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HARVEST OF CEREALS AND OILSEEDS RAPE BY COMBINE HARVESTERS NEW HOLLAND CX 8090 AND NEW HOLLAND CR 9080

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Abstract: The article is focused on evaluation of the throughput, the fuel consumption and the performance of combine harvesters New Holland CX 8090 and New Holland CR 9080 during harvest of cereals and oilseeds rape. During harvest of winter wheat the throughput of New Holland CR 9080 combine harvester was 15,73 $kg \cdot s^{-1}$. The throughput of New Holland CX 8090 was 13,27 $kg \cdot s^{-1}$. The throughput of the combine harvester New Holland CR 9080, during harvest of winter wheat, was 12,60 $kg \cdot s^{-1}$ for the New Holland CX 8090 it was 8,68 $kg \cdot s^{-1}$. The fuel consumption of New Holland CR 9080 was 17,3$l \cdot ha^{-1}$ during harvest of winter wheat and 16,4 $l \cdot ha^{-1}$ while harvesting winter oilseed rape. New Holland CX 8090 had consumption 16,5 $l \cdot ha^{-1}$ for winter wheat and 15,9 $l \cdot ha^{-1}$ for winter oilseed rape. General operational performance pW_{07} during harvest of winter wheat was, for the New Holland CR 9080, 4,26 $l \cdot ha^{-1}$, weight operational performance mW_{07} was equal to 21,91 $t.h^{-1}$. For harvesting wheat with New Holland CX 8090 the general operational performance pW_{07} was 3,70 $ha.h^{-1}$ and the weight operational performance mW_{07} was 19,03 $t.h^{-1}$. While harvesting oilseed rape the surface operational performance pW_{07} for CR 9080 was 3,13 $ha.h^{-1}$, for CX 8090 it was 2,79 $ha.h^{-1}$. The weight operational performance, of the combine harvester New Holland CR, mW_{07} was 10,00 $t.h^{-1}$, the combine harvester CX 8090 had mW_{07} equal 8,90 $t.h^{-1}$.

Key words: *Combine harvester, throughput, fuel consumption, efficiency*

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INTRODUCTION

Combine harvesters are used for harvesting seed crops by mowing or collecting. Subsequently a combine harvester threshes the weight, cleans and separates the wheat from other parts of the plant, collects it in the tank and prepares it to be transported. Straw and chaff are prepared to be harvested and incorporated into the soil. Comparison of the performance of machinery, which is used for these field operations, is the theme of many scientific papers [1-6].

Effective general performance of a combine harvester in $ha \cdot h^{-1}$ is determined by the width of the working width and working speed of the machine. The most efficient types of leading manufacturers achieve operational performance of about 5 $ha \cdot h^{-1}$ with an average yield of 4÷6 t of grain per one ha with qualitative grain loss below 2%. Deployment on land with extremely low cereal yields 2÷3 $t \cdot h^{-1}$ no longer allows to secure operational conditions for optimal throughput and therefore the maximum utilization of a combine harvester because of ergonomic and technical reasons.

MATERIAL AND METHODS

Researching operational parameters of combine harvesters. During the measurement of the (CH) throughput, the amount of weight that goes through the combine harvester (expressed in $kg \cdot s^{-1}$) is measured. For objective measurement it is the best to move with the machine at least 30 meters from the edge of the land. The measuring is done when the thresher of a CH is totally filled. Throughput is determined by equation (1)

$$Q = B_p \,.\, v_{pr} \,.\, m, \tag{1}$$

where:

Q [$kg \cdot s^{-1}$] - throughput of a CH,
B_p [m] - the average width of the cutting table,
v_{pr} [$m \cdot s^{-1}$] - the average operational speed,
m [$kg \cdot m^{-2}$] - yield of the mass.

Combine Harvester fuel consumption. The fuel consumption is measured by refuelling the tank to the neck of the tank, by the end of a shift. The fuel consumption is then determined by equation (2)

$$m_{phm} = O_l \,.\, P^{-1}, \tag{2}$$

where:

m_{phm} [$l \cdot ha^{-1}$] - fuel consumption PHM,
O_l [l] - the amount of refuelled fuel,
P [ha] - harvested area.

The method of researching the performance. The performance is determined according to the methodology designed by [7]. General performance is calculated from the harvested area P per particular time T. There were researched general performance, pW_1 (effective), pW_{02} (operative), pW_{04} (productive) and pW_{07}

(operational). The weight performance is calculated from the observed weight of the sample *m* per time *T*. We search for the weight performance, mW_1 (effective), mW_{02} (operative), mW_{04} (productive) and mW_{07} (operational). The working time of a combine harvester is determined on the basis of recorded time frame, its evaluation and determination of the main time T_1 for the effective performance W_1, time T_{02} for operative performance W_{02}, time T_{04} for the productive performance W_{04} and time T_{07} for the operational performance W_{07}.

