

THE INFLUENCE OF GLASSINESS ON THE MECHANICAL RESISTANCE OF WHEAT GRAIN

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INTRODUCTION

In all conditions of mechanized harvesting and afterharvest processing of cereals grain is exposed to damage caused by the action of working elements of machines. Damage can cause a very considerable lowering of the biological and technological qualities of grain. That is why from among the many physical properties of grain the mechanical properties, and particularly resistance, i.e. the resistance of grain to damage caused by external loadings, are paid the greatest attention.

In most cases so far investigations of resistance were carried out under the conditions of quasi-static loadings, and the most often applied measuring system was one in which grain was compressed between two parallel plates (1, 3, 4—7). In such investigations evaluation parameters of resistance were taken from the mechanical characterization made in the load-deformation relation (6, 7) or from the distribution of the number of grain damages in function of loading (4, 5). One of them that can

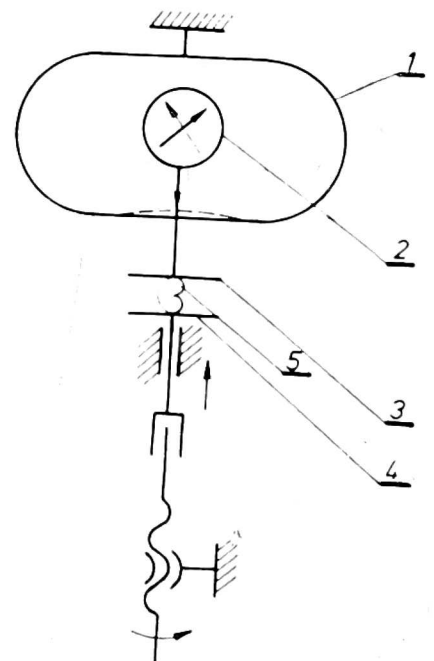


Fig. 1. Diagram of device for resistance experiments on grain: 1 — bow spring, 2 — deviation meter, 3 — resistor plate, 4 — loading plate, 5 — grain

be determined from the mechanical characterization or directly with the help of a simple measuring system (Fig. 1) applied in own investigations is the immediate resistance of grain. This parameter determines the value of the destroying loading — causing the deranging of the cohesion of grain. It characterizes well the susceptibility of grain to damage for moisture contents not exceeding 15% [4]. The resistance of grain depends on its inner structure. Glassiness can be considered as one of the properties characterizing the inner structure of grain. Glassiness means such a consistency the characteristics of which are compactness and conductivity of light through grain. It is caused by a high content of gluten and by cohesion of the positioning of starch grains in the cells.

Investigations of the resistance of grain of 10 winter wheats (varieties: Kaukaz, Helenka, Maris Huntsman, Grana, Jana, Luna, Mironowska, and the breeds: 363/71, Pol. 7971/70, 449/70) clearly differentiated as to glassiness were carried out.

METHODOLOGY

The resistance experiments consisted in static compressing of grain between flat metal plates to the limit of the immediate resistance, at different directions of the loading action (along the three basic dimensions of grain). Such experiments were made on grain air dry (moisture content 12%) segregated according to thickness (fractions: 2.0—2.2 mm, 2.2—2.5 mm, 2.5—2.8 mm, 2.8—3.0 mm, 3.0—3.2 mm) for 200 grains from each fraction (two repetitions of 100).

The resistance for the particular varieties was calculated as weighted mean according to the formula:

$$P_{od} = \frac{\sum_{i=1}^k P_i f_i}{100} \quad (\text{N})$$

where

- f_i — percentage of fraction i ,
- P_i — immediate resistance of fraction i ,
- k — number of grain fractions.

The glassiness of a variety was determined according to a generally accepted methodology, considering its degree in grain intersections made on farinotom for two samples of 100 grains (2).

RESULTS AND CONCLUSIONS

The results of the investigations are presented in a Table. For the particular varieties the relative resistance related to the least resistant variety, and the correlation coefficient between the relative resistance

Table

Influence of glassiness on the immediate resistance of grain of 10 varieties of winter wheat

Variety (breed)	Glassiness (%)	Relative immediate resistance		
		Operating direction of loading along the axis		
		the shortest	the medium	the longest
Kaukaz	78	1.36	1.64	1.69
Helenka	60	1.00	1.19	1.16
Maris Huntsman	65	1.06	1.21	1.32
Grana	80	1.11	1.26	1.28
Jana	45	1.00	1.00	1.10
Luna	59	1.01	1.11	1.07
Mironowska	84	1.21	1.52	1.42
363/71	55	1.04	1.09	1.00
Pol. 7971/70	76	1.13	1.25	1.44
449/70	67	1.16	1.34	1.34
Correlation index		$r_{xy} = 0,88$	$r_{xy} = 0,88$	$r_{xy} = 0,82$

and glassiness were calculated. High and significant statistical correlation coefficients for all the cases of loading action indicate a very considerable influence of grain glassiness to its resistance.

The results of the carried out experiments allow to state that in investigations of the physico-mechanical properties of cereal grain ample attention should be paid to the evaluation of the influence of the inner structure of grain on its resistance to mechanical damage.

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WPLYW SZKLISTOSCI NA WYTRZYMAŁOŚĆ MECHANICZNĄ
ZIARNA PSZENICY

Streszczenie

Przeprowadzono badania nad wpływem szklistości ziarna na jego odporność przeciw powstawaniu uszkodzeń (wytrzymałość mechaniczną). Przedmiot badań stanowiło ziarno 10 pszenic ozimych. Próby wykonano w warunkach obciążeń quasi-statycznych działających na ziarno w różnych kierunkach. Wykazano istotny wpływ szklistości na wytrzymałość mechaniczną ziarna.

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ВЛИЯНИЕ СТЕКЛОВИДНОСТИ НА МЕХАНИЧЕСКУЮ ПРОЧНОСТЬ
ЗЕРНА ПШЕНИЦЫ

Резюме

Провели исследования влияния стекловидности зерна на его устойчивость к повреждениям (механическая прочность). Предметом исследований являлось зерно 10 озимых пшениц. Испытания провели в условиях квазистатических нагрузок, воздействующих на зерно в различных направлениях. Показали существенное влияние стекловидности на механическую прочность зерна.

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