction of intensive technologies in the cultivation of grain crops and grass seeds such as no-till, mini-till stipulates a sharp increase in the requirements for the distribution of plant residues on the field, as well as reducing the cost of harvesting. A harvesting method based on combing only the grain part of the plant obtains these qualities. The characteristic advantages of the method are: evenly distributed non-cut stubble, an increase in the productivity of harvesting units by 35-50%, a decrease in fuel consumption by 20-25%.

When harvesting flax seeds by combing method, there is an increase in productivity of the harvesting unit by 50-60%. All these advantages are formed from the fact that straw does not enter the milling device of the combine, reducing loading of the threshing-separating bodies of the combine harvester, in this connection losses of grain behind the grind decrease, and productivity of the combine unit increases [1].

MATERIALS AND METHODS

Nowadays, there are three main producers of combing harvesters on the present day market, such as Shelboyrne Reynolds (Great Britain), PJSC Penzmash (Russian Federation) – OZONE harvesters and UKR. Agro-Service (Ukraine) – harvesters "Slavyanka". Foreign reapers are very expensive for the domestic agricultural producer, they are very expensive to operate and are not always adapted to the domestic working conditions. To solve this problem, Penza state agrarian university (PSAU) in cooperation with PJSC "Penzmash" developed an experimental design of the combing rotor, which allows to operate at high speeds with minimal losses (figure 1) [2].

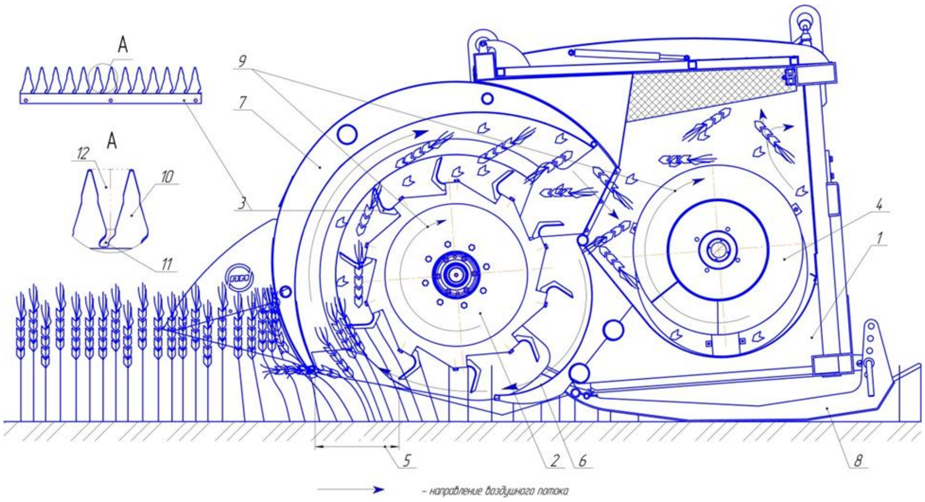

Figure 1: Technological scheme of operation of single-rotor reaperwith upgraded combing rotor 1 – frame; 2 – the combing rotor; 3 – removable combs; 4 – screw; 5 – zone forcombing; 6 – concave; 7 – a cowl; 8 – boot; 9 – directions of rotation of the screw and rotor

The object of the research was the process of combing the spike part of the plant with the rotor.

The subject of the research was the regularities, conditions and modes of combing the spike part of the plant with the combing rotor, as well as the calculation of percentage of grain losses after combing.

The criterion for assessing the optimality of operation was a generalized indicator – the percentage of grain losses.

The rate of grain loss behind the combing reaper depends on many factors. In this regard laboratory researches were carried out using methods of planning of multi-factorial experiment [3, 4].

During the experiments sowings of spring wheat varieties "Daria" yield of 35 kg / ha, plant height of 1 m, 35% rooting, grain moisture of 25%, with losses from self-shattering were used.

For the experiment, the combing reaper JO-6 "OZONE" hung on the combine "New Holland CS6090" was used, then instead of the rotor the authors installed the upgraded rotor and carried out testing.

The sequence of experiments was following: preliminary setting up and preparation of the device for carrying out the experiment. For this purpose a cowling together with a serial rotor was removed and the modernized sample of the rotor was installed. It was equipped with combs with the tangential channel (Figure 2).

Figure 2: Comb with tangential channel

Depending on the required speed and the desired frequency of rotation of the combing rotor for the experiment, the frequency of rotation of the combing rotor is regulated by switching speeds on the gearbox.

EXPERIMENTAL PART

After the preparatory work on the field and at the laboratory the experiment was started.

The main factor evaluating the quality of operation of the combing reaper is losses of grain behind the reaper.

Determining the optimal value of the width of the combed area and the forward speed of the harvester, the authors selected factors that have a significant impact on the percentage of grain losses:

s - width of the gap between the combing teeth of the comb of the central tube of the frame, mm; z – the number of rows of the combing combs, units; $h_{combing}$– height of reaper combing, mm; n – frequency of rotation of the combing rotor, min(-1); b– the width of the tangential channel of the combing comb, mm; γ – the installation angle of the combing combs, degree, *l*– the length of the tangential channel of the combing comb, mm; α –pitch angle of the combing tooth of the comb, degree.