RESULTS AND DISCUSSION

The combine harvesters always worked on the same lands, of an agricultural company that belongs to AGROFERT concern, as seen in the Table 1.

Table 1. The characteristics of harvested lands

Land	*Crop*	*Species*	*Harvested area P[ha]*	*Yield of grain m_z [t.ha^{-1}]*	*Humidity of grain v_z [%]*
1.	*Winter wheat*	*Midas*	*55,300*	*5,700*	*14,200*
2.	*Winter wheat*	*Midas*	*28,900*	*5,280*	*16,700*
3.	*Winter oilseed rape*	*Pulzar*	*34,800*	*3,130*	*8,800*

Throughput of a combine harvester. The different throughputs of harvesters are presented in Table 2 for winter wheat and for winter oilseed rape in Table 3.

Table 2. The throughput of combine harvesters during harvest of winter wheat

	New Holland CX 8090	*New Holland CR 9080*
The yield of mass m [kg·m^{-2}]	*1,197*	*1,197*
The average operational speed v_p [m·s^{-1}]	*1,540*	*1,460*
The average width of the cutting table B_p [m]	*7,200*	*9,000*
Throughput of a CH Q [kg·s^{-1}]	*13,270*	*15,730*

Table 3. The throughput of combine harvesters during harvest of winter oilseed rape

	New Holland CX 8090	*New Holland CR 9080*
The yield of mass m [kg·m^{-2}]	*0,886*	*0,886*
The average operational speed v_p [m·s^{-1}]	*1,380*	*1,580*
The average width of the cutting table B_p [m]	*7,200*	*9,000*
Throughput of a CH Q [kg·s^{-1}]	*8,680*	*12,600*

The fuel consumption. The fuel consumption of both combine harvesters is presented in Table 4. The fuel consumption, during harvest of winter wheat was measured in the lands 1 and 2, whereas the fuel consumption of a CH, during harvest of winter oilseed rape, was measured in the land 3.

Table 4. Fuel consumption of different combine harvesters during harvest of winter wheat and winter oilseed rape

Combine harvester	Fuel consumption m_{phm}	
	Winter wheat [l.ha^{-1}]	Winter oilseed rape [l.ha^{-1}]
New Holland CX 8090	16,500	15,900
New Holland CR 9080	17,300	16,400

The performance of combine harvesters. The general performance is presented in the Tables 5 and 6, the weight performance is presented in the Tables 7 and 8. The time frames were recorded in lands 1 and 2 while harvesting the winter wheat and in the land 3 during harvest of the winter oilseed rape.

Table 5. The general performance during harvest of winter wheat in lands 1 and 2

The general performance pW	New Holland CX 8090 [ha·h^{-1}]	New Holland CR 9080 [ha·h^{-1}]
effective pW_1	5,920	6,750
operative pW_{02}	5,100	5,730
Productive pW_{04}	4,200	4,910
operational pW_{07}	3,700	4,260

Table 6. The general performance during harvest of winter oilseed rape in the land 3

The general performance pW	New Holland CX 8090 [ha·h^{-1}]	New Holland CR 9080 [ha·h^{-1}]
effective pW_1	4,800	5,190
operative pW_{02}	4,090	4,300
productive pW_{04}	3,660	3,610
operational pW_{07}	2,790	3,130

Table 7. The weight performance of combine harvesters during harvest of winter wheat

The weight performance mW	New Holland CX 8090 [t·h^{-1}]	New Holland CR 9080 [t·h^{-1}]
effective mW_1	30,44	34,71
operative mW_{02}	26,24	29,46
productive mW_{04}	21,59	25,22
operational mW_{07}	19,03	21,91

Table 8. The weight performance of combine harvesters during harvest of winter oilseed rape

The weight performance mW	New Holland CX 8090 [t·h^{-1}]	New Holland CR 9080 [t·h^{-1}]
effective mW_1	15,31	16,60
operative mW_{02}	13,06	13,75
productive mW_{04}	11,67	11,56
operational mW_{07}	8,90	10,00

The throughput evaluation. The bigger throughput was reached with the combine harvester New Holland CR 9080, during harvest of winter wheat it was 15,73 kg·s^{-1}, New Holland CX 8090 reached the throughput of 13,27 kg·s^{-1}. During harvest of winter

oilseed rape went through the combine harvester New Holland CR 9080 12,60 kg·s^{-1} of mass, through the combine harvester New Holland CX 8090 it was 8,68 kg·s^{-1}. Measurements have confirmed bigger throughput of axial combine harvesters in comparison with tangential ones. The results confirms the measurement [8] when the combine harvester JD 9880 STS reached the throughput of 13,59 kg·s^{-1}during harvest of wheat and the combine harvester New Holland CR 9080 reached the throughput of 15,25 kg·s^{-1}. The throughput of JD 9880 STS during harvest of oilseed rape was 7,83 kg·s^{-1} and New Holland CR 9080 reached the throughput of 8,43 kg·s^{-1}.

