RESULTS OF THE COMPARATIVE RESEARCH OF GRAIN LOSSES IN WHEAT HARVEST BY WHEAT COMBINES WITH TANGENTIAL HARVESTING DEVICE

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Abstract: *The introduction of high productive combines in harvest technology process, is represented by point of quality loss of harvested grains. In the paper there is comparatively showen data of investigations of two wheat combin types.The effects and losses of wheat grains have been underlined, in dependence on adjusted parameters.The achieved results have been analyzed and expertise has been done.*

Key words: C*ombines, harvest, losses grain,drum,underdrum.*

INTRODUCTION

The Importance of cereals comes as the result of their usability. Grains are being used in bread baking, which is the main element of human food. The most important role in human food belongs to wheat which is the most often planted in the world. Harvest and threshing of wheat today is being done one-fazed, by the usage of wheat combines.Combines for wheat harvest can be equipped with different types of harvesting devices. The classic harvesting chamber in which drum is situated transversal, wheat mass flow goes tangential and straw shakers separate grains by oscillation (TTO); drum situated transversal, wheat mass goes tangential, and separation organs are rotating (TTR); threshing and separation is being done in longitudinal placed drum (A); tangentially situated drum with axial composition of threshing and grain separation from straw and chaff (TA); Tangential entrance, transversally, and grain separation axially (TTA). The fact is that significant percentage of nowadays combines is older than 15 years, which is certainly unsatisfyng.The intention is to, by introducing modern wheat combines, reduce harvest losses up to 2.0-2.5%, which is unacceptable in actual conditions, because calculated on yields of over than 7 mt ha^{-1}, losses are very high calculated on absolute values. Based on results presented by other authors in their papers, it can be concluded important presence of the problem in wider and closer sense. R. T. Schuler, et al. (1975) analyze harvest losses in North Dacota and they concluded that grain moisture has signifficant influence on losses and should be carefully monitored. Thus, Stankovic et al.(1991) investigated new technical solutions on wheat combines. They concluded that modern wheat combines are intended to have constructions with simple technical solutions, with not too many movable parts, with new constructions of drum, underdrum, straw-shaker and separator. In technology of combining of wheat, according to Tadic (1994), losses are usual collateral and can not be avoided, but with proper combine exploitation there cold be achieved minimum losses. Therefore the author proposes the application of the method of fast loss calculating, which is the most simple and exact, instead of the classic method which is te most complicated and the most expensive. The number of winch revolutions on wheat combines should be adjusted to a moving speed of combines. Losses on drum rotation are 0.1-1.0%, while total losses of threshing engine are 0.15-0.8% of the yield. Optimal working quality in the combining of cereals is being achieved in moisture of 14-16%. The general trend in modern combines' usage is the introduction of high capacity combines and avoiding all semi solutions. Large combines works are the most efficient with the low costs if have enough activities. From the stand point of fluid dynamics, clean biomass, separation processes grain losses that occur can be characterized as a gas / solid multiphase flow with moving boundaries of influence. Physics of this type of flow is very complicated and presents a unique challenge for the development of methods for the characterization of these flows (Chao et al., 1998). Since Mansouri and Minaee (2003) concluded that an increase in cylinder rotational speed from 750 to 950 rpm would double grain breakage, it is recommended that cylinder rotational speed of 800 rpm be chosen. Djokic (2003) who analyzes effects of wheat combining in agroecological conditions of Srem, concludes that losses of grains, quality of threshed mass and effects are in direct dependence of conditions of crops and harvest moment, good order and adjusting of combine and trained combiner. Practicaly, losses should not be higher than 2% of biological yield. Losses of the combine threshing machine should not be over 0.8% and impurities in threshed mass not over 2%. Introduction of new high performance combines in technology, are represented in low losses and high quality of harvested grains (Malinovic et al. 2005). Barac et al. (2008) stated the losses on the harvested device in combine JD satisfactory, wich is not the case with the combine Z142RM. M. Lashgari et al. (2008), presents the qualitative analyze by wheat harvest combine – John Deere 955 in the Carraya county. Interaction: moving speed, rotation speed and underdrum-drum spacing, has manifested significant influence on grain breakage. The highest grain breakage was 5,47%. As the most suitable adjustment, the authors underline low speed (about 2 kmh^{-1}), drum rotation 800 min^{-1}-900), with inlet hight of 25mm. H.S. Hasani et. al. 2011. consider grain losses with wheat harvesting combine JD 1165, and underline that grain losses from the combine platform were 1,29%, and combined losses – 0,96% in average.

