EXPERIMENTAL STUDY OF THE GRAIN LOSS IN RAPESEED HARVESTING

ЕКСПЕРИМЕНТАЛНО ИЗСЛЕДВАНЕ НА ЗАГУБАТА НА ЗЪРНО ПРИ СЪБИРАНЕ НА РАПИЦА

Krasimir Bratoev¹*, Zhivko Demirev², Ventsislav Dobrinov³

¹ Department of Agricultural Engineering, University of Ruse, Ruse, Bulgaria, kbratoev@uni-ruse.bg
² Department of Agricultural Engineering, University of Ruse, Ruse, Bulgaria
³ Department of Agricultural Engineering, University of Ruse, Ruse, Bulgaria

Abstract: Harvesting of oil seed rape and avoiding of big grain losses require specific adjustments of the machine. The basic level of grain machine losses comes from the entrance device (header) added the losses from the following up devices in accordance of the applying technological scheme. To reduce the seed losses into the harvester it is recommended to operate with the header in accordance with the rotor or hybrid type thresher-separator device.

Key words: grain harvester, seed rape, grain losses, harvesting, threshing cleaning.

Material and Methods

The modern harvesters do not allow to way out the mechanical effects influence on the harvesting devices on the plants, but offers a variety of technical solutions to enhance their efficiency. Some of these decisions are related to changes in the structure corresponding to the crop type and others having the ability for precisely adjustment the machine in accordance of the conditions under which they are harvested. Since the losses come mainly from the header and threshers - separator device, then the variety of technical solutions are greatest.

According to some researchers (Vasilev et al., 1980) the part of losses in the header exceeds the losses from the threshers - separator device for threshing easier to rape is strong. This is confirmed by the fact that the harvest of this crop is done with special headers for rape, while threshers - separator device harvesters provided opportunities for more accurately perform of its technological adjustments.

Introduction

The modern harvesters do not allow to way out the mechanical effects influence on the harvesting devices on the plants, but offers a variety of technical solutions to enhance their efficiency. Some of these decisions are related to changes in the structure corresponding to the crop type and others having the ability for precisely adjustment the machine in accordance of the conditions under which they are harvested. Since the losses come mainly from the header and threshers - separator device, then the variety of technical solutions are greatest.

According to some researchers (Vasilev et al., 1980) the part of losses in the header exceeds the losses from the threshers - separator device for threshing easier to rape is strong. This is confirmed by the fact that the harvest of this crop is done with special headers for rape, while threshers - separator device harvesters provided opportunities for more accurately perform of its technological adjustments.

Material and Methods

The study was conducted in the village of DZS - Ruse. The rape seed is a variety of "Hammer" produced in the area of 115 da and negligible (≈ 4,5 %) weeds. Plant heights phase of fully mature is 0,8 m and the density is 44 plants / m². Despite unfavorable weather conditions during the year for growing, resulting organic extraction is corresponding for the average value - U = 385 kg / da at the ratio of the vegetative part to the nipple of 3:1. During the harvest moisture of the grain is W₉ = 9,6 % and the vegetative part - Wᵣ = 12,9 % which corresponds with the agricultural requirements. Harvested grain has a specific weight of ρ = 682 kg / m³ and absolute weight mₐ = 2,7 g .

Abstract: Harvesting of oil seed rape and avoiding of big grain losses require specific adjustments of the machine. The basic level of grain machine losses comes from the entrance device (header) added the losses from the following up devices in accordance of the applying technological scheme. To reduce the seed losses into the harvester it is recommended to operate with the header in accordance with the rotor or hybrid type thresher-separator device.

Key words: grain harvester, seed rape, grain losses, harvesting, threshing cleaning.

Introduction

The modern harvesters do not allow to way out the mechanical effects influence on the harvesting devices on the plants, but offers a variety of technical solutions to enhance their efficiency. Some of these decisions are related to changes in the structure corresponding to the crop type and others having the ability for precisely adjustment the machine in accordance of the conditions under which they are harvested. Since the losses come mainly from the header and threshers - separator device, then the variety of technical solutions are greatest.

According to some researchers (Vasilev et al., 1980) the part of losses in the header exceeds the losses from the threshers - separator device for threshing easier to rape is strong. This is confirmed by the fact that the harvest of this crop is done with special headers for rape, while threshers - separator device harvesters provided opportunities for more accurately perform of its technological adjustments.

Material and Methods

The study was conducted in the village of DZS - Ruse. The rape seed is a variety of "Hammer" produced in the area of 115 da and negligible (≈ 4,5 %) weeds. Plant heights phase of fully mature is 0,8 m and the density is 44 plants / m². Despite unfavorable weather conditions during the year for growing, resulting organic extraction is corresponding for the average value - U = 385 kg / da at the ratio of the vegetative part to the nipple of 3:1. During the harvest moisture of the grain is W₉ = 9,6 % and the vegetative part - Wᵣ = 12,9 % which corresponds with the agricultural requirements. Harvested grain has a specific weight of ρ = 682 kg / m³ and absolute weight mₐ = 2,7 g .

