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RESEARCH REGARDING THE PERFORMANCES OBTAINED BY THE 560 AND THE 750 CLAAS LEXION COMBINES IN SUNFLOWER HARVESTING

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Abstract

This work presents the results of laboratory experiments and field studies in harvesting of the sunflower crop by two combine harvesters: Claas Lexion 560 and Claas Lexion 750, both made in Germany. There are differences between this two combines at both constructive level and the degree of automation. This work has tracked the impact of the existing automation elements in the construction of the combines on the growth of their performance, by determining the work quality indexes and the energetic and operating indexes of the combines studied. The major difference has been done by both the values of the working capacity indexes and the values of the operating coefficients, which were higher for the Claas Lexion 750 combine, to the values obtained by the Claas Lexion 560 combine. Overall, the Claas Lexion 750 combine has been proven better performance, the higher level of automation of this combine had done the difference.

Key words**:** *combines, harvesting, performance, sunflower, work indexes.*

INTRODUCTION

Since the sunflower harvest period is relatively short, it is important that all harvesting operations run on time to avoid significant grain losses. In order to use sunflower harvesters effectively, the combines need to satisfy certain parameters. The purity percentage of the grains collected has to be at least 97% [1]. Moreover, it is necesary that the shaken grains on the top of the the ground to be less than 1 g/m^2 and the percentage of broken grains to be below 5% [3].

MATERIAL AND METHOD

The experimental research were conducted in 2011 at "SA Zimbrul SA", in the farm no. 2 of the "Ialomita Pond" (Făcăeni - Ialomiţa) on plots with sunflower hybrid Cobalt MK.

The measurement and the calculation of the work quality indexes, the energetic and operating indexes of the Claas Lexion 560 and the Claas Lexion 750 combines have been done according to the specifications.

The measurements were taken in three variants, represented by the three feeding flows of each combine. For each variant a total of three repetitions were performed. The working capacity indexes have been measured and calculated on an 8 hours shift, at a normal working combines' speed, which provided an optimal feeding flow, specific to each combine.

Table 1. The crop's agrobiological characteristics

Specification	The measurement unit	The average value of the biological characteristics
Grain moisture	%	11.20
Plants' density	thousands plants/ha	51.29
Plants' average height	cm	168.92
Average number of leaves per plant	-	19.5
Average stalk diameter	cm	1.8
Recumbent plants percentage	%	3.6
Average grain production per hectare	kg/ha	3409.94
Hectoliter mass	kg/hl	43.04
The 1000 seeds mass	g	59.11

Operating measurements were conducted under normal production conditions. The experiments took place in plots with shapes and sizes that could ensure the mechanized harvesting.

The air temperature was 30°C, without rainfall in the last 24 hours at the Claas Lexion 560 combine testing and the air temperature was 28°C, without rainfall in the last 24 hours at the Claas Lexion 750 combine testing.
The main technical characteristics of the combines tested are listed in table 2.

Table 2. The main technical and functional characteristics of the combines tested

The characteristics' name	M. U.	Combine	
		CLAAS LEXION 750	CLAAS LEXION 560
Header – working width	m	7.5	7.5
Beater	-		
- width	mm	1680	1680
- diameter	mm	600	600
- number of rails	-	8	8
- rotation speed	rot/min	395-1150	395-1150
concave	-		
- number of rails		10	10
- wrapping angle	degrees	90	90
Rotary separator	-	yes	no
First ceaning			
- cleaning area	m^2	5.80	5.80
Second cleaning	-	yes	yes
- number of shackers		2 rotory	6
- separation area	m^2	3.00	9.85
Chopping equipment	-	yes	yes
Bunker - capacity	l	10500	10500
Engine - model	-	Caterpillar C-13	Caterpillar C-10
- cylinders' capacity	l	12.5	10.3
- Fuel tank capacity	l	800	800
Transmission - number of speeds	-	3x2	3x2
-rear tires' size		600/55 - 26.5	16.5/85 - 24
-front tires' size	-	800/65 R 32	650/75 R32 R1
-length with header	m	11.42	11.42
- length without header	m	9.2	9.2
-width	m	3.5	3.5
- maximum height	m	4.85	4.85
Combine's mass	kg	17320	15655

Grain moisture was within the acceptable limits of 10-13% during the harvest [2]. The combines' working process stages were photographed daily and the daily worksheets were prepared. In these records were recorded: the experiments' location, the crop, the time when the work started, the operations and the period of each operation, the time when the work has ended, the plot's drawing and harvested area, the quantity of the grains harvested, the cutting height, the fuel consumption and the grain moisture.
In the experimental research were also used: metric frame, electronic scale, moisture meter, sheet to collect grains, vegetable scrap, plastic bags to collect the grain samples, stopwatch, daily monitoring sheets.

