Original scientific paper

Oil rape harvesting by special adapter

Jan Turan[1], Vladimir Višacki[1], Aleksandar Sedlar[1], Pavol Findura[2]

[1]*University of Novi Sad, Faculty of Agriculture Novi Sad, Trg Dositeja Obradovica 8, Novi Sad, Serbia, (jturan@polj.edu.rs)*
[2]*Slovak University of Agriculture, Faculty of Engineering, Trieda A. Hlinku 2, Nitra, Slovakia*

Abstract
Examination of the universal combine equipped with the new adapter for oil rape harvesting was conducted in 2012 yield.
Combine of new design, with 202 kW of engine power, was equipped with modern solution of adapter for oil rape harvesting, which is added – upgraded on to the existing wheat header. Examination of combine with adapter for oil rape harvesting was conducted with the goal to get the results of working quality and productivity which will serve as the mark index of applicability and payoffs of equipping combine with this kind of adapter.
Key words: oil rape, combine, losses, quality, output

INTRODUCTION

Based on a literature sources (Malinović et al., 2003, Turan et al., 2007), average losses for combine in oil rape harvesting are 4% to 25%. Besides that, mentioned literature sources point out that the level of harvesting losses is significant feature for a beginning and a deadline of the harvest and also applying of new sorts with reduced content of eurica acids and glucosinolates, which have the features of even maturing and there are no grain wasting in harvesting (collecting).
Examinations of losses and working quality in soy harvest were intensively conducted in the beginning of '80-es, when the oil rape also, as the cultivated plant, penetrated in to these areas.
That the harvest should begin when the grain moisture is optimal under 15%, and to end it before the harvest of winter barley and wheat. Influence on the maturing of oil rape has a line of factors: sort features, fore crop, fertilizing, climate conditions and such (Marinković 2006, Malinović, 2002). The fact that after the technological maturity, and which begins 10 to 14 days before the full maturity, there are no increment of dry matter and oil in grains, sends to application possibilities of certain procedures for accelerated moisture diminishing.
Modern combines which in their basic construction have more specific power apropos to generations before, with significant construction improvements of separators that accomplish working speeds in oil rape harvesting to 2 m/s, respectively about 7 km/h. Therewith the losses percentage has to be maintained in acceptable limits. (Turan, 2007).

MATERIAL AND METHODS

Combine
For examining the combine with oil rape adapter a combine with tangential threshing system was used, which technical features are in Table 1.
Combine's header desk is a modern wheat variant solution. Separation and attaching to header elevator is easy. The commands for regulation of horizontal and vertical winch position are placed on a joystick, by which the commanding of position control is easily performed.

Table 1. Technical-technological combine features

Parameters	Combine type
	Tangential - LCS
Engine power (kW/HP)	202/275
Oil rape adapter Type	Laverda Biso Integral CX 100
Working width (m)	6.6
Characteristic of combine	
Drum	1
Width (m)	1.67
Diameter (mm)	600
Effective surface of threshing + separation (m^2)	5.58 + 9.06
Hopper volume (l)	8.800

Figure 1. Oil rape adapter

Device for oil rape harvesting

A mean of adaptation for oil rape harvesting is a better adaptation of existing headers to oil rape harvesting. It enables an adaptation to working conditions and successful cutting of the path and the undone part of the crops (Figure 1). Its purpose is universal, adapted to all worlds' header builders with engagement width from 4.8 to 7.6 m.

Crop

Oil rape harvesting is conducted yield, (Table 2).

Table 2. Basic crop data

Parameters	Marks
A. Crop	Oil rape
1. Accomplished yield (t/ha) - Biological - Collected	 4.800 4.637
2. Grain and straw moisture (%)	9.5 / 58.60
3. Assembly (plants/m^2)	34
4. Crop state	clear/upright
5. Grain: straw relation	1:3.46
6. Mass of 1000 grains (g)	3.48

Combine working regime

The combine worked in standard regime of adaptation for oil rape harvesting (Table 3).

Table 3. Combine working regime

Parameters	Value
1. Drum revolution (min^{-1})	750
2. Threshing concave extroversion	16-17
3. Fan revolution (min^{-1})	1.100
4. Sow adjustment: upper, lower (mm)	12/3/0
5. Working speed (km/h)	4.0
6. Mass flow (kg/s)	14.77
7. Grain flow (kg/s)	3.31

Working method

A test issue covered quality and exploitation parameters of combine work. Among quality parameters, the most important ones were established losses.

Thresher losses are recorded by use of the cloth for collecting a threshed mass, while header losses presented grains and husks, which were collected beneath the cloth. The data collected in the laboratory were processed by standard mass measuring apparatus, while the data were processed by standard statistical methods and presented in tables together with research results.

