Int. Agrophysics, 2000, 14, 255-257

RAPESEED STORAGE AND THEIR MECHANICAL STRENGTH

J. Tys, G. Szwed

Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, PO. Box 201, 20-290 Lublin 27, Poland

Accepted January 25, 2000

A b s t r a c t. Three varieties of rape were investigated Bolko, Polo, Leo. Each variety was investigated in two maturates: technical and full ones. Each sample with proper maturity and humidity (6 and 11 %) was stored according to the elaborated methodology in containers at stable temperatures of: 7, 20 and 30 ^{o}C and the stress invoked in the seeds due to internal pressure application was: 150 and 300 kPa. Our investigation showed that storage conditions significantly affect dynamical resistance of the stored seeds. The initial storage period (20 - 40 days) did not clearly differentiate stability features in the stored material. The following storage time strongly differentiated seed resistance to the dynamical loads. It refers especially to external conditions (temperature 30 ^{o}C and pressure 300 kPa) when the changes dynamics was very clear. This dynamics is also affected by the moisture and the maturity of the investigated seeds.

K e y w o r d s: rapeseed, storage, damage, maturity, varieties, mechanical strength

INTRODUCTION

Rapessed is characterised by very poor mechanical properties because of it internal structure and chemical composition. Technological value of rape depends mainly on the conditions at harvest, i.e., maturity (chlorophyll content), number of broken seeds, amount and kind of admixtures [2] as well as conditions of handling after harvest, which directly and indirectly influence the number of microorganisms, acid number and peroxide number [4]. Seed damage gives many unfavourable changes, which strongly influence the quality of final products of rapeseed processing, i.e., oil, extracted cake etc. [7]. Some results [1] indicated significant decrease of rapeseed damage resistance during 12 month storage (in small sacks in ideal conditions). Microstructure changes occurred during incorrect drying process (too high temperature and very moist seed) are additional factors, which influence mechanical resistance of rape seed [7].

All this factors appeared in the regular industrial conditions and made the amount of seed damage considerably exceed the standards. It leeds to the conclusion, that both the reasons for quantitative characteristics of rapeseed damage during storage should be studied.

MATERIAL AND METHODS

The following varieties of winter rape were taken into consideration Bolko, Leo and Polo. Real storage conditions were simulated in compression chambers, which allowed to simulate extreme values of seed moisture content, temperature, stress (compression) [5].

The experimental stand allowed for the simultaneous study of seed samples under two storage conditions:

a) 300 kPa at the temperature of 7 and 30 ^{o}C,

b) 150 kPa at the temperature of 30 ^{o}C.

Seeds came from one and two stage harvesting. They were conditioned to achieve two levels of moisture content: 6 and 11%. Storage time was 180 days for each seed sample. Seeds with signs of deterioration, i.e., lumping and moulding, were excluded.

Every 20 days some seeds were taken for the strength tests. The experimental stand's design and methodological criteria allowed for the simulation of dynamic loading encountered in practice in threshing and transport by means of typical agricultural machines. Seed was hit by a beater installed in a rotating arm meeting the following test requirements: smooth control of the beater rotations per min and possibility to set any required orientation of the seed in relation to the hitting surface of the beater [3]. Before the strength tests, seeds were conditioned to the equal moisture content of 6 %. A special method used allowed to estimate seed damage.

Linear hit velocity was 22 m s^{-1} and weight of 1000 seeds was 4.1 g.

RESULTS

The present investigation showed that shortly after one stage harvesting the seeds were more resistant to dynamic loads than the seeds harvested with the two-stage method, which were immature (Table 1). Many seeds were brown and red. A similar relation was observed after 20 days of storage (Fig. 1). Moreover seed strength when gathered with a two-stage method decreased more during longer storage than with the one-stage method. After 180 days of storage seeds gathered with one-stage method had 20-30% better mechanical properties.

Mechanical strength was also determined by the features related to variety - the most significant differences were noticed for the Bolko variety. Metabolic processes during storage influence the internal structure of seeds, and in consequence, their mechanical properties. Moisture content affected most of the seed mechanical properties, together with the temperature of storage and stress resulting from external loading (Fig. 2). Seeds at 11% moisture content could be stored at the temperature of 30 ^{o}C for the maximum of 40 days. Longer storage under this conditions led to lumping. It was accompanied by a significant seed deformation and an increase in the number of microorganisms [6]. The influence of low storage temperature on the seed mechanical resistance was less than expected.

Estimation of changes in the rapeseed technological value during storage allows to avoid errors, which could occur in postharvest handling. It also allows to identify factors which affect technological value of seeds.

