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THE INFLUENCE OF WORK PARAMETERS OF THE THRESHING SET ON THE AMOUNT OF SEED GRAIN DAMAGES

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A b s t r a c t. The results of comparative studies of the types of grain combine-harvesters gathering wheat for seed production are presented. One of them was a traditional grain combine-harvester equipped with one-drum threshing set with key shakers, powered continuously. The other one was a combine-harvester without shakers equipped with a rotary separator of grain from straw mass. In the study the influence of capacity, peripheral speed of drum and size of the slot between the drum and the threshing floor on biological quality of the output grain is presented. The research and the statistic analysis proved that grain gathered with the combine-harvester equipped with a multi-drum separating set demonstrates considerably lower seed value in comparison with grain gathered with a combine of traditional construction.

K e y w o r d s: grain damage, wheat grain, combine-harvester

INTRODUCTION

Nowadays new varieties of grain are introduced into agricultural production. Grain harvest is usually conducted by combine harvesters with different structures of the threshing and separating set. Evaluation of technical and utilizable helpfulness of these machines requires constant field and laboratory testings. Such examination has been conducted in the world for many years. It is confirmed by abundant literature [1-4, 8-10]. Results of the studies are used by growers and specialists in agricultural technology. The construction of a new good grain combine-harvester requires good knowledge of the influence of the structure of the threshing and separation set and parameters of its work on the quality of obtained grain.

The material presented below discussed the examination of grain harvest by a combine-harvester with a traditional construction of the threshing set and a combine in which key shakers were replaced by a multi-drum rotary separator.

The goal of the work was to define the influence of capacity, tangential velocity of the threshing drum and size of the slot between the drum and the threshing floor on the sowing value of wheat grain.

GENERAL CHARACTERISTICS OF THE OBJECT AND CONDITIONS OF THE RESEARCH

In field testings two types of combine-harvesters were used differing in structure of separating sets. The first was a combine-harvester of a traditional construction of the thresher, model Bizon Z058 (Fig. 1). The other of the tested combine-harvesters Bizon Z110 did not posses key shakers and their function was performed by a multi-drum

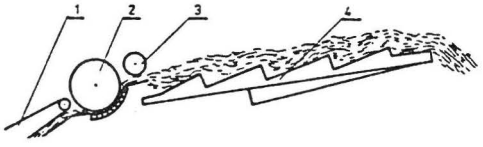

Fig. 1. The scheme of a traditional threshing and separating set of a combine harvester Bizon Z058: 1 - inclined conveyor, 2 - flail threshing set, 3 - straw thrower, 4 - key shaker.

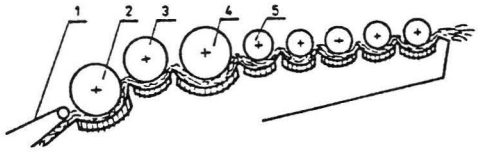

Fig. 2. The scheme of threshing and separating set without shakers in a combine harvester Bizon Z110: 1 - inclined conveyer, 2 - flail threshing set, 3 - straw thrower, 4 - threshing up and separating drum, 5 - five-drum rotary separator.

rotary separator (Fig. 2). Most important characteristics of the objects of the examination and conditions of harvest are presented in Table 1.

METHODS

There were field and laboratory researches conducted. Methodology of field examination covered: definition of standing corn characteristics and method of harvesting by combine-harvesters with various capacities of grain mass.

The programme of laboratory research covered definition of the influence of a combine-harvester type and change of its parameters of work on the quality of obtained grain. Evaluation was done comparing indices of grain quality (damage, germination) of a check sample with corresponding indices of grain from a combine harvesting. The following indices of evaluation

Table 1. The characteristics of the objects of the examination and conditions of harvest

Specification	Units	The model of combine-harvester Bizon	
		with traditional threshing set Z058	with a multi-drum threshing and separating set Z110
Capacity of grain mass:			
Q_1	kg/s	2.5	
Q_2		4.5	
Q_3		6.5	
Tangential velocity of flails of threshing drum:			
v_1		22.6	28.2
v_2	m/s	29.8	31.4
v_3		32.9	34.5
Rotary speed of separating drums	r.p.m	-	750
Size of the slot between the drum and threshing floor, inlet/outlet:			
s_1	mm	22/8	40/18
s_2		28/11	50/28
Size of the slot between separating drums and the great inlet/outlet for:			
Q_1=2.5kg/s		-	14/61
Q_2=4.5kg/s	mm	-	21/46
Q_3=6.5kg/s		-	32/32
Kind of grain	-	wheat	
Variety	-	Emika	
Grain yield	t/ha	4.12-5.42	
Relataion of grain mass to straw mass	-	1:1.18 for 1:1.38	
Range of blade length	m	0.812- 0.865	
Range of grain moisture content	%	11.4-21.6	
Range of straw moisture content	%	14.1-2.61	

were accepted: micro-damages, macro-damages, germination capacity, vigour of growth.

