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EFFECTS OF CASINGS AND CANOPY DIVIDERS INSTALLED IN A SPRAYING UNIT ON RAPESEED LOSSES DURING DESICCATION

Dariusz Choszcz, Zdzisław Kaliniewicz, Stanisław Konopka, Adam Lipiński, Piotr Markowski, Tadeusz Rawa
Chair of Machinery and Separation Processes
University of Warmia and Mazury in Olsztyn

Key words: rapeseed, desiccation, rapeseed losses, casings, canopy dividers.

Abstract

The objective of the present study was to determine rapeseed losses recorded during desiccation with Avans Premium 360 SL, and caused by natural shattering. Shattering seeds were trapped with elastic sticky tapes. Rapeseed losses were determined for a traditional spraying unit and one equipped with canopy dividers, a screen and tractor undercarriage casings. It was found that the additional equipment installed in a spraying unit allowed to reduce rapeseed losses.

WPŁYW OSŁON I ROZDZIELACZY ŁANU ZASTOSOWANYCH W AGREGACIE OPRYSKUJĄCYM NA STRATY NASION PRZY DESYKACJI RZEPAKU

Dariusz Choszcz, Zdzisław Kaliniewicz, Stanisław Konopka, Adam Lipiński, Piotr Markowski, Tadeusz Rawa
Katedra Maszyn Roboczych i Procesów Separacji
Uniwersytet Warmińsko-Mazurski w Olsztynie

Słowa kluczowe: rzepak, desykacja, straty nasion, osłony, rozdzielacze łanu.

Streszczenie

Badano straty nasion rzepaku podczas desykacji środkiem Avans Premium 360 SL oraz straty nasion spowodowane następczym samoosypywaniem. Do rejestracji osypujących się nasion zastosowano lepkie podłoża. Straty określano dla tradycyjnego agregatu oraz wyposażonego w rozdzielacze łanu, ekran i osłony podwozia. Stwierdzono, że zastosowanie wyposażenia dodatkowego w naziemnym agregacie opryskującym przyczyniło się do obniżenia strat nasion.

Introduction

One of the major problem in rape growing is its uneven ripening and silique breaking, followed by seed shattering, which causes rapeseed losses at a level of several per cent. These losses can be reduced by desiccation with various chemical preparations (*Mechanizacja* .... 1993).

The main difficulty encountered in studies of rapeseed losses is seed identification on the soil, due to their dark color and a relatively small diameter (Rawa, Wierzbicki 1993).

Rapeseed losses can be determined using an indirect method which consists in counting the plants that had grown from shattered seeds, or a direct method which consists in counting seeds falling into containers placed between plant rows or on the soil surface (Loof, Jonsson 1970, Rudko 2000). Under field conditions rapeseed losses may be also determined with specially constructed frames with specified surface areas. This method enables to estimate losses in the cutting, threshing and cleaning sections of a harvester (Szot et al. 1988, Szot, Tys 1991, Szot et al. 1991).

The solution which allows not only to determine rapeseed losses, but also their transverse distribution, is placing elastic sticky tapes between plant rows, to trap shattering seeds (Rawa, Wierzbicki 1993, Lipiński et al. 2003). This method, considered most efficient, was used in the present experiment, whose objective was to determine the effects of casings and canopy dividers installed in a spraying unit on rapeseed losses recorded during desiccation with Avans Premium 360 SL, and caused by natural shattering between desiccation and harvest, as compared with those recorded in the case of a traditional spraying unit.

Conditions and Methods

Rape plants were desiccated with Avans Premium 360 SL in the first decade of July 2002, in the plots of the Production-Experimental Station "Bałcyny" Ltd. This treatment was performed with a unit consisting of a Ursus 1201 tractor and a sprayer, type S-320 ND18 C320, with a working width of 18 m. The tractor was equipped with narrow tires: steering wheels

– 7.5-20, driving wheels – 12.4 R36. Tire width of front and rear wheels was 19 and 31.5 cm respectively. The equipment and accessories ("Syngenta Crop Protection" Ltd, Warsaw), shown in Figure 1, i.e. a screen, tractor undercarriage casings and canopy dividers, were used in the investigations. The screen, in the form of a steel-reinforced Plexiglas rigid plate, was used for bending plants in a belt between technological tracks. To prevent plant catching on protruding elements of the spraying unit (tractor + sprayer) undercarriage, two parts of a protective apron were used. The apron was made of canvas paulin with a synthetic coating. The steering (front) and driving (rear) wheels of the tractor were equipped with a divider, designed for canopy dividing in technological tracks.

