Research of rapeseed harvesting losses

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Abstract. Interaction between rapeseed, a twin-blade active separator and a reel is analysed in this paper. The conducted research substantiates the driving speed of a combine harvester, the width of an additional table and position of a twin blade separator in order to make seeds, falling on the bottom of the harvester, threshed from pods by reel pins and the separator. A mathematical model is made and correlation between the reel λ, the driving speed of the combine harvester, position of the twin-blade separator and seed losses are established. Investigations motivated the importance of the additional harvesting table, the optimum driving speed of the combine harvester, the reel λ and specified methods for the establishment of rapeseed separation losses.

Key words: rapeseed, harvesting, combine harvester, active separator, seed losses.

Introduction

Rape pods are sensitive to mechanical action, seeds are elastic and after threshing by reel pins from pods they fall in different directions, therefore some part of them does not reach the harvester’s bottom. The overall rapeseed harvesting losses make about 4 % (Domeika, 1998). Intertwined branches of rapeseed varieties, which are 2.5 t ha⁻¹ more productive, make a dense carpet that cannot be separated by harvester separators.

R. Chevrier has suggested to fix a cutter of the cutterbar (Chevrier, 1986) to a harvester's side in a vertical position but the blade does not have enough time to cut branches, it breaks them and threshes the pods. A. Mishin (Mishin, 1994) has established that an active chain separator with fixed pins does not fit to separate lodged rape as it tears up stems and threshes pods. A. Strakšas and others have recommended to fix an active separator of the silage combine harvester KSS-2.6 (Strakšas, 1990) to a rape seed harvester. They have established that the active separator loses two times less seeds than the passive one.

Little research on rapeseed harvesting has been done in Lithuania. Parameters of the active separator, the additional harvesting table and their usage fields have not been substantiated, no correlation of interaction between seed losses, the reel, the separator and rapeseed has been established.

The objective of the research is to motivate the reel λ, the width of the additional harvesting table and the driving speed of the combine harvester in order to make seeds, threshed by reel pins and the separator, fall on the harvester's bottom, and to establish correlation of interaction between seed losses, the reel, the active twin blade separator and rapeseed.

Materials and methods

The research was carried out by means of an active twin-blade separator which consisted of five holders bolted to the frame with two uniform blades moving between them. Sixteen blades with plane surfaces were attached to the cutterbar with 10 mm gaps between them. The oblique angle of blades with plane surfaces is 30°, the width of the apex is 13 mm, the width of the base is 73.7 mm, height - 52 mm. The gap between middle lines of blades with plane surfaces is 76.2 mm and the run is 38.1 mm. Both blades were moved by connecting rods joined with a crank. The crank was run by an electric engine joined to it by a belt drive. The number of blade motions was 700 min⁻¹. The electric engine power was 300 W.

The additional table 0.7 m wide with a left side active twin blade separator was fixed to the combine harvester E 524S. The cutterbar consisted of 33 double pins attached to the table and the blade. There were 66 blades with plane surfaces with toothed slanted blades pointed up and down attached to the cutterbar. They cut stems at the upper and lower edge of the pin. The gap between pins and middle lines of blades and the run of the blade was 76.2 mm.

The seed spread from the pods threshed and free falling through rape branches on the surface of an artificial 1 m² plot were established while pouring by one and more seeds at the centre of the plot above the stem tops.

Interaction between the active twin-blade separator and rape plants was investigated in an artificial rapeseed plot. The separator was moving along the central line of the plot. Cut, broken pods and threshed seeds were counted and seed separation losses were calculated.
Interaction between reel pins and rape plants was evaluated after counting seeds threshed by one reel pin and a pin line.

Seeds scattered during the cutting in (0.1 × 0.5) m plots were collected and seed harvesting losses were calculated.

Seed separation losses were established by a wire (0.1 × 0.1) m frame which was put on the separator's run line (0.2 m) ten times after the combine harvester had passed. Seeds inside the frame were counted and weighed. Seed separation losses in % were as follows:

\[
N_s = \frac{20am_l}{QB} - N_p - N_p',
\]

(1)

where \( a \) - average seed number in the area of the frame, units;

\( k_p \) - coefficient of combines harvester \( B = 6 \) m, \( k = 966.7 \) m, when \( B = 9.4 \) m, \( k = 963 \);

\( g \) - average mass of one 9 % moisture rapeseed, g;

\( D \) - biological rapeseed harvest, t ha\(^{-1}\);

\( N \) - natural seed scattering losses, %.