Fig.1 Types of combine harvesters: a) – conventional type; b) – rotor type; c) – combined (hybrid) type

Harvesting is done with conventional, rotary and combined (hybrid) type harvesters. The conventional type is "Claas Lexion 660" (Fig. 1 a), equipped with special rape header - V750 to "Claas". With customized header rape "2030 Case" e rotor combine harvester "Case 2388" (Fig. 1, b), while the hybrid-type "Claas Lexion 600" (Fig. 1, c) work with a header soy-beans S750 of "Claas". The header S750 has a flexible cutting machine and cutting height when it is limited to 150 mm.
The three types of headers have the same winch radius and number of blades. Two specialized headers are equipped with active dividers and exporting to the first cutting mechanism at 300 mm. Table 1 presents some operational and technical parameters of the three harvester combines.

Table 1. Technical specification of combine harvesters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Claas Lexion 660</th>
<th>Claas Lexion 600</th>
<th>Case 2388</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reel radius - m</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
</tr>
<tr>
<td>Header width - m</td>
<td>7.6</td>
<td>7.6</td>
<td>6.1</td>
</tr>
<tr>
<td>Cutting height - m</td>
<td>0.2</td>
<td>0.15</td>
<td>0.2</td>
</tr>
<tr>
<td>Ratio of the cinematic regime of the reel ((\lambda))</td>
<td>1.4</td>
<td>1.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Speed – km/h</td>
<td>4.2</td>
<td>5</td>
<td>4.2</td>
</tr>
<tr>
<td>Reel axes displacement b - m</td>
<td>0.39</td>
<td>0.39</td>
<td>0.41</td>
</tr>
<tr>
<td>Threshing cylinder diameter - m</td>
<td>0.6</td>
<td>0.6</td>
<td>0.76</td>
</tr>
<tr>
<td>Width/ longitude of the threshing rotor - m</td>
<td>1.7</td>
<td>1.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Efficiency – kg/s</td>
<td>11.6</td>
<td>14.6</td>
<td>9.3</td>
</tr>
<tr>
<td>Engine power - kW</td>
<td>261</td>
<td>431</td>
<td>213</td>
</tr>
</tbody>
</table>

Sampling of the land was made by some method (Damjanov et al., 1986), that is to take into account the operation of each of the three machines when entering the area in its middle point. Thus being sought and the influence of load on the combine harvester grain losses.

Fig. 2 shows a diagram of sampling during the work of the harvester combine. With \(P\) is assigned the crop flow is indicated by the header area per unit distance \(Q\) and the field presents area measurement framework. Measurement framework is an area of 0.25 m² and is divided by the 156 squares with an area of 0.0016 m². In the distance traveled by a combine harvester of the corresponding width of the header they harvested area will be as follows: \(P=7.6\) m² - Lexion 660, \(P=7.6\) m² - Lexion 600 and \(P=6.1\) m² - Case 2388. The total grain loss are reported as the number of grains \((n_Q)\) caught in the area \(Q\) refer to the number of grains \((n_P)\) located in the area harvested. The number \(n_P\) of grains is determined by the following formula:

\[
n_p = \frac{U \cdot P}{m_u} \cdot 10^3 ,
\]

and the number of beans \(n_Q\):

\[
n_Q = n_z \cdot \frac{P}{Q} ,
\]

where \(n\) is the average number of grains found in a box of the measurement framework;

\(z\) - the number of squares in the measurement framework.

The six plots, which have been sampled are sizes length 10 m and width 7.5 m in each of the three locations is recorded amount of grain through the measurement framework. The resulting average grain losses \((\varepsilon, \%)\) in different plots for each of the three harvesters are presented graphically in fig.3.

**Fig.3. Experimental results**

**Conclusions**

The investigated three harvesters operate close to the nominal performance of their models, which ensures optimal load of their working units. In this mode, the resulting grain losses are 2.5% less than satisfying agro-technical requirements for the implementation of direct harvest. The graph in Figure 3 shows that grain losses in outer plots in the crop harvesters are - smaller than inner plots the crop. This is due to insufficient load of the header working with agricultural harvesting mass.

Although the conventional type combine harvester is equipped with a special header for rape to it the admitted losses are higher than the other two types of harvesters. This is mainly due to lower separation ability of the straw walkers. The increased intensity of separating the hybrid type combine harvester, as well as the lower cutting height (0.15m) significantly contribute to the reduction of total losses even though the header 6750 is not intended to rape. Least total losses are recorded during rotor type combine harvester, where increased intensity of separation in threshing - separating device complements the positive aspects of the job header rape. Positivetype of the performance of header for rape is the possibility of removing the cutting unit forward at 300 mm, in which the distance \(b\) changes from 0,41 m down to 0,11 m Also, the presence of active divider reduces losses from self crumble of the grain passing through the crop area. The little difference in losses between the rotor type and hybrid type combine harvester can be compensated if the latter works with header for rape.

The general conclusion is that to reduce the grain losses at grain harvest, it is recommended for rape headers to work in conjunction with hybrid type or rotary type combine harvester.

**Acknowledgements**

The authors of the article acknowledge the agricultural cooperative ST "Dicho Dichev", presented by Tsvetomir Dichev and the company "Rapid" KB - Rouse with head...
manager Nikolai Tsekov for the opportunity and materials to carry out the study.

References