Among the exploitation parameters on the field, working speed was recorded, engagement width and production time structure. Based on these parameters, working exploitation parameters of combine with adapter for oil rape harvesting were calculated.

The examination of universal combine equipped with the adapter for oil rape harvesting was conducted yield on daily temperature of 34ºC and relative air humidity of 40%.

New conception combine, engine power of 202 kW, was equipped with modern solution adapter for oil rape harvesting, which was upgraded on to the existing old variant wheat

header. The examinations of the combine with an adapter for oil rape harvesting was conducted to get the results of working quality and productivity, which will serve as the mark index of applicability and payoffs of equipping combine with this kind of adapter.

Results and discussion

Qualitative parameters of combine work

Header losses

Analyzing the loss examination results in conditions of biological yield of 4.8 t/ha oil rape, the header losses were low. Header losses in a form of free grain are insignificant and on the level of 2.17% with 4 km/h to 3.53% with the speed of 6 km/h. Grain losses in husk is not significant (Table 4). Total header losses were around 2.17% with the speed of 4 km/h and 3.53% with 6 km/h of biological yield. Lying crops and relatively high plant humidity explains this level of losses.

Table 4. Header losses

Working speed (km/h)	Mass flow (kg/s)	Grain flow (kg/s)	Header losses					
			Free Grain		Grain in husk		Total	
			kg/ha	%	kg/ha	%	kg/ha	%
4	14.77	3.31	104.24	2.17	0	0	104.24	2.17
5	18.46	4.14	137.15	2.86	0	0	137.15	2.86
6	22.15	4.96	169.34	3.53	0	0	169.34	3.53

Thresher losses

Thresher losses in a given examination conditions for oil rape have a tolerated value. Free grain losses were 0.53% respectively 2.77% depending on combine's working speed (Table 5). We can notice a significant increment of losses in the form of free grain by the function of working speed (from 0.53 to 2.77%).

Table 5. Thresher losses

Working speed (km/h)	Mass flow (kg/s)	Grain flow (kg/s)	Header losses					
			Free Grain		Grain in husk		Total	
			kg/ha	%	kg/ha	%	kg/ha	%
4	14,77	3,31	25,66	0,53	0	0	25,66	0,53
5	18,46	4,14	41,91	0.87	0	0	41,91	0,87
6	22,15	4,96	133,04	2,77	0	0	133,04	2,77

Total losses

Combine total losses represent a sum of header losses and the losses on the thresher. In this case they were from 2.71 to 6.3% with the working speeds of 4 to 6 km/h, which was expected for this crop and increased humidity and plant mass conditions like this (Table 6).

Table 6. Total combine losses

Working speed (km/h)	Mass flow (kg/s)	Grain flow (kg/s)	Header losses					
			Free Grain		Grain in husk		Total	
			kg/ha	%	kg/ha	%	kg/ha	%
4	14.77	3.31	129.91	2.71	0	0	129.91	2.71
5	18.46	4.14	179.05	3.73	0	0	179.05	3.73
6	22.15	4.96	302.39	6.30	0	0	302.39	6.30

Exploitation parameters of combine work

The combine is equipped with wheat header of engagement width 6.6 m. Engagement width accomplished was a working width of 6.2 m, respectively 0.94 of engagement width. Respectively engagement width was 28 rows of an inter row distance of 0.25 m. Working speed, which is one of the basic output factors, was 4 km/h.

Transport organization and reception capacities didn't interfere the working of combine, so that weren't any organizational stoppages during the working of combine. A display of basic exploitation parameters of combine working is given in Table 8.

Table 8. Harvester exploitation indexes

Parameters	Value
1. Working width (m)	6.6
2. Working speed (km/h)	4
3. Used time quotient (-)	0.9
4. Collected proceeds (t/ha)	4.63
5. Acreage output (ha/h)	2.23
6. Mass output (t/h)	10.72
7. Acreage productivity of the driver (min/ha)	26.9
8. Mass productivity of the driver (min/t)	5.6

Conclusions

Exploitation examinations of universal combine harvester were conducted in dry crop grains (9.5%). The crop was lying with increased plant mass humidity, which resulted in harder working conditions and increased losses on combine thresher (2.77 %), with the working speed of 6 km/h.

Based on losses that were realized by combines of older technological constructions that are used even today in Vojvodinian conditions, it wouldn't be surprising that the thresher losses, the header also, had even higher values.

In the given examination conditions the combine accomplished acreage output of 2.23 ha/h, respectively mass output or grain flow of 4.63 t/h.

An impression is imposed that there is a reason of applying the adapters for oil rape harvesting with two side scythes.

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