MATERIAL AND METHODS

This study was performed in two experiments in the wheat harvest in the agroecological conditions of Srem. Surfaces chosen for the trials had there right forms and the sizes are related to an average crops condition, with the uniformed crop structure and its uniformed heights. Surfaces on which the investigations were done were mainly flat or a bit inclined. After the selection of land, biological yield has been determined in sense of land diagonal. Sample surface was 2sqm, and at least 3 samples were taken. In the investigations were used combines ZMAJ142 RM and John Deere 2264. Losses have been determined on threshed device, on the drum depend on distance underdrum-drum and the peripheral speed, and revolution number of drum.

Moving speed of combine was constant 1.250 m s^{-1}. Losses were determined by setting the pot while combine moving, between front and back wheels diagonal or obliquely, under the angle of 10-20^o to the direction of combine moving, expressed in kg/ha. When combine crosses over the pot, we shook out straw and chaff, separated grains and free grains noting in forms, and number of grains in the pot was adequate to a surface of 1 sqm. For the applied method we can say it was standard for this problem, for field-laboratory and exploitation investigation of combine.

RESULTS AND DISCUSSION

During the investigation combines were working in relatively good condition, with a high yields (5 t ha^{-1}), with a lot of wheat mass. Losses on combine threshing device John Deere 2264 in dependence of Distance drum-underdrum, grain moisture and periphery speed presented in table 1. The highest losses of the combine threshing device JD 2264 on the space drum-underdrum of h_1=10mm and the periphery drum speed 33.00 m s^{-1} were 14.88 kg ha^{-1} (0.26%), and minimum loss 12.43 kg ha^{-1} (0.22%), on periphery speed 26.70 m s^{-1}. At drum-underdrum h_2=12 mm the highest losses were at the periphery speed of 33.00 m s^{-1}, and were 13.87 kg ha^{-1} (0.25%). The lowest losses on threshing device at the same drum-underdrum space were at the periphery speed of 26.70 m s^{-1} – 11.62 kg ha^{-1} (0.22%). At the space drum-underdrum of h_3= 15 mm, the highest losses were 12.88 kg ha^{-1} with the periphery speed 33.00 m s^{-1}, and the lowest 10.20 kg ha^{-1} (0.18%) with the periphery speed of drum 26.70 m s^{-1} (table 1). Losses of combine threshing device John Deere 2264 in dependence of adjusted parameters were analyzed in the second experiment. The highest losses were at drum-underdrum space of h_1=10 mm – 10.59 kg ha^{-1} (0.23%), on the periphery speed of drum 33.00 m s^{-1}. The lowest losses at the same drum space, were registered at the periphery speed of 26.70 m s^{-1} – 8.63 kg ha^{-1} (0.19%). At drum-underdrum space of h_2=12 mm the highest losses were achieved at the periphery speed of 33.00 m s^{-1}, in quantity of 9.67 kg ha^{-1}.

Table 1.

Losses on combine threshing device John deer 2264

Expeeriment	Grain moisture (%)	Periphery drum speed (m s^{-1})	Space drum-underdrum (mm)						LSD	
			h_1=10		h_2=12		h_3= 15		5%	1%
			Losses of wheat grain							
			kg ha^{-1}	%	kg ha^{-1}	%	kg ha^{-1}	%		
The first	13.32	26.70	12.43	0.22	11.62	0.21	10.20	0.18	0.158	0.219
		29.80	13.24	0.25	12.43	0.22	11.62	0.22		
		33.00	14.88	0.26	13.87	0.25	12.88	0.23		
The second	11.22	26.70	8.63	0.19	7.61	0.16	6.71	0.14	0.330	0.460
		29.80	9.57	0.22	8.63	0.19	7.85	0.17		
		33.00	10.59	0.23	9.67	0.21	8.64	0.19		

The lowest losses were achieved at the periphery speed of 26.70 m s^{-1} in quantity of 7.61 kg ha^{-1}. At the drum-underdrum space of h_3= 15 mm, the highest losses were 8.64 kg ha^{-1}, with the periphery speed of 33.00 m s^{-1}. At the same drum-underdrum space the lowest losses were at the periphery drum speed of 26.70 m s^{-1} and in quantity of 6.71 kg ha^{-1} (0.14%). Results of variance analyze of losses at the threshing device of combine JD 2264 in first experiment show statistically very significant influence of clearance drum-underdrum, as well as drum revolution number on the losses of wheat on the threshing device. Interraction of these two factors is not statistically significant on registered losses. In the second experiment clearance drum-underdrum was statistically very significant influence on loses as well as the periphery drum speed. Interaction of clearance drum-underdrum and number of revolutions did not show statistically significance in sense of achieved losses on combine threshing device in second experiment (table 1).