Under production conditions rapeseed harvesting losses were established by the wire frame (0.1 × 0.1) m which was put on the harvester's track or separator's run line (0.2 m). Seeds and pods in the area of each frame were collected, pods were threshed, seeds counted and weighed. Seed harvesting losses in % were calculated.

Results and discussion

Proving of the width of the additional harvesting table and the driving speed of the combine harvester

The fall of seeds threshed from pods by reel pins at a slanting trajectory vertically down was investigated. The combine harvester has to drive at such a speed that a seed falling at a slanting trajectory in its driving direction should fall on the harvester's bottom (Fig. 1). It was assumed that surrounding air resistance force \( R = kv \) or \( R = kv^2 \).

To calculate the optimum combine driving speed seed's falling trajectory was established and equations were made to calculate its speed, time and distance to the initial position \( t_i \) when fallen.

Differential equations of the seed's fall at a slanting trajectory with respect to Decart's coordinates \( x \) and \( y \) when \( R = kv \):

\[
mx = -R_x,
\]

\[
m\dot{y} = -mg + R_y,
\]

(2)

where \( R_x \) and \( R_y \) - projection of surrounding air resistance force to coordinates.

Fig. 1. Scheme of interaction between rape plants and reel pins:
1 - reel pin; 2 - plant; 3 - cutter; \( g \) - acceleration of a free body fall; \( h \) - seed falling height; \( l \) - distance from the cutter to the plant; \( l_1 \) - distance from the plant to the fallen seed; \( m \) - seed mass; \( R \) - surrounding air resistance force; \( v \) - seed falling speed; \( v_0 \) - starting speed of the falling seed; \( v_r \) - combine driving speed.

\( x \) and \( y \) - coordinates; \( \alpha_0 \) - initial angle of the falling seed; \( \omega \) - reel spinning speed.

After solving equations and putting in constant values \( (t=0; x=0; v=v_0; a=a_0 \) and \( y=h) \) it was established:

\[
x = \frac{v_0}{k_0} \cos \alpha_0 (1 - e^{-k_1 t})
\]

(4)

\[
y = h \left( \frac{v_0}{k_0} \sin \alpha_0 - \frac{g}{k_0^2} (1 - e^{-k_1 t}) - \frac{g}{k_0^2} t \right)
\]

(5)

where \( k_0 \) - seed's flying coefficient \( k_0 = klm_0 \);

\( t \) - falling time of the seed in a general case.

Then MacIvor's series were used in the equation (5) and seed's falling time was rearranged. After that it was established:

\[
t = \left( \frac{V_0^2 \sin^2 \alpha_0 + 2h(g - k_0v_0 \sin \alpha_0) - v_0 \sin \alpha_0)}{g - k_0v_0 \sin \alpha} \right)
\]

(6)

where \( k_0 \) - seed's flying coefficient, m\(^{-1}\);

\( \alpha_0 \) - initial angle of the seed's fall, deg.;

\( h \) - height of the seed's fall, m;

\( v_0 \) - initial speed of the seed's fall, m s\(^{-1}\).

Horizontal distance of a fallen seed from its initial position \( (l) \) is calculated by putting in time \( t \), value into the equation (4). Then the combine driving speed (m/s) in order to make the seed fall on the harvester's bottom:

\[
v_i = \frac{(l + l_1)(g - k_0v_0)}{\sqrt{v_0^2 \sin^2 \alpha_0 + 2h(g - k_0v_0 \sin \alpha_0) - v_0 \sin \alpha_0}}, \tag{7}
\]

when the seed is falling vertically down:

\[
v_i = \frac{l(g - k_0v_0)}{\sqrt{v_0^2 + 2h(g - k_0v_0)}} - v_0. \tag{8}
\]

After the evaluation of rape biometrical indicators and accepting that rapeseed critical speed is 8 m s\(^{-1}\) it was established that vertically falling seeds \((v_i=0.2 \text{ m s}^{-1})\) will fall on the harvester's bottom when the combine drives at a speed of 5 km h\(^{-1}\). With an additional table 0.35 m wide (total width 0.7 m) fixed on the harvester's bottom the combine's driving speed can be reduced to 2 km h\(^{-1}\).