The fuel consumption evaluation. Lower fuel consumption was reached with both combine harvesters during harvest of winter oilseed rape when the recorded consumption of New Holland CX 8090 was 15,9 l·ha^{-1} and the consumption of New Holland CR 9080 was 16,4 l·ha^{-1}. Bigger consumption is probably caused by bigger throughput which means bigger engine load. The fuel consumption of New Holland CX 8090, during harvest of winter wheat, was 16,5 l·ha^{-1} and the fuel consumption of New Holland CR 9080 was 17,3 l·ha^{-1}.

The performance evaluation. During harvest of winter wheat the New Holland CR 9080 combine harvester reached general operational performance of 4,26 ha·h^{-1}, New Holland harvester CX 8090 reached the value of 3,70 ha·h^{-1}. During harvest of winter oilseed rape New Holland CR 9080 reached the general operational performance of 3,13 ha·h^{-1}, New Holland CX 8090 reached the general operational performance of 2,79 ha·h^{-1}.

During harvest of winter wheat, the reached weight operational performance of New Holland CR 9080 was 21,91 t.h^{-1}, for winter oilseed rape, was 10,00 t.h^{-1}. New Holland CX 8090 reached, during harvest of winter wheat, weight operational performance of 19,03 t.h^{-1} and during harvest of winter oilseed rape it was 8,90 t.h^{-1}.

BIBLIOGRAPHY

[1] Hühn, M. 1993. Comparison of harvest index and grain/straw-ratio with applications to winter oilseed rape. *Journal of Agronomy and Crop Science*, Vol. 170, Issue 4, pp. 270-280.

[2] Simonović V., Marković, D., Mladenović, N., Marković, I., Čebala, Ž. 2015. Impact of Triticale Mass Yield on harvest speed. *Agricultural Engineering*, Vol. 1, pp. 11-18.

[3] Mašek, J., Novák, P., Kroulík, M., Jasinskas, A. 2015. Performance evaluation of combine harvesters. *Proceedings of the 7th International Scientific Conference Rural Development 2015*, ISSN 1822-3230, pp. 1-6.

[4] Neale, M. A., Hobson, R. N., Price, J. S., Bruce, D. M. 2003. Effectiveness of three types of grain separator for crop matter harvested with a stripping header. *Biosystems Engineering*, Vol. 84, Issue 2, pp. 177-191.

[5] Dhimate, A., Mahal, J. S., Singh, M., Dixit, A. K., Manes, G. S. 2015. Refinement and evaluation wheat straw combine for better straw quality. *Agricultural Engineering*, Vol. 1, pp. 31-40.

[6] Spokas, L., Steponavicius, D. 2011. Fuel consumption during cereal and rape harvesting and methods of its reduction. *Journal of Food Agriculture & Environment*, Vol. 9, No. 3–4, pp. 257-263.

[7] Wollner, A., Bartoš, P., Celjak, I., Dolan, A., Petrovic, A. 2015. Rating of Harvester Threshers Case 8120 and New Holland CX 8080. *Agricultural Engineering*, Vol. 1, pp. 19-30.

[8] Fríd, M., Frolík, J., Celjak, I. 2014. Hodnocení výkonností sklízecích mlátiček John Deere 9880 a New Holland CR 9080 při sklizni ozimé pšenice a řepky ozimé. *Komunální technika*, č.6, roč. VIII, ISSN 1802-2391, s.89-93.

ŽETVA STRNIH ŽITA I ULJANE REPICE KOMBAJNIMA NEW HOLLAND CX 8090 I NEW HOLLAND CR 9080

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Sažetak: Rad se bavi ocenjivanjem protoka, potrošnje goriva i performansi kombajna New Holland CX 8090 i New Holland CR 9080 u žetvi strnih žita i uljane repice. U žetvi ozime pšenice protok kod New Holland CR 9080 bio je 15,73 $kg \cdot s^{-1}$. Protok kod New Holland CX 8090 bio je 13,27 $kg \cdot s^{-1}$. Protok kod New Holland CR 9080 u žetvi ozime pšenice bio je 12,60 $kg \cdot s^{-1}$, a kod New Holland CX 8090 8,68 $kg \cdot s^{-1}$. Potrošnja goriva kod New Holland CR 9080 bila je 17,3 $l \cdot ha^{-1}$ u žetvi ozime pšenice i 16,4 $l \cdot ha^{-1}$ u žetvi ozime uljane repice. New Holland CX 8090 imao je potrošnju od 16,5 $l \cdot ha^{-1}$ kod žetve ozime pšenice i 15,9 $l \cdot ha^{-1}$ pri žetvi uljane repice. Opšte radne performanse pW_{07} pri žetvi ozime pšenice bile su, kod New Holland CR 9080, 4,26 $l \cdot ha^{-}$. Pri žetvi žita sa New Holland CX 8090 opšte performance bile su pW_{07} 3,70 $ha.h^{-1}$.

Ključne reči: *kombajn, protok, potrošnja goriva, efikasnost*

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