MONITORING OF RAPESEED DAMAGE DURING POSTHARVEST HANDLING

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ABSTRACT

The physical condition of rapeseed delivered to fat industry plants plays a significant role in the formation of the qualitative features of the raw material for oil production and, consequently, of the oil itself. Rapeseed is stored in silos, frequently for months, before it is subjected to processing. During the long storage, the condition of the seed cover is very important, as the seed cover provides natural protection of the seed against the effect of the environment. Seeds with damaged seed cover are more easily affected by mildew, and the rate of chemical processes, deteriorating the quality of oil contained in the cotyledons is faster in such seeds. Cracked seed covers facilitates also the growth and development of microorganisms. So as rapeseed damage occurring in the course of harvest and the post-harvest processing have a negative effect on the quality and quantity of oil the seeds contain.

The study presented here was aimed at examining the typical process of purchasing and handling of rapeseed in fat industry plants, in the aspect of the occurrence of mechanical damage to the seeds. Special attention was paid to the condition of rapeseed immediately after combine harvesting; next, the successive stages of technological handling of the seed were examined, observing the operation parameters of the particular machinery and equipment in order to identify those operations which caused deterioration in the quality of the material (seeds). Seed samples were taken successively from the following: the hopper, prior to cleaning, after cleaning, prior to drying, after drying, from dry rape silo.

The total level of damage increased through the handling. The content of unusable contaminants had the tendency to decrease in the successive operations, though the actual values still exceeded levels permitted by standards. The study

allow to indicate the operations of postharvest technological process, which cause the most seed damage as well as gave quantitative description of the losses ocurred.

Key Word: Rapeseed, Damage, Seed purchasing, Post-harvest handling

INTRODUCTION

After the Polish rapeseed market broke down in early nineties some last years proved the tendency to growth. With this increase also quality demands played more important part, with a special effect on the amount of mechanically damaged seeds. Broken seed cover allow the mildew growth and development of microorganisms as well as chemical changes of oil contained in the cotyledons. All of the above causes that, apart from the seed moisture content, the physical condition of the seed coat has a decisive effect on the possible duration of seed storage, as well as on the eventual quality of the final product. Table 1 published by Daun and Burch (1984) presents a comparison of the qualitative features of oil contained in seeds with mechanical damage, sprouted seeds, "overheated" seeds and in weed seeds, with relation to whole seeds (sound). It is clearly seen evident deterioration of qualitative features of oil contained in these sort of seeds, what led to investigations on the influence of various operation on breakage level of rapeseed.

Stępniewski et al. (1991) described the qualitative losses occurring during seed processing in a sugar works, where equipment designed for the drying and transport of beet pulp was used for rapeseed. Stępniewski and Szot (1995) described the changes in the quality of rape seed at a various purchasing points, pointing out the operations of harvest and drying as the most detrimental to the quality of the oil-bearing raw material. Studies on the occurrence of mechanical damage to seeds in the course of transport and harvest processing in a combine harvester were conducted by Gieroba and Dreszer (1984 and 1986). Fiscus et al. (1972) investigated physical damage of grain caused by various handling techniques. These studies were used by the authors to indicate the fundamental problems related to the occurrence of damage to plant material in the course of its mechanical handling - harvesting and transport. However there

was still need to describe a typical post-harvest technological process of rapeseed in the aspect of it breakage.

The objective of this study was to identify those operations which cause a deterioration in the quality of the material, beginning with harvest until dry seed storage.

MATERIAL AND METHOD

Generally, the process of post-harvest processing of rapeseed ran according to the following sequence:

1. Weighing
2. Unloading on tipplers
3. Fanning (coarse cleaning of the seeds)
4. Wet seed storage
5. Drying
6. Dry seed storage
7. Transport to oil production plant
8. Storage

Between each successive operation the seed was transported, the transport operation varying at the particular purchasing points as to the distance and the types of conveyors used. The cleaning and drying of rape seed at the purchasing points were performed on various types of fanners and dryers; seed storage facilities and equipment differed as well .