Fig. 1. Spraying unit equipped with a screen, canopy dividers and tractor undercarriage casing

A 60 × 72 m bed, encompassing the width of four running tracks, was separated in the plantation. Approximately 20 and 40 m from the bed margin, along its width, two paths (each approx. 40 cm in width) were cut with hedge shears.

Measurements of the moisture content of rapeseeds and some symptoms of their ripening, such as seed browning, stand color, silique opening in U or V bend tests (*Produkcja*.... 1996), provided the basis for determining the time of desiccation.

Shattering seeds were trapped with sticky tapes (RAWA, WIERZBICKI 1993) made of white rubber floor finish, approx. 2 mm in thickness. The measuring area of each tape was divided into 10 elementary sub-surfaces. To obtain adequate tape stickiness its surface was covered with a 0.5 mm layer of grease (ŁT-4). At least 20 tapes were placed within the running track (approx. 4 m in width) of the spraying unit. After the spraying unit passage the seeds found in the tape elementary sub-surfaces, 80 cm^2 each, were count-

ed. Seed weight in each elementary sub-surface was calculated multiplying the number of seeds by the average weight of a single seed determined on the basis of 1000 seed weight, harvested with a combine. Rapeseed losses determined for particular elementary sub-surfaces were then calculated per ha. Rapeseed losses were determined only for plants subjected to direct mechanical impact of the spraying unit elements. Apart from the belt with technological tracks, these were also adjacent belts with tapes, where the number of seeds constituted at least 50% of the number of seeds found on the neighboring tapes on the sprayer's side.

The results of the experiment were analyzed statistically (analysis of variance) using the computer program Statistica Pl (1997). The following zero hypothesis (H_0) was verified: mean rapeseed losses in the areas compared are the same. The same hypothesis was tested while comparing the two spraying units used in the experiment.

Results and Discussion

During rape desiccation temperature and air humidity were 19.0°C and 58% respectively. Rape plants were "standing", also in the belt between technological tracks, where plants were of the same height before desiccation as in the main part. Technological tracks, used during spraying, were covered with plants growing in the adjacent belts, but could be recognized easily.

Figure 2 shows tapes with shattered rapeseeds in the belt between technological tracks, and Figure 3 presents an example of transverse distribution of rapeseed losses caused by the mechanical impact of spraying unit elements during desiccation, and by natural shattering. The results of a statistical analysis of rapeseed losses in selected areas are given in Tables