Comparison of quality of grain gathered by the examined combine-harvesters was done by means of a three-factor model of the analysis of variance taking into consideration all tested factors: capacity, tangential velocity of the threshing drum, size of the working slot between the drum and threshing floor.

RESULTS AND DISCUSSION

Influence of peripheral speed of threshing drum

The research conducted proved that tangential velocity of the flails of threshing drum is the most important cause of grain damage lowering its biological value.

Combine-harvesters Bizon Z058 and Z110 used in the testing have traditional construction of threshing sets which are supposed to separate as much grain as possible during transportation of grain mass through the working slot. A big part of grain separated from ears in the working slot gets out of threshing set through the threshing floor. Meanwhile, grain staying longer in the working slot is more exposed to damage, which increase with increase of tangential velocity of threshing drum. In Fig. 3 the influence of tangential velocity of drum flails on value of evaluation index of wheat grain variety Emika is illustrated.

The bigger tangential velocity of threshing drum, the bigger amount of wheat grain damage. In the range of peripheral speed of the drum flails from 26.5 to 30.0 m/s (for both types of combine-harvesters) increase of damages and lowering of sowing value were insignificant (Fig. 3). Meanwhile, with higher tangential velocity amounting to over 30 m/s progressive increase of damage and lowering of sowing value of grain were observed.

Analysis of data presented in Fig. 4, allows to conclude that process of grain damage, in both types of combine-harvesters is similar although it is more dynamic in combine-harvesters provided with rotary separators.

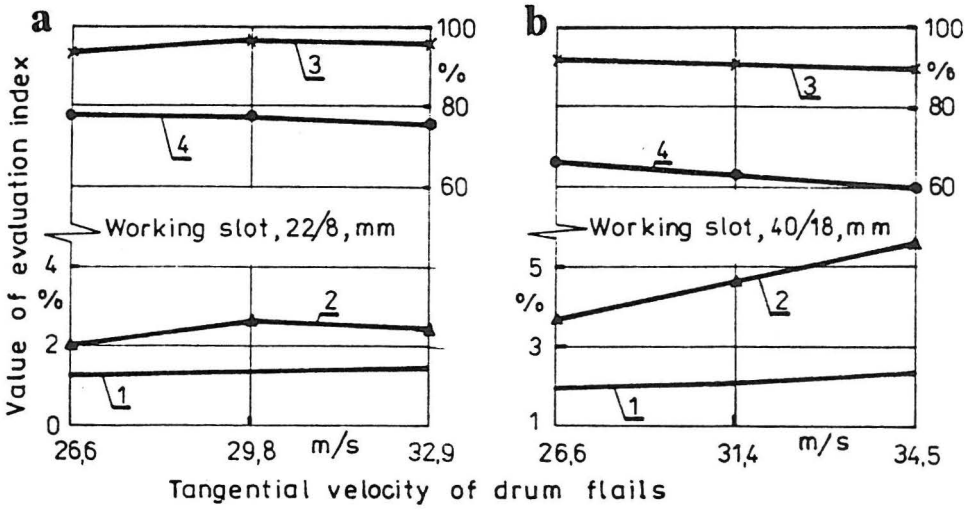

Fig. 3. Influence of tangential velocity of threshing drum flails on value of evaluation index of wheat grain Emika variety with the capacity Q=4.5 kg/s (mean from 5 years of research): a - combine-harvester Bizon Z058, b - combine-harvester Bizon Z110 ; 1 - macro-damage, 2 - micro-damage, 3 - germination capacity, 4 - vigour of growth.