The first in the sequence of operations performed at the purchasing points was seed weighing. Rape seeds were on trailers from which the purchasing personnel took samples for laboratory analysis to determine the moisture content and the content of contaminants. Then the seed was unloaded on tipplers into the hopper. This was the point where the first sample was taken for the study, the sample representing the condition of rape seeds after combine harvesting. Then the seed was transported to the fanner, where parts of stems, pods, crumbs of the soil, and other larger contaminants were separated. At some purchasing points seed cleaning was omitted. The second seed sample was taken after cleaning, if performed, or directly from wet seed storage, in order to identify changes taking place during the transport of seeds with a high moisture content. Than seed was

drying. The third sample was taken at the point of dryer charging, and the fourth at the dryer outlet. Dry rape seed was transported to storage, from where, after loading, it was delivered to the oil producing plant. The final (fifth) seed sample was taken from dry seed storage and represented the condition of the seeds after the full cycle of preparation for industrial processing.

The inter-operation transport of seeds was performed by means of various equipment, including the following:

1. worm conveyors,
2. belt conveyors,
3. bucket elevators,
4. Redler conveyors,
5. chutes.

Fig. 1 presents a schematic of the post-harvest processing of rape seed at typical purchasing point. Seed samples were taken before and after every operation (A-F - sampling points). At each sampling point a sample was taken every 15 minutes for 5 hours per day, each taken from the moving flow of seed, due consideration being given to accessibility and safety precautions while sampling (moving parts of conveyors and elevators). This procedure guaranteed representativeness of the samples.

The seed samples taken had a mass of about 250 g and were packed in nylon bags. Before the bags were sealed, a preliminary measurement of seed moisture content was made by means of a portable moisture meter made by Agrofarm, Denmark, which was followed, within 24 hours, by a laboratory test of seed moisture content performed according to the oven method. Samples taken were delivered to a laboratory, where first their moisture content was determined, and then, after drying the seed at room temperature to the air-dry level, the following qualitative features of the seed were determined: level of micro- and macrodamage and the content of unusable admixtures (parts of stems and pods, seeds of wheat, weeds, etc.). The category of macrodamage covered broken parts of cotyledons and seed cover, and seeds with visible cracks of the seed cover. The content of this fraction was expressed in terms of weight percentages of 10 g samples. Likewise, unusable admixture separated from 10 g samples were expressed as weight percentages. After the separation of seeds with macrodamage

and of unusable admixture, the level of microdamage was determined. For this purpose, ten groups of 100 seeds each were taken and placed on wet tissue, where they swelled and, an hour later, it was possible to count the number of seeds with cracked seed cover. The level of microdamage was expressed in percentages as the number of seeds per one hundred.

RESULTS

Monitoring of rapeseed post-harvest handling established that the fundamental cause of the occurrence of mechanical damage to rapeseed was combine harvesting. The content of mechanically damaged seeds after harvesting had a considerable effect on the final content of that fraction. This final amount of broken seeds considerably depended also on the weather conditions during harvest and on the weather during the whole growing season, so as it differed in the successive years. Similary the amount of unusable admixture depended on the state of a plantation and also considerably varied in the succesive years.

At the begining of handling the amount of broken seed (macro and microdamage) in samples was at the average 7.48% and increased to the average 9.1% in samples after drying (Fig. 2). The amount of broken seed slighty decreased till 8.3% at the end of the whole technological process in the purchasing centre. This decrease resulted from the decrease in the level of microdamage - from 3.67% before drying to 2.52% at the end of the full cycle. The level of macrodamage increased slowly from 5.31% to 6.09% until the final operation, i.e. transport of dry rapeseed, when a decreased to 5.77%. The decrease in the number of seeds with microdamage during drying could have been caused by the expansion of it into macrodamage, the level of which increased in the operation. The temperature and water stress during drying increased seed coat microcracks.