The change in the number of rows of combing combs was done by removing a row from the combing rotor. The installation angle of the combs, the width of tangential channel of the comb, the length of the tangential channel, and the pitch angle of the tooth of the comb were changed with specially made removable combs that were changed in rows in one section [5].

In order to determine the optimal width of the b-point zone for combing and the forward speed of the harvester, a single-factor experiment was carried out, which reduced the number of experiments and the complexity of further research. The sequence of the experiment was the following: adjustment and preparation of the device to conduct the experiment, adjustment of the width of the zone for combing (b, mm) using the hydraulic system of the reaper.

Next, the experiment is carried out by passing each stage with every variable value of the width of the zone of combing (b, mm) in three forward speeds of the combine motion [6].

After processing the results of screening experiment unimportant factors from further consideration were eliminated.

RESULTS

The results of the multivariate experiment were processed on computers under the programs Excel 2010 and Statistic av. 6.1. There were identified three most important factors: ***hcombing*** (x1); n (x2); (X3). An adequate second-order mathematical model describing the dependence of P=$f(hcombing; n; в)$in a decoded form was obtained:

$$Y = 5{,}198555 - 0{,}013040 \cdot hcombing - 0{,}008772 \cdot n - 0{,}275102 \cdot в + 0{,}000045 \cdot hcombing^2 + 0{,}000005 \cdot n^2 + 0{,}006806 \cdot в^2 - 0{,}000001 \cdot hcombing \cdot n + 0{,}000188 \cdot hcombing \cdot в + 0{,}000260 \cdot n \cdot в \quad (1)$$

To describe the response surface by the second order equation we used the central composite orthogonal planning of the second order, which is simple and easy to calculate (quite economical in the number of experiments). Based on the results of experimental data processing, graphic images of two-dimensional sections were constructed. The analysis shows that the lowest grain loss behind the reaper PJ = 0.3% from the total number of grains may be reached at the height of the reaper combing ***hcombing***= 125...150 mm; the frequency of rotation of the combing rotor *n* = 632...692 min^{-1} and the width of the tangential channel of the comb *b* = 7.5...8.5 mm.

The width of the gap between the combing teeth of the comb and the central tube of the frame influences the ventilation effect of the air flow produced by the rotor, which affects the grain losses behind the reaper. To determine the optimal width of the gap between the tooth of the comb and the central tube of the frame*s* the one-factor experiment was conducted. Analyzing the data obtained as a result of the experiment, it can be said that the optimal value of the width of the gap between the tooth of the comb and the central tube of the frame is 13 mm, in which the loss of grain behind the reaper will be 48%.

The optimal number of rows of combing combs *z* on the combing rotor was also investigated. It turned out that the optimal number of rows of combs is 10, the loss of grain behind the harvester being 0.35%. With fewer rows of combs the loss of grain behind the reaper as untreated ears increase, especially in the lying and tangled vegetation, as well as in the presence of weed vegetation in the harvested mass.

CONCLUSION

Thus, the combing reaper with the modernized rotor allows to operate at a speed interval of 10...12 km / h, which allows to harvest crops with allowable losses of 0.31...0.44%.

REFERENCES

[1] Kukharev, O. N. Research of dimensional characteristics of wheat grain / O. N. Kukharev, I.N. Semov, M. A. Fedin / / Participation of young scientists in solving urgent problems of the Russian agro-industrial complex: collection of articles of the All-Russian scientific-practical conference / Penza SAA. – Penza: EPD PSAA, 2016. – P. 20-23.

[2] Kukharev, O. N. Study of physical and mechanical components of the plant stem / O. N. Kukharev, I.N. Semov, M. A. Fedin / / Participation of young scientists in solving urgent problems of the Russian agro-industrial complex: collection of articles of the All-Russian scientific-practical conference / Penza state agricultural academy. – Penza: EPD PSAA, 2016. – P. 17-20.

[3] Kukharev O.N. The technology of obtaining high-quality seeds of sugar beet / O.N. Kukharev, A.V. Polikanov, I.N. Semov // Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2017 – T. 8. № 1. – C. 1210-1213.

[4] Kukharev, O.N. The technical solution for a laminated coating on a rounded surfaces / O.N. Kukharev, I.N. Semov E.G. Rylyakin Contemporary Engineering Sciences. 2015. T. 8. № 9.C. 481-484.

[5] Fedin, M. A. Grain harvesting by method of combing / M. A. Fedin // Innovative ideas of young researchers for the agro-industrial complex of Russia: proceedings of the International scientific-practical conference.– Penza: EPDPSAA, 2014.–P. 231-233.

[6] Fedin, M. A. Modernization of the combing harvester of the type "OZONE" / M. A. Fedin // Innovative ideas of young researchers for the agro-industrial complex of Russia: proceedings of the International scientific-practical conference.– Penza: EPDPSAA, 2015.– P. 55-57.