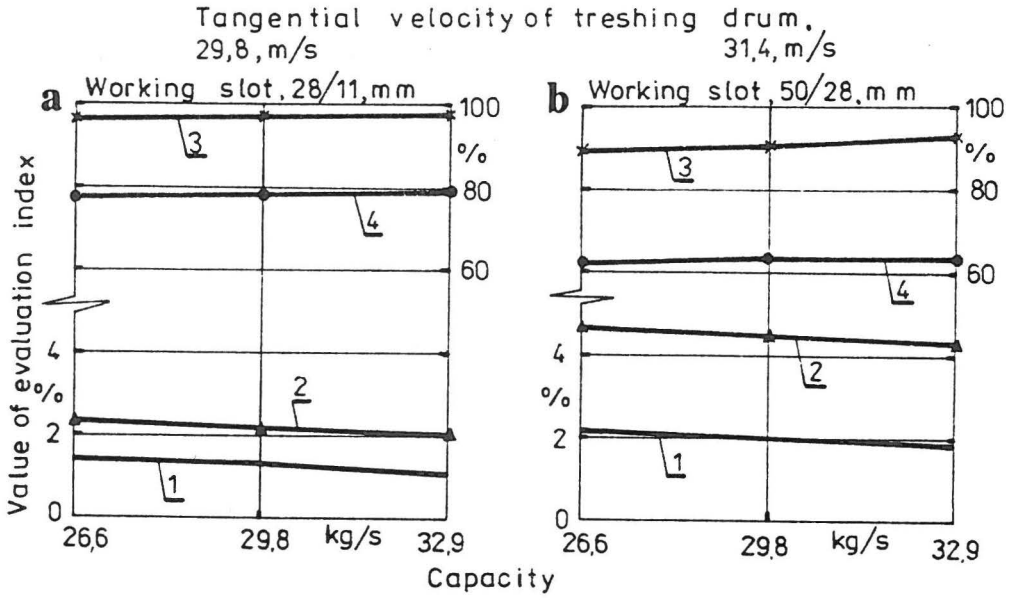

Fig. 4. Influence of capacity of the threshing set on value of evaluation index of wheat grain Emika variety (mean from 5 years of research): a - Bizon Z058, b - Bizon Z110, 1 - macro-damage, 2 - micro-damage, 3 - germination capacity, 4 - vigour of growth.

Summing up, it must be noted that harvest of wheat grain for seed production should be conducted with possibly low tangential velocity of threshing drum.

Influence of size of the working slot

Next parameter from the group of technical and regulating factors having influence on the quality of separated grain is size of the working slot. It is generally accepted that the bigger the distance between the drum and the threshing floor, the smaller amount of mechanical damage of grain during the threshing. In the research two ranges of the working slot (Table 1) were chosen in such a way that minimal loss of grain in underthreshing was assured - below 1.5 % (Fig. 5). Such an opinion is presented by other scientists, too [1-4].

Influence of level of powering of threshing set

Field and laboratory testings proved that level of powering of the threshing set is one of the most important factor deciding about biological value of wheat grain and quality of combine-harvester work. Analysis of the results showed that with increase of capacity the amount of macro- and micro-damages decreased with simultaneous increase of sowing value (Fig. 4).

Comparison of quality of work of combine-harvesters

Comparison of quality of work of combine-harvesters was done in terms of capacity. Analyses of variances proved that evaluation indices of wheat grain gathered by a combine-harvester Z110 were considerably lower in comparison with parameters obtained in the harvest by a combine-harvester Z058. In spite of the fact that the process of grain threshing and separation in a combine-harvester Z110 goes with considerably bigger working slots and slightly differing tangential velocity of threshing drum (Table 1), the quality of grain was really worse in comparison with the grain gathered by a combine-