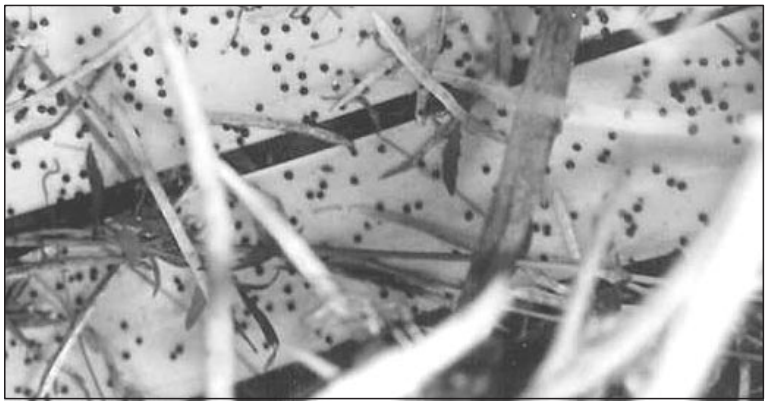

Fig. 2. Tapes with rapeseeds shattered during desiccation

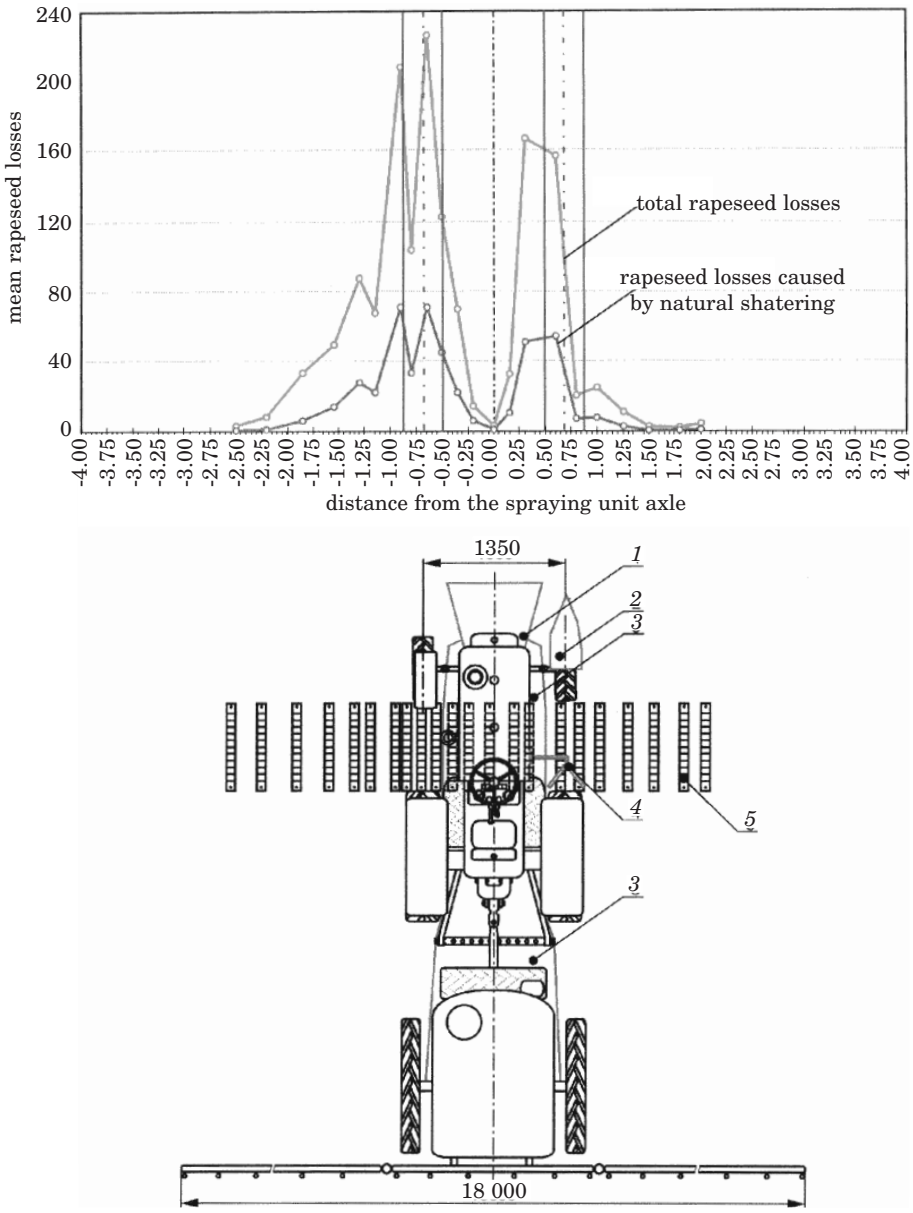

Fig. 3. Example of transverse distribution of rapeseed losses during desiccation with Avans Premium 360 SL and caused by natural shattering for a spraying unit with additional equipment: *1* – screen, *2* – canopy divider mounted at the front wheel, *3* – protective aprons, *4* – canopy divider mounted at the rear wheel, *5* – measuring tapes

Table 1

Comparison of rapeseed losses during desiccation with a spraying unit with and without additional equipment

Range of impact	Number of elementary sub-surfaces	Rapeseed losses		
		mean value (kg/ha)	standard deviation (kg/ha)	coefficient of variation (%)
1. Spraying unit with additional equipment	290	51.15	65.0839	127.24
2. Spraying unit without additional equipment	230	91.81	132.9562	144.82
Significance level			α=0.05	
Calculated value of F statistics			F = 20.8300	
Probability of exceeding F statistics			$p(F)$ = 0.0000	
Because $p(F) < \alpha$, the zero hypothesis (H_0) has been rejected, and the alternative hypothesis H_1 has been adopted				
Significance of differences by the Duncan test: 2 > 1**				
**statistically significant differences at α=0.01				

Table 2

Comparison of total rapeseed losses during desiccation with a spraying unit with and without additional equipment

Range of impact	Number of elementary sub-surfaces	Rapeseed losses		
		mean value (kg/ha)	standard deviation (kg/ha)	coefficient of variation (%)
1. Spraying unit with additional equipment	290	75.59	82.5427	109.20
2. Spraying unit without additional equipment	230	137.95	176.5811	128.00
Significance level			α=0.05	
Calculated value of F statistics			F = 28.3702	
Probability of exceeding F statistics			$p(F)$ = 0.0000	
Because $p(F) < \alpha$, the zero hypothesis (H_0) has been rejected, and the alternative hypothesis H_1 has been adopted				
Significance of differences by the Duncan test: 2 > 1**				
**statistically significant differences at α=0.01				

Table 3

Comparison of rapeseed losses during desiccation in the range of impact of elements of a spraying unit without additional equipment

