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THE EXPERIMENTATION OF THE TC 5050 NEW HOLLAND COMBINE HARVESTER IN WINTER WHEAT CROP HARVESTING

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Abstract

The work presents the results of laboratory experiments and field studies in winter wheat crop harvesting with the New Holland TC 5050 combine harvester. The combine's harvesting performance was monitored on the level and slope field by determining the work quality indexes and the energetic and operating indexes of the combine studied. When driving on sloping land on the valley-hill direction, grain losses have exceeded the maximum allowable limit, reaching values over 6%. When movement was along level curves, the grain loss had registered values close to maximum allowed limit (2.5%), being therefore the recommended method. Fuel consumption has increased considerably when driving on sloping land compared with driving on the level field. In order to achieve a quality harvesting work, combine harvesters should be adjusted and operated in accordance with land condition and with the agrobiological characteristics of the crops.

Key words**:** *combine, grain losses, fuel consumption, winter wheat, work indexes.*

INTRODUCTION

The straw grains combine harvesters are complex agricultural machinery capable to perform all the technological stages that are needed to obtain the main product (grains). It should be noted that even if those machines were initially designed only for mechanized harvesting of the straw grains, over the years they have been gradually equipped with new working boddies in order to harvest other crops: maize, sunflower, soybean, rapeseed, beans, peas, etc. [3].

This paper studies the performance of the TC 5050 New Holland combine in winter wheat harvesting on the level and slope land. A special attention should be paid to the level of seed losses, which tend to be very high when harvesting is done on slopping fields.

This paper aims to identify the optimum operating procedures for harvesting winter wheat according to the land condition and to highlight the links and the relationship between the work quality, energetic and operating indexes.

MATERIAL AND METHOD

The experimental research took place in 2011 at the Ezăreni Farm, which belongs to the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" Iaşi, on plots with winter wheat Alex variety.

The agrobiological characteristics of the winter wheat crop on which the experimental research were carried out are presented in Table 1.

Table 1. The crop's agrobiological characteristics

Specification	M.U.	The average value of the biological characteristics
Grain moisture	%	14.5
Plants' density	plants/m^2	376
Plants' average height	cm	75.1
Total mass of the plants:	g/m^2	991.25
- grain mass	g/m^2	441.61
- straw mass	g/m^2	468.59
- weed mass	g/m^2	81.05
Recumbent plants percentage	%	0.67
Grain production per hectare	kg/ha	4467.3
Average straw production per hectare	kg/ha	4698.5
Grain-straw ratio	-	0.94
The 1000 seeds mass	g	47.05
Mass per storage volume	kg/hl	78.6

Operating measurements were conducted under normal production conditions. The plots on which the experiments took place had shapes and sizes that would ensure the mechanized harvesting. The grain moisture at harvest was within the regulatory limit of 14-16%.
The work quality indexes, the energetic and operating indexes of the TC 5050 New Holland combine in winter wheat harvesting were measured.
The main technical and functional features of the TC 5050 New Holland combine can be found in table 2.

Table 2. The main technical and functional characteristics of the TC 5050 New Holland combine

The characteristic name	M.U.	New Holland TC 5050
Header – number of rows	-	4
Beater	-	
- width	mm	1040
- diameter	mm	607
- number of rails	-	8
- rotation speed	rot/min	430-1037
concave	-	
- number of rails		14
- wrapping angle	degrees	111
Rotary separator		no
Cleaning		
- cleaning surface	m^2	5.80
- total area under air flow	m^2	3.27
-cleaning area	m^2	4.00
- number of shackers	-	4
Chopping equipment	-	yes
Bunker - capacity	l	4,000
Engine	-	New Holland
- cylinders' capacity	l	6.80
- fuel tank capacity	l	300
Transmission	-	hidrostatic – 3 speeds
-length with header	m	10.72
- length without header	m	8.13
-width	m	3.00
- maximum height	m	4.00
Combine's mass	kg	7600

The combine used in experimental research was the TC 5050 New Holland combine, equipped with header for harvesting straw cereals with a 4.5 m width.
Daily stages of the combine working process were photographed and daily worksheets have been prepared. In those particular sheets were recorded the following: the experiments' location, the crop, the time when the work has started, the operations and the duration of each operation, the time of completion the work, the plot's draw and the plot's area which have been harvested, the quantity of the grains harvested, the cutting height, the fuel consumption and the grain moisture.
The combine was tested in operation conditions on the level and slope land: on the hill-valley direction, the valley-hill direction and along the contour, in first gear and the second gear. For each gear were used rotation speeds of 1500 rpm and of 1800 rpm and for each rotation speed, a number of three repetitions were done [1].
In the experimental research were also used: metric frame, electronic scale, moisture meter, tilt to collect grains and vegetal residues, plastic bags to collect the grain samples, stopwatch, and daily monitoring sheets.
The working capacities 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 [2].

RESULTS AND DISCUSSIONS

The work quality indexes were calculated according to the land's slope, to the combine's movement direction and to the combine's speed. The average values of the total losses, purity and broken grains obtained by the TC 5050 New Holland combine in winter wheat harvesting are grouped in table 3, 4 respectively 5.

