Evaluation of some technical indicators for New Holland TC 5050 harvester on harvesting losses of rice crop

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Abstract:

This study was conducted in one field of Al-Shamia district in Diwaniyah governorate, Iraq in 2017, for studyingsome technical indicators of New Holland TC 5050 harvester on harvesting losses of rice crop,by using New Holland TC 5050 harvester in various cutting height and threshing cylinder speed. This study was studied two factors: included three cutting heights 10,15 and 25 cm. and three threshing cylinder speeds 450,500 and 550 rpm. The properties which were studied including: percentage of cutting losses, percentage of threshing losses, percentage of separating losses and percentage of cleaning losses. A factorial experiment was carried out in a Randomized Block Design (R.C.B.D) with four replicates. The results showed the

following: increasing cutting height from 10 to 15 and 25 cm caused a decrease in the percentage of cuttinglosses, the percentage of threshing losses, the percentage of separating losses and the percentage of cleaning losses. Threshing cylinder speed 450 rpmobtained significant superiority up onthreshing cylinder, speed550rpm achieved lesspercentage of cutting losses and the percentage of threshing losses, while threshing cylinder speed 550 rpmachieved lowerpercentage of separating losses and percentage of cleaning losses. Increasing threshing cylinder speed from 450 to 500 and 550 rpm caused an increasing in the percentage of cutting losses and percentage of threshing losses, and decreasing in the percentage of separating losses and percentage of cleaning losses.

Keywords: cutting height, threshing cylinder speed, percentage of cutting losses and threshing losses

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Introduction:

Rice is one of the most important crops in the world. It is equivalent to the wheat crop in terms of importance as a food source for humans and comes after it in terms of production and cultivated area. Mechanical harvesting one of the basic operations in the rice crop production which affecting directly in the quantity and quality of the crop for the unity of the cultivated area. The harvester has lost significant amounts of rice as it passes on its different units: cutting, threshing, separating and cleaning unit (1). There is found that the property of grain breakage is considered an important factor in increasing losses percentage, especially for threshing unit. The rice grain is under mechanical stress during harvesting and separation of grain from the heads, this causing the grain breakage, cracked and crushed grains because of the cylinder speed, clearance between cylinder and concave and the type of the cylinder and concave.Grain harvesting is the last agricultural operation carried out on the crop after the process of tillage, sowing and mechanical and chemical control (2). It is also difficult to process, because it's takes place at a time when the atmosphere is relatively humid and cool in addition to the dust resulting from the harvesting process.This requires the provision of all the necessary resources to carry out the harvesting process and completion it with high productivity, low cost and the fastest time. Harvesters are used to harvest grain crops with separate grains from their shells and to clean themand then be packaged.Harvesters can be used to harvest small, medium and large grains.Harvester is an integrated machine consisting of a set of main components such as cutting, threshing, separating, and cleaning units.The cutter baris the main part of these units that works to cut the crop, the construction of the cutter bar is similar to that of a mowing machine(4). process of raising and lowering cutter bar can be controlled according to the height of the crop. Bawatharani *et al*.(6) noted that there are four indicators affecting the feed crop passing during the header is: the plant density, practical width and cutting height beside the forward speed of harvester.

This study aimed to determining appropriate threshing drum speed and cutting height for reducing grain loss(including grain damage) and producing better quality of grain rice variety Jasmine in mechanical harvesting operations.

Materials and Methods:

The study was conducted in the field of Al-Shamia district in the governorate of Diwaniyahin2017.Combine field speed

was 2.3 km.h^{-1}. The study was performed by using the factorial experiment according to randomized complete block design (RCBD) with four replications of rice variety Jasmine with moisture content of 16%. Two factors were used in this study included:

1- Cutting height: which included heights10, 15 and25 cm, was done by raising and lowering the cutter bar hydraulically and the measuring of the height by using steel- measuring tape (1).
2- Threshing cylinder speed: included speeds of 450, 500 and 550 rpm, this was measured by using a digital Tachometer DT – 2234B (3). The drum type was spike- tooth with a diameter of 0.607 m and a width of 1.04 m.