The content of unusable admixture showed a tendency to decrease in the successive operations, the differences observed, however, were statistically insignificant, even during cleaning. Rape seed delivered to the purchasing centre contained on average 3.2% of unusable admixtures, while at the end of the cycle their content was 2.94% (Fig. 3).

The moisture content of seed before drying strongly depended on weather

conditions close before drying. Initially the moisture content varied from 13 till 19%. However in dry sommer the moisture content decreased till 9 - 10%. In the most cases drying was performed correctly and the final seed moisture was from 5 till 6%.

From the above it is seen, that harvest operation had a basic importance for the amount of broken rapeseed in the whole processing. Level of mechanically broken seed was different within succiding years, but decided about the total level of this fration at the end of processing. Postharvest operations had only slight influence on the amount of this fraction, however it was possible to notice characteristic changes within all handling procedure. These changes could suggest some improvements in the postharvest technological process in order to avoid mechanically broken seeds. Especially in accordance to the earlier results (Stępniewski et al. 1991) it is possible to make some conclusions i.e.: elimination of pneumatic transport of seed, cooling of the seed after drying, or replacement of some sort of conveyors for another - better from the breakage point of view.

CONCLUSIONS

1. Rape seeds are subject to mechanical damage during combine harvesting, and the level of damage sustained in the course of harvest has a decisive effect on the content of damaged seeds at the end of the cycle of postharvest processing at the purchasing points.
2. The level of macrodamage decreased or did not change significantly during the initial operations after delivery to the purchasing point until drying, when it increased. The final level of macrodamage remained constant after drying, or decreased slightly, remaining insignificantly higher than the initial level of macrodamage after the combine (5.3% after the combine and 5.77% after drying).
3. The level of microdamage increased until the operation of drying (from 2.17% to 3.66%) where it decreased (to 2.39%), after which it increased insignificantly (to 2.52%). The decrease in the number of seeds with microdamage during drying could have been caused by the expansion of some of the instances into macrodamage, the level of which increased in the operation. A probable cause of the increase was the interoperation transport.

4. The content of unusable admixture generally decreased in the course of rape seed processing. The operation of seed cleaning was found to be ineffective (only larger parts of stems and siliques were separated), which resulted in the high content of the contaminants at the end of post-harvest processing, exceeding the value permitted by the applicable standard.
5. Seed moisture content after drying fell within the range prescribed by the Polish Standard. Moreover, no burnt seeds were recorded, which indicates that the drying operation was performed correctly.
6. An improvement in the working parameters of the combine during the harvest, and its proper adjusting, would significantly improve the quality of rape seed delivered to the purchasing points, while the application of an efficient process of seed cleaning prior to drying would result in a decrease in the content of unusable admixture.

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Table 1. Effect of sprouted seeds, weed seed and bin-heating seed on the quality of rapeseed (Daun and Bruch 1984)

SAMPLE OF SEED	OIL CONTENT [%]	CHLOROPHYLL IN OIL [ppm]	FREE FATTY ACIDS [%]
Sound	42.2 - 45.8	0.2 - 8	0.0 - 0.4
Broken	46.4	28	5.0
Sprouted	39.6 - 44.2	3.0 - 47	0.5 -3.7
Weed	13.2	66	4.7
Bin-Heated 0%	-	-	0.3
28%	-	-	0.6
40%	-	-	2.3
66%	-	-	19.2
98%	-	-	37.9