RESULTS AND DISCUSSIONS

The work quality indexes were calculated based on the feeding flows of the combines. The working quality indexes obtained by the combines in sunflower harvesting are grouped in table 3.

Table 3. The work quality indexes obtained by the Claas Lexion 560 and the Claas Lexion 750 combines in sunflower harvesting

Specification	M.U.	Average values					
Combine	-	Lexion 560			Lexion 750		
Average speed	Km/h	3.21	4.19	5.51	4.23	6.12	7.78
Feeding flow	kg/s	3.55	5.41	6.46	4.88	5.84	7.75
Total losses	%	0.99	1.83	1.58	0.85	0.98	1.88
Purity	%	98.06	98.40	97.78	98.16	97.19	95.93
Broken grains	%	3.94	3.15	2.87	4.57	2.98	2.90

For the feeding flows on which the combines were tested, the losses value did not exceed the maximum allowable limit of 2%. There were, however, significant losses on both combines for the biggest feeding flows in the experiments. Yet, although both combine reported losses to bigger feeding flows, losses percentage were higher in Claas Lexion 560 case.
To be metioned the fact that for a feeding flow of 7.78 kg/s achieved by the Claas Lexion 750 combine in sunflower harvesting the grain purity value fell below the minimum allowable limit of 97%.
The operating indexes of the combines tested were calculated based on the timing sheets prepared during the operating experiments.
The average values of the operating coefficients of the combines studied are shown in table 4.
As it can be seen on table 4, the Claas Lexion 750 combine recorded higher values at almost all of the coefficients compared to the Claas Lexion 560 combine.
The Claas Lexion 750 combine registered lower values for the operational safety

coefficient and for the technical safety coefficient in sunflower harvesting, but the differences were insignificant.

Table 4. The operating coefficients of the Claas Lexion 560 and the Claas Lexion 750 combines in sunflower harvesting

Specification	Symbol	M.U.	Specification	
Combine	-	-	Lexion 560	Lexion 750
Hourly work capacity on effective time	Wef	t/h	11.18	11.31
Hourly work capacity on operative time	W02	t/h	9.17	14.98
Hourly work capacity on production time	W04	t/h	8.30	13.79
Hourly work capacity on shift time	W07	t/h	7.37	12.71
Work capacity on a 8 hours shift	Wsch	t/sch	58.96	101.68
Fuel consumption per reference unit	Gc	l/ha	8.67	9.39

The work capacities and the fuel consumption average values of the both combines can be found in table 5.

Table 5. The work capacities and the fuel consumption of the Claas Lexion 560 and the Claas Lexion 750 combines in sunflower harvesting

Specification	Symbol	M.U.	Specification	
Combine	-	-	Lexion 560	Lexion 750
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Work capacity on a 8 hours shift	Wsch	t/sch	58.96	101.68
Fuel consumption per reference unit	Gc	l/ha	8.67	9.39

The Claas Lexion 750 combine had registered better values on the work capacities, compared to Claas Lexion 560 combine in sunflower harvesting. The fuel consumption per reference unit was higher on the Claas Lexion 750 combine, then the one registered on Claas Lexion 560 combine, mainly due to the bigger quantity of material threshed and to the bigger cylinders' capacity of the Claas Lexion 750 combine's engine.

CONCLUSIONS

From experimental research results can be observed a directly proportional relationship between the feeding flow and the total grains losses of the combines, and a reverse relationship between the feeding flow and the percentage of broken grains.

The grains losses did not exceed the maximum allowable limit of 2%, this fact is actually proving a quality and a reliability of both combines' construction, especially on threshing and cleaning systems' performance.

The Claas Lexion 750 combine, had performed better than the Claas Lexion 560 combine, the major difference being made by the working capacity indexes and the operating coefficients values. Higher values of those indexes registered in operation by the Claas Lexion 750 combine were due to the existence in its construction of the separating rotors that have replaced the classic walkers and the existence of the automation elements, namely: the combine's automatic routing by the chain's edge, the automatic control system of the working speed according to the chain's characteristics and the automatic control of grains losses.

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