![Graph](image_url)

Fig. 2. Influence of the initial speed \((v_i)\) of a vertically falling seed on the harvester's driving speed \((v_{kl})\): \(R=kv, h=1 \text{ m}, v_0=8 \text{ m s}^{-1}\),

\(1 - l=0.6 \text{ m}, v_{kl}=1.07 + 4.78, r_1=1; 2 - l=0.25 \text{ m}, v_{kl}=0.445 + 1.99, r_1=1.\)

When seeds fall at a slanting trajectory the driving speed of the combine depends on the initial angle \( \alpha_0 \) of the seed's fall, speed \( v_0 \) and distance \( l_1 \). When \( v_0=0.2 \text{ m s}^{-1} \) and \( \alpha_0=20^\circ \), then \( l_1=0.087 \text{ m} \) and at \( \alpha_0=85^\circ \) \(- l_1=0.014 \text{ m} \). The combine has to drive at a speed of 5.5 km h\(^{-1}\) when \( l_1=0.087 \text{ m} \). When the initial seed fall angle \( \alpha_0 \) is bigger the combine can drive slower \((v_0=0.2 \text{ m s}^{-1}, l_1=0.4 \text{ m})\):

\[
v_i = 0.5 \cdot 10^{-6} \alpha_0^2 - 0.0014 \alpha_0 + 3.89, \quad r^2 = 0.99. \tag{9}
\]

When surrounding air resistance \( R=kv^2 \), differential equations of the seed's fall at a slanting trajectory (2) and (3), without preconditions with respect to time \( t \), are unsolvable. Having established the change of the speed of seed's fall and used time \( t \) expression given in the Theory of Ballistics:

\[
t = \frac{v_i(\alpha_0) \sin \alpha_0}{g \cos \alpha_0}, \tag{10}
\]

rearranging equations (2) and (3), and integrating the obtained expression we get \( v_i \) expression:

\[
v_i = \left[ \frac{1}{v_0^2 \cos^2 \alpha_0} + \frac{k_0}{g} \left( \frac{\sin \alpha_0}{\cos^2 \alpha_0} - \frac{\sin \alpha}{\cos^2 \alpha} \right) + \frac{\ln \left( \frac{\pi}{4} + \frac{\alpha_0}{\alpha} \right)}{\frac{\pi}{4}} \right]^{0.3}. \tag{11}
\]

Then:

\[
dx = - \frac{v_i^2}{g \cos \alpha} d\alpha, \tag{12}
\]

\[
dy = \frac{v_i^2 \tan \alpha}{g \cos^2 \alpha} d\alpha, \tag{13}
\]

where \( \alpha \) - direction angle of seed's falling speed with a horizontal plane.

Integration of equations (12) and (13) gives seed motion trajectory equations with respect to the angle \( \alpha \). Then, after calculating seed's falling speed at the moment of contact with the soil surface and the angle with a horizontal plane and putting into the equation (10), we can calculate seed's falling time and the driving speed of the combine, respectively.

Seeds, falling at a slanting trajectory in the direction of the combine drive, will fall on the harvester's bottom when the combine drives faster than at \( R=kv \). It will be possible to reduce the driving speed by attaching an additional table to the harvester.

Seeds falling vertically down \((R=kv^2)\) will fall on the harvester's bottom when the combine drives faster than 5 km h\(^{-1}\). It will be possible to reduce the combine's driving speed by attaching an additional table to the harvester.

Summarizing conclusions of the theoretical analysis we can state that rape should be cut at driving faster than 5 km h\(^{-1}\) and it is possible to drive slower if an additional table is fixed to the harvester.

**Rape biometrical indices**

Biometrical indicators and seed harvesting losses of winter rape variety 'Senta' and spring varieties 'Star' and 'Sponsor' have been established.