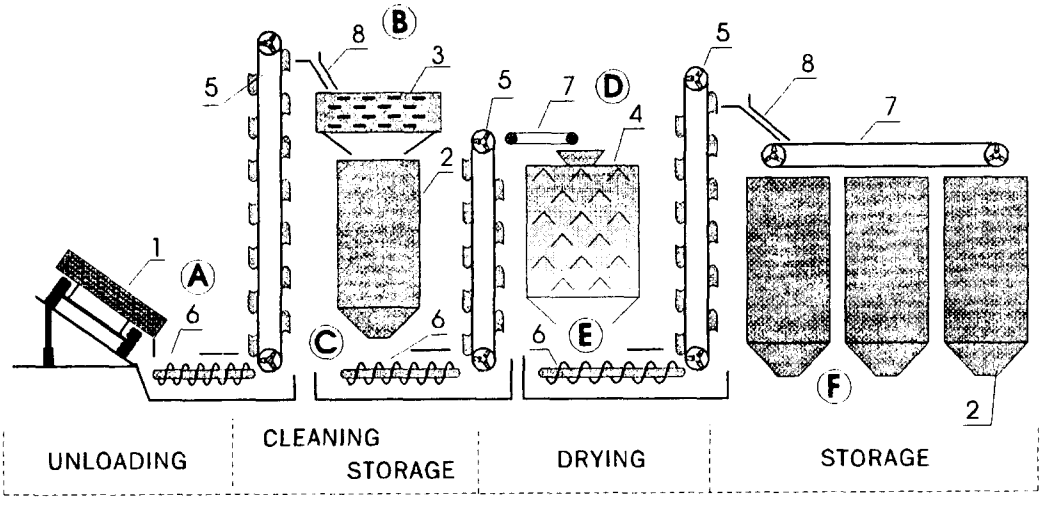

Fig. 1. The scheme of typical postharvest technological process of rapeseed.
A - F - sampling points
1. tippler 2. silo 3. cleaner 4. dryer 5. bucket elevator 6. screw conveyer 7. belt conveyer 8. chute

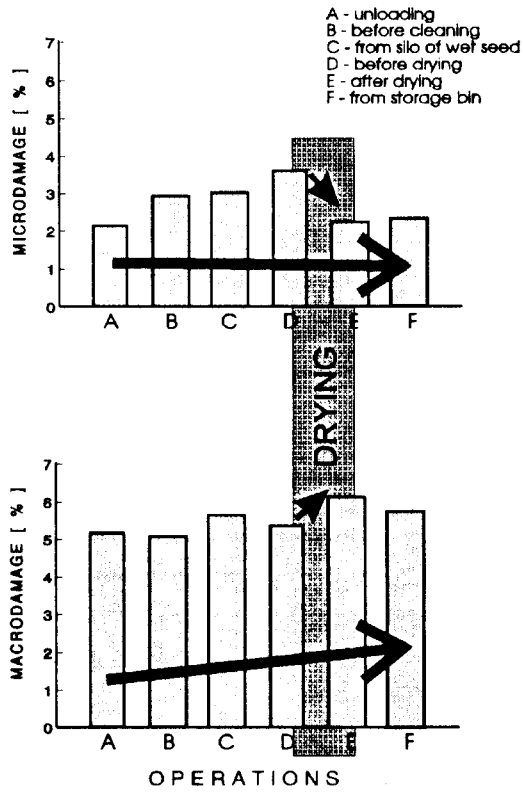

Fig.2. Changes of the amount of seed micro- and macrodamage during rapeseed postharvest processing

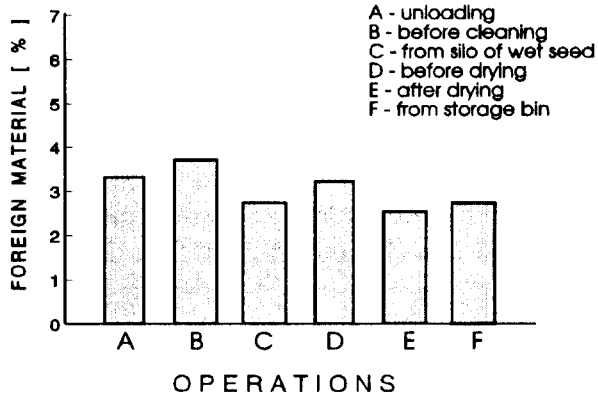

Fig. 3. Changes in the amount of unusable admixture during postharvest processing