Four random samples were taken from the field by means of a wooden frame measuring 1 m^2 to estimate the percentage of loss before harvest. Four samples were also taken to estimate the yield of the grain by harvesting and threshing them manually. The yield was estimated at 3170 kg. ha^{-1} and the samples were taken from the side and the rear of the combine to estimate the following(1) :

1- The grain and the heads fallen off straw line where converted to loss ratios for cutting unit after subtract the weight of grains before harvest.
2- The grain loss inside straw line where unthreshed heads and damaged grains collected from randomly selected sample area was manually threshed and estimated percentage loss of the threshing unit.
3- The grain loss under straw line after upload the straw from areas which taken from the previous sample, collect the falling grains on the ground under straw after subtracting grain loss out of straw line, the weight taken and convert it to the loss percentage for separating and cleaning units.
4- The total crop yield calculated in kg.ha^{-1} as follows:

Total crop yield = Net yield in harvester tank + yield loss during harvesting + preharvest yield loss.

Indicators studied:

1- Percentage of cutting losses: this was calculated according to the following equation (1):

$$C_L = \frac{M_2 - M_1}{P} * 100\ \%$$

C_L = percentage of cutting losses %

M_1=the weight of the fallen grains on the ground before the harvesting process kg . ha^{-1}.

M_2= the weight of the fallen grains on the ground under the cutter bar after the passage of the Harvester kg . ha^{-1}.

P= productivity rate kg .ha^{-1} which was 3170 kg.ha^{-1} .

2- Percentage of threshing losses: the following equation was used to calculate the losses(1):

$$T_L = \frac{T}{P} * 100\ \%$$

T_L = Percentage of threshing losses %.

T= Losses of threshing unit kg. ha^{-1} which estimated from the unthreshed and damaged

seeds quantity in plants were randomly which picked from the straw falling behind the harvester according to the following equation:

$$T = \frac{m * d}{50\ \text{plant}}$$

m = grain weight of 50 plant. Inkg.

d = Plant density rate per hectare. In plant. ha^{-1} .

3- Percentage of separating losses: this was calculated according to the following equation(1):

$$S_L = \frac{S}{P} * 100\ \%$$

S_L = percentage of separating losses

S = losses of separating unit kg . $ha^{-1}$are estimated according to the following:

$$S = \frac{S_m * 10000}{A} \ldots \text{kg. ha}^{-1}$$

S_m = the weight of grain which is collected of the samples from the output of separating unit.

A = the area from which the sample was taken is m^2 , represented by the actual working width of harvester *length of sample stripe 10 m.

4- Percentage of cleaning losses: this was calculated according to the following equation (1):

$$CL_L = \frac{CL_c}{P} * 100\ \%$$

CL_L = percentage ofcleaning losses %

CL_c = losses of cleaning unit kg . $ha^{-1}$are estimated according to the following :

$$CL_c = \frac{CL_m * 10000}{A} \ldots \text{kg. ha}^{-1}$$

CL_m =

the weight of grain which is collected from the output o

. Kg.

Results and Discussion:

1- Percentage of cutting Losses:

The results of the statistical analysis showed that there are significant effect of cutting height on cutting losses where the superiority cutting height25 cm on cutting height10cm achieved the less percentage of cutting losses amounted 2.23%, also registered threshing cylinder speed450 rpm

achieved less percentage of cutting losses amounted 2.32% Table 1,it is also observed that cutting height 25cm and threshing cylinder speed 450 rpm achieved less percentage of cutting losses 2.16 %, while cutting height10cm and threshing cylinder speed550 rpm achieved higher percentage of cutting losses2.77 %. The reason was due to the large quantity of harvested crop at a height of 10 cm led to an increasing in the length of the stems of cut plants and intertwined with each other and overcrowding at the cutter and fall some of its from cutter bar to the ground as well as wrapping the crop around the reel as a result of increasing the length of plants and swaying it(14,15).