Main rapeseed biometrical indices

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Measure units</th>
<th>Winter rape 'Senta'</th>
<th>Winter rape 'Star'</th>
<th>Winter rape 'Sponsor'</th>
<th>Spring rape 'Senta'</th>
<th>Spring rape 'Star'</th>
<th>Spring rape 'Sponsor'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop density</td>
<td>units m²</td>
<td>53±8.1</td>
<td>60±17.8</td>
<td>176.5±18.6</td>
<td>85.5±83.7</td>
<td>124±27.4</td>
<td>108±24.3</td>
</tr>
<tr>
<td>Plant's height</td>
<td>mm</td>
<td>911±19.9</td>
<td>1250±4.0</td>
<td>859±35.7</td>
<td>1120±31</td>
<td>1164±7.4</td>
<td>1040±23</td>
</tr>
<tr>
<td>Number of pods on a plant</td>
<td>units</td>
<td>32±2.83</td>
<td>49±2.0</td>
<td>27.2±3.6</td>
<td>70.4±9.94</td>
<td>30.8±1.4</td>
<td>44.9±3.73</td>
</tr>
<tr>
<td>Number of seeds in a pod</td>
<td>units</td>
<td>26.1±0.50</td>
<td>28.7±0.86</td>
<td>26.3±0.66</td>
<td>26.6±0.92</td>
<td>20.7±0.2</td>
<td>24.9±1.07</td>
</tr>
<tr>
<td>1000 seed mass</td>
<td>g</td>
<td>4.4±0.31</td>
<td>4.1±0.31</td>
<td>3.3±0.03</td>
<td>3.6±0.26</td>
<td>3.48±0.1</td>
<td>3.0±0.22</td>
</tr>
<tr>
<td>Biological productivity</td>
<td>t ha⁻¹</td>
<td>1.95±0.11</td>
<td>3.1±0.14</td>
<td>2.9±0.12</td>
<td>2.1±0.11</td>
<td>2.75±0.1</td>
<td>2.4±0.08</td>
</tr>
</tbody>
</table>

Spread of freely falling seeds

Seed spread on an artificial plot surface was investigated by pouring rapeseed 'Senta' through plant branches of the field. It was identified that 'Senta' seeds ($W_i=9.6\%$) falling from 0.4 m height are spread insignificantly as they meet few branches. Seeds falling from plant tops ($h=1.2$ m) are spread in ($s$) 0.24 m² plot:

$$s = 0.234 \ln (h) + 0.215, \quad r^2=0.98 \quad (14)$$

$$0.4 \leq h \leq 1.2, \quad W_i=9.5\%.$$

Moister seeds ($W_i=18\%$) struck against moister plant branches were spread out in a smaller area (0.21 m²). While establishing seed losses scattered by the separator it is necessary to take into account the seed spread and the frame should be put on the seed spread track.

Interaction between the twin blade separator and rape plants

Spread of seed separation losses was established in an artificial field of rape variety 'Senta' (70 st m², $W_i=18\%$). When the separator was moving at 10 km h⁻¹ threshed seeds and cut pods were spread along the track 0.4-0.6 m wide to both sides from the separator's action line. At the separator's run line 15% of all seeds were spread. At a speed of 2 km h⁻¹, the width of the spread seed did not change but they were less scattered. In the plot of spring rape (140 st m², $W_i=20\%$) seeds were spread along the track 0.5 m wide to both sides from the separator and rape interaction line. About 19% seeds were spread in 0.1 m track and only about 2% in edge tracks.

Influence of the motion speed of an active separator on rapeseed separation losses was established (Fig. 3). While changing separator's motion speed from 2 to 10 km h⁻¹, losses of moist rapeseed ($W_i=32\%$) separation were nearly unchanged and losses of dry rapeseed ($W_i=9.6\%$) increased by more than 2%.

![Graph showing influence of motion speed on rapeseed separation losses](image)

### Fig. 3. Influence of the motion speed ($v_i$) of the twin blade separator on rapeseed 'Senta' separation losses ($N_i$): harvester's width $B=5.4$ m, productivity $D=2.6$ t ha⁻¹, $2\leq v_i \leq 10$ km h⁻¹:

1. $W_i=9.6\%$, $N_i=0.736 e^{0.49v_i}$, $r^2=0.98$;
2. $W_i=18\%$, $N_i=0.462 e^{0.09v_i}$, $r^2=0.90$;
3. $W_i=32\%$, $N_i=0.405 e^{0.05v_i}$, $r^2=0.87$.

Loses of spring rape 'Star' seed separation were much less than in winter rape. While changing the motion speed of the separator from 2.2 to 7.8 km h⁻¹, losses of rapeseed $W_i=20\%$ separation increased from 0.13 to 0.2% ($B=5.4$ m, $D=3$ t ha⁻¹; $2\leq v_i \leq 8$ km h⁻¹):

$$N_i=0.151 e^{0.26v_i}, \quad R^2=0.99 \quad (15)$$

While cutting dry rape ($W_i=9.8\%$) the motion speed of the separator had a considerably greater influence on seed separation losses. Driving at a speed
of 7 km h\(^{-1}\), 0.84 % seeds were scattered:

\[ N_s = 0.151 e^{0.26t}, \quad r^2 = 0.99. \]  

(**16**)  