Table 3. The total losses of the TC 5050 New Holland combine in winter wheat harvesting

Working speed			Total losses (%)			
Gear	rpm	Km/h	Level land	Level curves	Hill-valley	Valley-hill
I	1500	4.1	0.88	2.56	6.79	7.33
	1800	5.3	0.71	3.19	6.90	7.66
II	1500	6.8	0.65	2.62	6.68	7.47
	1800	9.3	1.10	3.39	7.14	7.59

When driving on sloping land on the hill-valley direction and on the valley-hill direction, the grain losses have exceeded the maximum allowable limit, reaching values over 6.5%.

When movement was along the contour, grain losses have been close to the maximum allowable limit (2%).

Table 4. The grains' purity obtained by the TC 5050 New Holland combine in winter wheat harvesting

Working speed			Purity (%)			
Gear	rpm	Km/h	Level land	Level curves	Hill-valley	Valley-hill
I	1500	4.1	98.73	96.51	94.33	95.75
	1800	5.3	98.09	96.32	94.05	95.15
II	1500	6.8	99.19	97.15	94.29	96.09
	1800	9.3	98.29	96.40	93.76	95.45

The purity of the grains was very high when the combine's movement was on the level land, but fell below the minimum allowable limit of 98% when combine's movement was on the slope field, reaching values below 94%.

Table 5. The percentage of broken grains obtained by the TC 5050 New Holland combine in winter wheat harvesting

Working speed			Broken grains (%)			
Gear	rpm	Km/h	Level land	Level curves	Hill-valley	Valley-hill
I	1500	4.1	3.25	3.49	3.66	3.65
	1800	5.3	3.11	3.11	3.42	3.29
II	1500	6.8	2.59	2.90	3.21	3.16
	1800	9.3	2.44	2.54	2.84	2.65

The percentage of broken grains showed higher values when the combine have been driven at lower speeds, due to the weak flow of grains which have been feeding the threshing apparatus.

The average values of the operating coefficients of the combine studied are shown in table 6.

Table 6. The operating coefficients of the TC 5050 New Holland combine in winter wheat harvesting

Specification	Symbol	Value
Operational time usage coefficient	K02	0.86
Production time usage coefficient	K04	0.76
Shift time usage coefficient	K07	0.55
Turns coefficient	K21	0.93
Technological service coefficient	K23	0.88
Technical care coefficient	K31	0.96
Technological safety coefficient	K41	0.98
Technical safety coefficient	K42	0.88
Operational safety coefficient	K4	0.83

The operating indexes of the combines tested were calculated based on the timing sheets prepared during the operating experiments.

The values of the main operating coefficients of the TC 5050 New Holland combine were: the operational safety coefficient 0.83; the technological safety coefficient 0.98; the technical safety coefficient 0.88; the turns coefficient 0.93.

The hourly work capacity on shift time of the TC 5050 New Holland combine has recorded a decrease on average by 15-23% at harvesting on sloping land compared to on the level land harvesting, due to the slope, which reduced working speed by 16-27% which led to a decrease of the shift time usage coefficient to 0.55.

The work capacities and the fuel consumption average values of the TC 5050 New Holland combine can be found in table 7.

Table 7. The work capacities and the fuel consumption of the TC 5050 New Holland combine in winter wheat harvesting

Specification	Symbol	M.U.	Value
Hourly work capacity on effective time	Wef	t/h	7.78
Hourly work capacity on operative time	W02	t/h	6.79
Hourly work capacity on production time	W04	t/h	6.58
Hourly work capacity on shift time	W07	t/h	5.34
Work capacity on a 8 hours shift	Wsch	t/sch	42.72
Fuel consumption per reference unit	Gc	l/t	6.10

The fuel consumption of the TC 5050 New Holland combine obtained in winter wheat harvesting on the sloping land has increased on average by 17-28% comparing to the fuel consumption obtained on the level land movement.

During the experimental research, we have seen that the combine's safety is not ensured on the hill-valley movement balance facing valley, especially on slopes above 22% and when the bunker had a load over 1,500 kg of grains.

CONCLUSIONS

The TC 5050 New Holland combine had the total grain losses below the allowable limit of 2% when driving on the level and just above this limit when the combine's movement was on the slope land along the contour. When driving the combine on the hill-valley, and on the valley-hill directions, the combine's total grain losses have exceeded the allowed limit, reaching values of 7.66% at the most.

The percentage of broken grains was reverse proportional to the speed of the combine and has not been explicitly influenced by the slope.

In the experimental research, the 5050 TC New Holland combine has reduced its work capacity by 15-23% and has increased fuel consumption by 17-28% when driving on the slope land comparing to the level land movement.

The time for technical fixes has immobilized the combine 14-19 min./shift on average, which drew reduction of the shift time usage coefficient to 0.55, and the operational safety coefficient to 0.83.

In order to achieve a quality harvest work, the combines should be adjusted and operated in accordance with land condition and with the agrobiological characteristics of the crops.

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