Range of impact	Number of elementary sub-surfaces	Rapeseed losses		
		mean value (kg/ha)	standard deviation (kg/ha)	coefficient of variation (%)
1. Spraying unit with additional equipment	140	53.61	82.9182	154.65
2. Spraying unit without additional equipment	90	151.23	169.9494	112.38
Significance level			α=0.05	
Calculated value of F statistics			F = 33.7540	
Probability of exceeding F statistics			p(F) = 0.0000	
Because p(F) < α, the zero hypothesis (H_0) has been rejected, and the alternative hypothesis H_1 has been adopted				
Significance of differences by the Duncan test: 2 > 1**				
**statistically significant differences at α=0.01				

Table 4

Comparison of total rapeseed losses during desiccation in the range of impact of elements of a spraying unit without additional equipment

Range of impact	Number of elementary sub-surfaces	Rapeseed losses		
		mean value (kg/ha)	standard deviation (kg/ha)	coefficient of variation (%)
1. Spraying unit with additional equipment	140	80.16	106.2813	132.59
2. Spraying unit without additional equipment	90	227.86	221.7069	97.30
Significance level			α=0.05	
Calculated value of F statistics			F = 45.8341	
Probability of exceeding F statistics			$p(F)$ = 0.0000	
Because $p(F) < \alpha$, the zero hypothesis (H_0) has been rejected, and the alternative hypothesis H_1 has been adopted				
Significance of differences by the Duncan test: 2 > 1**				
**statistically significant differences at α=0.01				

Table 5

Comparison of rapeseed losses during desiccation in the range of impact of elements of a spraying unit with additional equipment

Range of impact	Number of elementary sub-surfaces	Rapeseed losses		
		mean value (kg/ha)	standard deviation (kg/ha)	coefficient of variation (%)
1. Wheels without canopy dividers	110	61.09	70.0795	114.71
2. Screen and protective aprons	90	53.15	62.5601	117.71
3. Wheels with canopy dividers	90	37.01	59.1416	159.81
Significance level			α=0.05	
Calculated value of F statistics			F = 3.5107	
Probability of exceeding F statistics			p(F) = 0.0304	
Because p(F) < α, the zero hypothesis (H_0) has been rejected, and the alternative hypothesis H_1 has been adopted				
Significance of differences by the Duncan test:		1 > 3**		2 > 3*
** statistically significant differences at α=0.01 * statistically significant differences at α=0.05				

Table 6

Comparison of total rapeseed losses during desiccation in the range of impact of elements of a spraying unit with additional equipment

Range of impact	Number of elementary sub-surfaces	Rapeseed losses		
		mean value (kg/ha)	standard deviation (kg/ha)	coefficient of variation (%)
1. Wheels without canopy dividers	110	89.41	90.7042	101.45
2. Screen and protective aprons	90	79.76	79.5746	99.77
3. Wheels with canopy dividers	90	54.53	70.7949	129.83
Significance level			α=0.05	
Calculated value of F statistics			F = 4.7035	
Probability of exceeding F statistics			p(F) = 0.0098	
Because p(F) < α, the zero hypothesis (H_0) has been rejected, and the alternative hypothesis H_1 has been adopted				
Significance of differences by the Duncan test:		1 > 3**		2 > 3*
** statistically significant differences at α=0.01 * statistically significant differences at α=0.05				

1÷6. They indicate that the use of a spraying unit with additional equipment allowed to reduce rapeseed losses during desiccation almost twofold, compared with a traditional unit (51 kg/ha vs. 92 kg/ha). Similar results were obtained for total rapeseed losses recorded during desiccation and caused by natural shattering from desiccation to harvest (Table 2).

It was also found that rapeseed losses resulting from natural shattering depended on the impact of spraying unit elements during desiccation, regardless of the fact whether the unit was equipped with screens and canopy dividers, or not. In the case of a traditional spraying unit, the highest rapeseed losses were noted in the belt between technological tracks; they were almost threefold higher than in the other belts (Tables 3 and 4). As regards the spraying unit with additional equipment the lowest rapeseed losses were recorded within the range of impact of wheels with canopy dividers: during desiccation they amounted to approx. 37 kg/ha (Table 5), and including losses caused by natural shattering – to approx. 55 kg/ha (Table 6).

Conclusions

1. The use of a spraying unit equipped with screens, canopy dividers and protective aprons enables to reduce rapeseed losses during desiccation with Avans Premium 360 SL, and total losses including those caused by natural shattering.

2. In the case of a traditional spraying unit, the highest rapeseed losses were noted in the belt between technological tracks, which indicates that the plants were affected first of all by the tractor undercarriage.

3. Average rapeseed losses for the spraying unit equipped with casings were by approx. 50% lower in the impact range of wheels with canopy dividers than in the belt between technological tracks.

4. The additional equipment of a spraying unit proposed in the paper can bring measurable profits.

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