**Interaction between reel pins and rape**  
Interaction between metal and plastic reel pins and rape was analysed. In an artificial 70 st m\(^2\) dense plot of winter rape 'Senta' the metal pin scattered 1.3 times more seeds than the plastic one (Fig. 4). It was established that more than two times more seeds were threshed from dry pods \((W_t = 9.6 \%\) from moister \((W_t = 18 \%\) ones. In spring rape 'Star' plot (140 st m\(^2\)) the reel pin scattered five times more seeds than in 'Senta' plot as their pods are more resistant to blows.

\[ W_t = 18 \%, \quad B = 5.4 \text{ m}, \quad Q = 3.1 \text{ t ha}^{-1}, \quad 1.1 \leq \lambda \leq 2: \]

1 - metal pin, \(N_t = 0.0065 e^{0.79t}, \quad r^2 = 0.95;\)

2 - plastic pins \(N_t = 0.002 e^{0.36t}, \quad r^2 = 0.95.\)  

**Fig. 4.** Influence of the linear speed \((v_r)\) of the reel pin on the number of threshed 'Senta' rapeseeds \((k);\)
1-3) - metal pin, \(W_t = 9.6 \%, \quad k = 70, \quad v_r = 85.6, \quad t = 0.99;\)
2-4) - plastic pin, \(W_t = 9.6 \%, \quad k = 58.7, \quad v_r = 71.7, \quad t = 0.99;\)

3-4) - metal pin, \(W_t = 18 \%, \quad k = 49.6, \quad v_r = 66.2, \quad t = 0.99;\)
4-4) - plastic pin, \(W_t = 18 \%, \quad k = 43.7, \quad v_r = 62.3, \quad t = 0.97.\)

Spread of 'Senta' rapeseeds threshed by reel pins from pods (70 st m\(^2\), \(W_t = 18 \%\)) was investigated. It was established that, when reel \(\lambda = 1.1\), seeds were scattered in a track 1.5 m wide and when \(\lambda = 1.8 - 2\) m wide. Against the line of intersection between the pin and rape plants \((\lambda = 1.1)\) in the track 0.5 m wide about 15 % were scattered and the rest were beyond intersection line in the track one meter wide. When \(\lambda = 1.8,\) 30 % seeds were scattered against the line of intersection in the track one meter wide. Dry rapeseeds \((W_t = 9.8 \%\) were spread in an overall track 2 m wide. Winter rapeseeds 'Star' (140 st m\(^2\), \(W_t = 18 \%\)) were spread in the track 1.5 m wide.

The research established that plastic pins scattered less seeds than metal ones. After increasing the reel \(\lambda\) from 1.1 to 2, seeds were scattered 15 times more (Fig. 5).

Losses of spring rapeseed 'Star' were far less than losses of winter rapeseed \((B = 5.4 \text{ m}, \quad Q = 3 \text{ t ha}^{-1}, \quad 1.1 \leq \lambda \leq 2):\)

\[ N_t = 4 \times 10^4 e^{0.9t}, \quad r^2 = 0.91 \quad \text{(metal pins)}; \]

\[ N_t = 3 \times 10^5 e^{1.7t}, \quad r^2 = 0.90 \quad \text{(plastic pins).} \]  

The reel with plastic pins, when \(\lambda = 1.1\), suits better for rapeseed harvesting.

**Rapeseed separation losses using a twin-blade separator**  
The separator was attached to the side of the combine harvester "Don-1500". An artificial rapeseed 'Senta' plot of different density \((K)\) was cut driving at 5 km h\(^{-1}\). It was established that, varying crop density from 50 to 90 st m\(^2\), seed separation losses increased by 0.37 %:

\[ N_s = 0.0094K - 0.114, \quad r^2 = 0.98 \quad \text{(50stke590).} \]  

The least seed separation losses (0.51 %) were obtained when the separator coincided with interaction line between the reel and rape plants \((L=0)\). After pushing the separator \((L=200 \text{ mm})\) forward seed separation losses increased by 0.16 %:

\[ N_s = 0.0009 L - 0.05084, \quad r^2 = 0.97 \quad \text{(50stke500).} \]  

Rapeseed 'Senta' separation losses, using the twin-blade separator on the combine "Don-1500" and E 524 S with an additional table attached to the harvester, were investigated (Fig. 6). It was established that, cutting rape plants by the combine without an additional table, seed separation losses are about 0.4 % greater than cutting with an additional table attached to the harvester. When the driving speed of the combine was increased, reel pins threshed more seeds from pods.
Research of rapeseed harvesting under production conditions

Rape 'Senta' \((W_r=18\%\) was harvested by the combine "Don-1500" with an attached active twin-blade separator or passive triangular separator. It was established that the active separator scattered three times less seeds than the passive one which broke intertwined rape branches and threshed pods. During the research position of the active twin-blade separator was changed. The least number of seeds was scattered when the separator coincided with the line of interaction between reel pins and rape plants, what depends on the height of a rape plant. After the separator was adjusted 100 mm forward from the line of interaction, seed separation losses increased by 1.7 times and when adjusted by 360 mm - 2.3 times, respectively.