Table: 1 The effect of cutting height and threshing cylinder speed on percentage of cutting losses %

Cutting height (cm)	Threshing cylinder speed (rpm)			Average
	450	500	550	
10	2.43	2.49	2.77	2.56
15	2.38	2.36	2.58	2.44
25	2.16	2.21	2.32	2.23
L.S.D.		0.127		0.034
Average	2.32	2.35	2.56	
L.S.D.		0.090		

2- Percentage of threshing losses:

Table 2 shows that there are significant effect of cutting height on threshing losses by using L.S.D at 0.05 level that the superiority cutting height of 25 cm achieved the less percentage of threshing losses amounted 2.03% compared to other cutting heights, also registered threshing cylinder speed 450 rpm achieved less percentage of threshing losses amounted 1.93 %. As shown in table 2 that cutting height 25 cm and threshing cylinder speed 450 rpm achieved less percentage of threshing losses 1.69 %, while cutting height 10 cm and threshing cylinder speed 550 rpm achieved higher percentage of threshing losses 2.9%. The reason was due to increase the amount of stalks of plant and straw entering the threshing unit as well as the high speed of

threshing cylinder helped to increase in the percentage of grains damage which also consider as a losses(5,12).

Table: 2 The effect of cutting height and threshing cylinder speed on percentage of threshing losses %

Cutting height (cm)	Threshing cylinder speed (rpm)			Average
	450	500	550	
10	2.27	2.55	2.9	2.57
15	1.83	2.37	2.64	2.28
25	1.69	2.08	2.31	2.03
L.S.D.		0.112		0.031
Average	1.93	2.33	2.62	
L.S.D.		0.086		

3- Percentage of separating losses:

The table 3 shows that there are significant effect of cutting height by using L.S.D at the 0.05 level where the superiority cutting height 25 cm on cutting height 10 cm achieved the less percentage of separating losses amounted 1.64 %, also registered threshing cylinder speed 550 rpm achieved less percentage of separating losses amounted 1.63 %. Also the cutting height 25 cm and threshing cylinder speed 550 rpm achieved less percentage of separating losses 1.51%, while cutting height 10 cm and threshing cylinder speed 450 rpm achieved higher percentage of separating losses 2.08%. This is in conformity with the results obtained by (12) who reported that the reason was due to increase the speed of feeding crop components above straw walkers and not give enough opportunity to the grain to descend through the hay layers and complete the separation process.

Table: 3 The effect of cutting height and threshing cylinder speed on percentage of separating losses %

Cutting height (cm)	Threshing cylinder speed (rpm)			Average
	450	500	550	
10	2.08	1.84	1.69	1.87
15	1.92	1.71	1.62	1.75
25	1.77	1.65	1.51	1.64
L.S.D.		0.087		0.019
Average	1.92	1.73	1.63	
L.S.D.		0.052		

4- Percentage of cleaning losses:

The results showed that there are significant p≥ 0.05 effect cutting height where the superiority cutting height 25cm on cutting height 10 cm achieved the less percentage of cleaning losses amounted 1.37 %, also registered threshing cylinder speed 550 rpm achieved less percentage of cleaning losses amounted 1.34% (Table 4). The cutting height 25 cm and threshing cylinder speed 550 rpm achieved less percentage of cleaning losses 1.25 %, while cutting height 10 cm and threshing cylinder speed 450 rpm achieved higher percentage of cleaning losses 1.64%. This results confirms according the conclusion of (10 and 13) who reported that reason was due to suffocation of cleaning sieves by soft straw and chopped hay parts (chaff and debris)causing the flow of grain over it and not allow for getting out of the sieve openings, and therefore dispose of the grain with the air of the cleaning fanoutside the harvester led to increase the percentage of cleaning losses .

Table: 4 The effect of cutting height and threshing cylinder speed on percentage of cleaning losses %

Cutting height (cm)	Threshing cylinder speed (rpm)			Average
	450	500	550	
10	1.64	1.53	1.45	1.54
15	1.58	1.46	1.33	1.46
25	1.49	1.37	1.25	1.37
L.S.D.		0.064		0.015
Average	1.57	1.45	1.34	
L.S.D.		0.039		

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