Losses on combine threshing device ZMAJ 142 in dependence of distance drum-underdrum, grain moisture and periphery speed presented in table 2.Based on results presented in the table 2 it has been noted that the highest losses on the combine threshing device Z142 RM in the first experiment, at distance drum-underdrum of h_1=12 mm and the periphery drum speed of 31.10 m s^{-1}, in quantity of 23.67 kg ha^{-1} (0.42%), and minimal at the same distance drum-underdrum 18.73 kg ha^{-1} (0.33%), in the periphery speed of 27.60 m s^{-1}. At drum-underdrum space of h_2=16 mm the highest losses were achieved at the periphery speed of 31.10 m s^{-1} in value of 21.44 kg ha^{-1} (0.38%). The least losses at the same space drum-underdrum were achieved on the the periphery speed of 27.60 m s^{-1} in quantity 17.40 kg ha^{-1} (0.31%).

At the drum-underdrum space of h_3= 20 mm the highest losses on the threshing device were 15.68 kg ha^{-1} (0.27%), with the periphery speed of drum of 31.10 m s^{-1}, and the least 15.86 kg ha^{-1} (0.28%), with the periphery drum speed of 26.70 m s^{-1}.

Table 2

Losses of threshing device combine Z 142 RM

Expeeriment	Grain moisture (%)	Periphery drum speed (m s^{-1})	Space drum-underdrum (mm)						LSD	
			h_1=12		h_2=16		h_3= 20		5%	1%
			Losses of wheat grain							
			kg ha^{-1}	%	kg ha^{-1}	%	kg ha^{-1}	%		
The first	14.62	26.70	18.73	0.33	17.40	0.31	15.86	0.28	0.360	0.490
		29.80	20.42	0.36	18.92	0.34	16.91	0.30		
		33.00	23.67	0.42	21.44	0.38	15.68	0.27		
The second	10.15	26.70	14.51	0.31	13.25	0.29	12.84	0.28	0.285	0.393
		29.80	15.74	0.34	14.62	0.32	13.95	0.30		
		33.00	16.95	0.36	15.67	0.34	14.73	0.32		

During the second experiment losses of threshing device were a bit lower compared to the first experiment, for the same investigation conditions. Losses were analyzed depending on adjusted parameters. The highest losses on threshing device in drum-underdrum space of h_1=12 mm were 16.95 kg ha^{-1} (0.36%), with the periphery speed of 31.10 m s^{-1}. The lowest losses of the same space were noted on the periphery speed of 27.60 m s^{-1}, with the quantity of 14.51 kg ha^{-1} (0.31%). With drum-underdrum space of h_2=16 mm the highest losses were achieved in the periphery speed of 31.10 m s^{-1}, quantity of 15.67 kg ha^{-1} (0.34%). The lowest losses of threshing device in the same space drum-underdrum, achieved with the periphery speed of 27.60 m s^{-1} in quantity of 13.25 kg ha^{-1}. At the space of h_3= 20 mm the highest losses were 14.73 kg ha^{-1}, with the periphery speed of 31.10 m s^{-1}. At the same drum-underdrum space the lowest losses were at the periphery speed of 27.60 m s^{-1}, in quantity of 12.84 kg ha^{-1} (0.28%). Results of variance analyzes of losses on the threshing device on combine Z142 RM, in first shows existing statistically very significant influence of clearance drum-underdrum and number of drum revolutions on losses level of threshing device. Interaction of these two factors did not show statistically significant influence on losses of the combine threshing device. In the second experiment clearance drum-underdrum was statistically very significant in sense of losses as well as the periphery speed. Interaction of clearance drum-underdrum and drum revolution number was not statistically significant in sense of losses on the threshing device in second (table 2).

CONCLUSIONS AND FUTURE WORK

The introduction of high productive combines in harvest technology, reflects on the quality losses of quality of harvested grain. Considering performances investigated combines, it is noted significant and very significant influence of drum-underdrum clearance in interaction with the periphery drum speed on achieved grain loss, on the threshing device. Based on results for both combines, it has been noted that with the increasing of drum-underdrum clearance and the periphery speed, or nuber of drum revolutions, increase and values of losses of grains on the combine threshing device. Achieved values of losses are favourable at the combine John deere 2264, which is understandable, considering combine is recently generated, and technically higher sophisticated. Such conclusion can not be done with combine ZMAJ142 which is understandable, considering this combine is the older generation, with low level of automatization and classic construction solutions. Examined harvesters can be also used for harvesting in the study area and come to the fore, and the focus of future work in the education of the operator, the relevant settings and optimizing.

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