Influence of the driving speed of the combine on seed separation losses was investigated. It was established that, cutting rape 'Senta' while driving at 5.5 \(\text{km h}^{-1}\), seed separation losses were 1.9 times less than driving at 1.6 \(\text{km h}^{-1}\), and driving at 7 km h\(^{-1}\) they increased again because the blades did not have enough time to cut branches. The optimum motion speed of the investigated twin-blade separator is 4.5-5.5 \(\text{km h}^{-1}\).

When cutting rape plants with the twin-blade separator attached to the right side of the harvester, some part of rape plants got stuck in the gap between the active separator and the harvester's side, therefore it was covered. Seed separation losses decreased 3.7 times because more branches cut by the separator, pods and threshed seeds fell on the harvester's bottom.

Influence of the additional table to the combine harvester on 'Senta' rapeseed cutting losses was investigated. The reel \(\lambda\) was changed from 1.1 to 1.8 (Fig. 7). It was established that driving at 5 \(\text{km h}^{-1}\) \(\) the optimum \(\lambda\) was 1.1. After increasing the reel \(\lambda\) by 0.1, seed cutting losses increased about 0.1 %. Cutting rape plants by the combine E 524 with the additional table 0.7 m wide attached to the harvester, seed cutting losses were less by 0.2 % as some parts of seeds threshed from pods fell on the harvester's bottom. Production research proved the conclusion made by the theoretical research that, after attaching an additional table to the harvester, it is possible to increase the range of variation of the combine’s driving speed.

Spring rape 'Sponsor' were cut by the combine E 524 S with the table attached to the harvester, the driving speed was 5 \(\text{km h}^{-1}\) \(W_r=18\%\), \(D_s=2.7 \text{ t ha}^{-1}\) and the reel \(\lambda\) was alternated from 1.1 to 1.6. It was established that the reel \(\lambda\) alternation had an insignificant influence on the 'Sponsor' rapeseed cutting losses:

\[
N_p=0.123\lambda^3 - 0.225\lambda + 0.441, \quad r^2=0.95 \quad (1.1<\lambda<1.6),
\]
Conclusions

1. It was found out that, when seeds threshed by reel pins are falling, the combine harvester should drive at a speed higher than 5 km h⁻¹ in order to make seeds fall on the bottom of the harvester. If an additional header of 0.35 m working width is mounted, the combine harvester can drive at a speed 2 km h⁻¹.

2. The optimum position of the twin-blade separator is vertical at the line of interaction between reel pins and rape plants and the reel λ=1.1. Seeds, threshed by reel pins, falling through rape plants are spread on the soil surface in a track of 0.5 m wide against the line of interaction between the reel and rape plants and in one meter beyond the interaction line.

3. It was substantiated that the optimum reel λ=1.1 and the combine's driving speed is 4.4-5.5 km h⁻¹ by the mathematical model of interaction between the reel and rape plants.

4. The active twin-blade separator scatters 2-3 times less seeds than the passive separator. By attaching an additional table (overall width is 0.7 m) to the combine harvester, rapeseed cutting losses become about 0.2 % less than cutting with a traditional combine harvester (Q=2.5 t ha⁻¹).

References

Rapša sēklu zudumu pētījumi kombaina hederi

R. Domeika, L. Špokas, V. Butkus

Teorētiski pētīta tītava un aktīvā šķīrēja iedarbība uz rapša augu. Eksperimentāli nopamato ta pagarinātā hederi lietošanas nepieciešamība. Precizētas kombaina darība atruma vērtības, pagarinātā hederā platformas platums un aktīvā šķīrēja nostādījums, pie kura ar tītava pirkstiem izzistās sēkļuņas nokristu uz hederā platformas. Demonstrēta rapša sēklu zudumu noteikšanas metodika aktīvā šķīrēja zonā.