Table 1. Rapeseed resistance to dynamic loads by variety and harvest technology

Variety	Harvest technology	Amount of unmaturate seeds (%)	Amount of damaged seeds (%)
Bolko	I-stage	7	8
	II-stage	12	16
Leo	I-stage	11	9
	II-stage	28	22
Polo	I-stage	4	5
	II-stage	9	8

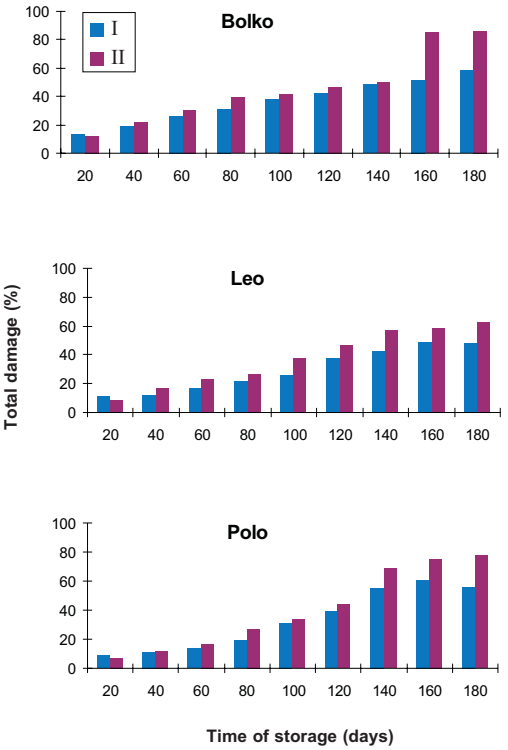

Fig. 1. Influence of varieties and harvest technology (I - one-stage harvesting, II - two-stage harvesting) on the seed mechanical resistance during storage. Storage conditions: temperature - 7 ^{o}C; seed moisture content - 6 %; loading - 300 kPa; varieties: Bolko, Leo and Polo.

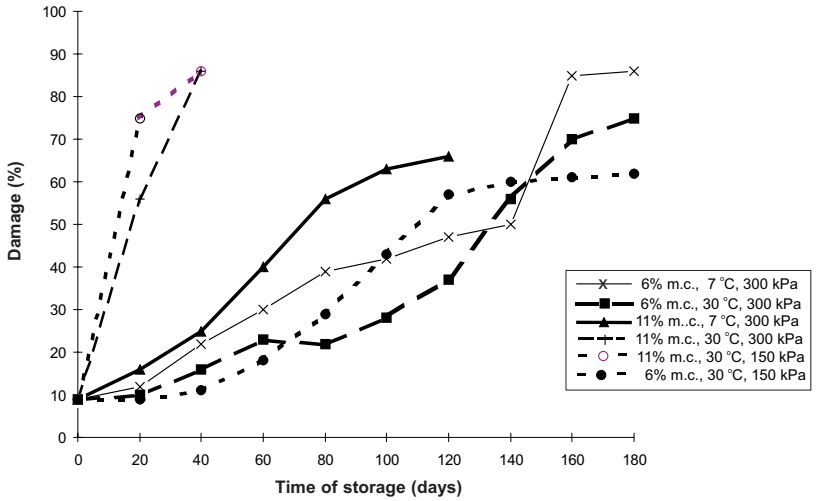

Fig. 2. Changes in the Bolko rapeseed strength during storage at various moisture content, storage temperature and loading.

CONCLUSIONS

1. The investigations showed that seed of various varieties reacted to storage conditions in different ways. The most preferable strength properties was observed in the Leo variety - about 15% less damage compared to the Bolko variety.

2. Harvesting technology (a one- or two -stage method) significantly influenced mechanical resistance of rape seed. Seed harvested with the one-stage method had about 25% greater resistance than the seeds harvested with the two-stage method after 180 days of storage.

3. Rapeseed mechanical strength depended mostly on seed maturity and moisture content, while temperature and pressure inside the chamber (seed loading) had less influence.

REFERENCES

1. **Szwed G., Tys J.:** Susceptibility of rapeseeds to dynamic damages depending on moisture and storage time. Zesz. Probl. Post. Nauk Roln., 427, 87-90, 1995.
2. **Tys J.:** Factors forming the rapeseed agrophysical properties (in Polish). Acta Agrophysica, Lublin, 6, 1997.
3. **Tys J., Szwed G.:** Dynamic resistance of rapeseeds. Int. Conf. on Agricultural Engineering, Madrid, 849-850, 1996.
4. **Tys J., Szwed G.:** Optimization of rapeseed storage (in Polish). Report of Grant No 5 S 30601507, Institute of Agrophysics, Lublin, 1997.
5. **Tys J., Szwed G.:** Simulation of rapeseed storage conditions in silos (in Polish). Rośliny Oleiste, XVIII, 451-457, 1997.
6. **Tys J., Szwed G., Strobel W.:** Influence of storage conditions on behaviour of rapeseeds in bulk. In: Operations on granular materials. Institute of Agrophysics, Lublin, 55-58, 1998.
7. The influence of rapeseed damage on protein and fat quality - Collective work. Rośliny Oleiste. Poznań, 123- 173, 1992.