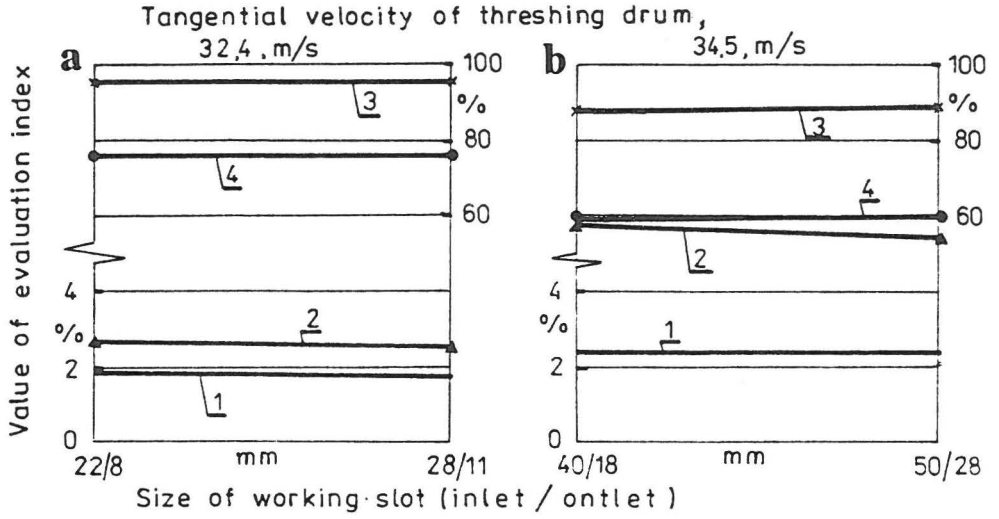

Fig. 5. Influence of size of the working slot on the value of evaluation index of wheat grain Emika variety with the capacity Q=2.5 kg/s (mean from 5 years of research): a - Bizon Z058, b - Bizon Z110; 1 - macro-damage, 2 - micro-damage, 3 - germination capacity, 4 - vigour of growth.

harvester Z058. It is caused by the structure of threshing and separating set (Fig. 2). The set consists of a traditional drum and a threshing floor as well as a multi-drum rotary separator. Sizes of the working slot between the drum and the threshing floor are larger in design than in a combine-harvester Bizon Z058 (Fig. 1 and Table 1). It results in decrease of grain screening through the threshing floor. Therefore more grain goes to a drum separator, together with a straw, undergoing damage. Summing up, it should be noted that a combine-harvester Bizon Z110 in comparison with a combine-harvester Bizon Z058 gained higher capacities but the quality of grain was worse and in many cases it did not fulfil the requirements contained in the norm PN-78 R-65028 defining quality of sowing grain.

CONCLUSIONS

The research conducted allows to formulate the following conclusions:

1. Considering introduction into production of new sorts and varieties of wheat and new constructions of combine-harvesters it is useful to conduct research covering influence of combine-harvesters on sowing value of gathered grain.

2. The research conducted proved that the quality of sowing grain depends on type of threshing and separating set, capacity of grain mass, peripheral speed of threshing drum and size of the working slot.

3. The research also proved that, in comparison with combine-harvesters provided with multi-drum separators, harvest by traditional combine-harvesters allows to gain wheat grain of considerably higher sowing value.

4. In the harvest tangential velocity of the threshing drum should not exceed 29.5 m/s. It is the speed lower than the critical one, when collisions of grain with hard elements of threshing set caused its mechanical damages.

5. While gathering wheat for seed production the working slot between the drum and the threshing floor should not be smaller than 28:22 mm in the inlet and 11:8 in the outlet.

6. The capacity of grain mass of combine harvester should not exceed 4.5-5.5 kg/s as higher capacities are accompanied by higher grain loss.

REFERENCES

1. **Arnold.R.E.**: The effect of harvest damage on the germination of barley. J. Agric. Eng. Res., 4, 1, 24-29, 1959.
2. **Arnold R.E., Coldwell F., Davies A.C.**: The effect of moisture content of the grain and the drum setting of the combine harvester on the quality of oats. J. Agric. Eng. Res., 3, 4, 336-345, 1958.
3. **Arnold R.E., Jones M.P.**: A survey of grain damage incurred and drum setting used during the combine harvesting of Cappelle Desperes wheat and Proctor barley. J. Agric. Eng. Res., 8, 2, 178-184, 1963.
4. **Beck T., Kutzbach H.D.**: The influence of crop properties on the performance of combines. Zesz. Probl. Post. Nauk Roln., 389, 9-18, 1991.
5. **Dudkowski J.**: Proces kombajnowego zbioru zbóż na cele nasienne (Ph.D. Thesis). Wydział Techniki Rolniczej Akademii Rolniczej, Lublin, 1993.
6. **Gieroba J., Dreszer K.**: Problemy strat i uszkodzeń ziarna podczas kombajnowego zbioru. Probl. Agrofizyki, 50, 1986.
7. **Gieroba J., Dreszer K., Nowak J.**: Czynniki warunkujące jakość ziarna siewnego zbieranego kombajnami. Probl. Agrofizyki, 57, 1988.
8. **Srivastowa A.K., Mahoney W.T., West N.L.**: The effect of crop properties on combine performance. Trans. ASAE, 33, 1, 63-72, 1990.
9. **Szot B.**: Rozwój badań właściwości fizycznych materiałów roślinnych. Probl. Agrofizyki, 5, 1972.
10. **Szumakow N.S.**: Omołot pszenicy na siemiena kombajnom SKD-5S. Mech. i Elektr. Soc. Siel. Choz., 10, 11-13, 1972.