

Innovative harvesting methods about the harvest losses for two machines

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Abstract

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The effect of harvest machines on wheat/Abad cultivar was observed based on some technical indicators. Two types of wheat harvesting machines (NewHolland -TC54 and Claas 68s) were tested at three speed (2.5, 3 and 4.24 Km .hr⁻¹) and two ranges of grain moistures (11–13% and 13–15%). The experiments were carried out in a factorial experiment under randomized complete block design with three replications. The results showed that the New Holland-Tc54 machine was significantly better than Claas 68s machine. The results gained were 3.281 and 3.576% respectively, while they were 3.493 and 3.669% respectively under the same operating conditions for Claas 68s machine, for two sites by different harvesting methods, the harvest losses for cutting unit, threshing unit, cleaning unit and packing unit. The harvest speed of 2.5 km hr⁻¹ was significantly superior to the other two levels of 3 and 4.243 Km hr⁻¹ in all studied properties, while the wheat grains moisture content at range of 11–13% was significantly superior to other range of 13–15% in all studied conditions.

Keywords: wheat; harvesting machines; moisture content; speed; sites

Introduction

Wheat is a very important crop. It grows in diversified environments and it is a staple food of millions of people. Wheat has a distinct place among the food grain crops. Carbohydrate and protein are two main constituents of wheat and supplies about 20% of the food calories, on average wheat contains 11–12% protein. Wheat ranks as a first crop in Iraq Alsharifi (2018).

The moisture content has a different influence on grains properties. The study of Alsharifi et al. (2017) showed that, when grains were subjected to uniaxial compression, it behaved as an elastic-plastic-viscous body which exhibited creep, stress relaxation and elastic after effects. If the amount of grain moisture content is high, it makes them enter the phase of the plasticity which makes wheat harvesting very difficult. Therefore, it needs more time to complete harvesting which leads to the decrease of machine productivity.

Alsharifi et al. (2019b). The combine harvester not only minimizes the post-harvest losses but also helps in shortening the harvesting period. While evaluating the performance of eight combines observed that time of harvesting, seed moisture content, relative humidity, field topography and varietal characteristics are the major factors affecting harvest losses. He concluded that mean total loss by different combines was 6.88% at wheat harvesting stage Shamabadi (2012).

Timely harvesting is utmost important, as delayed harvesting leads to a considerable loss of grain and straw owing to over maturity resulting in loss of grains by shattering and also delays in seed bed preparation and sowing operations for the next crop. The paucity of labour in the peak harvesting season is forcing the farmers delay harvesting causing high postharvest losses and sometimes loss of the crop by natural calamities. Due to increase of cropping intensity and production of different crops, the demand of agricultural labour has increased significantly (Veerangouda et al., 2010). Due to de-

lay harvesting, a large quantity of grain is lost each year in the country (Alsharifi et al., 2019a). Measured grain losses are of different wheat varieties with different models of combines during harvest stage. They observed that average pre harvest losses in all fields of study were 31.4 kg ha⁻¹ accounting for 12.71 percent of total losses Mirasi et al. (2013).

The wheat productivity increasing during harvest process was to be highly correlated with drum speed and so machine type Mostofi (2011). They concluded that threshing losses were mainly in the form of broken grains. They observed more post-harvest losses at farm level. The harvesting losses have added up to about 40.85 per cent. Begum et al. (2012). Wheat is one of the important food staff in consumption pattern of each country. More than 50% of human energy is supplied from bread in the developing country. Combine losses is less than 2–3% in developed countries, while in developing country is about 15–20% in different regions and circumstances of harvesting seasons and field conditions, Asadullah et al (2014) Quality losses of wheat include broken grains, weeds seed or any other material found in the produce. The quality losses were mainly in the form of broken grains. Muhammad et al. (2015).

The main goal of this research is to study the effect of harvesting machines on wheat specification under NewHolland -TC54 and Claas 68s harvesting machines at different speeds and different ranges of grain moisture content.

Materials and Methods

This study was conducted in 2018 to evaluate Claas 68s and New Holland TC54 harvesting machines performance. The experiments were done at two ranges of grain moisture contents of 11–13% and 13–15% and three speeds at lev-



Fig. 1 The machine (type New Holland C54), used for harvest wheat

els of 2.5, 3 and 4.24 Km h⁻¹. The harvesting New Holland TC54 machine has power 560Hp, Number of Shakers 6, Cutting width 4.8 m, Fuel type Diesel, Productivity of 5t.h⁻¹ (Figure 1). The harvesting Class 68s machine has power 560Hp, Fuel Type, Diesel, Number of Shakers 6, Cutting Width 4.2 m, Productivity 4 t.h⁻¹ (Figure 2). The initial moisture content of wheat was determined at 13–15%. The claas 68s type machine was adjusted on 0.5 mm clearance between cylinders for threshing unit and harvester speed of 4.24 km hour⁻¹ for both two sites. The cutting unit, threshing unit, cleaning unit and packing unit were calculated for each running test.



Fig. 2 The machine (type Claas 68s), used for harvest wheat

Moisture content of the grain

Moisture content has a marked influence on all aspects of wheat and it is essential that wheat harvesting at the proper moisture content to obtain the whole grain percentage no broken grains for wheat (Alwan et al, 2016).

$$W = \frac{W_w}{W_d} \times 100,$$

where: W is the moisture content of the grain (%); W_w is the wet weight and W_d is the dry weight.

Rotational speed

Advice was used to calculate the number of rotations through the speed of rotation and is made of magnet and installed on the rotary engine. Then the engine and the magnet rotation will be counting the number of cycles for determination ground speed for the harvester.

Harvesting methods

The first site, harvesting method by going and return

The harvest is done from the left toward the corresponding pillow than move to the right after lifting the cutting unit and resume the harvest process with back to the corresponding pillow, Figure (3).

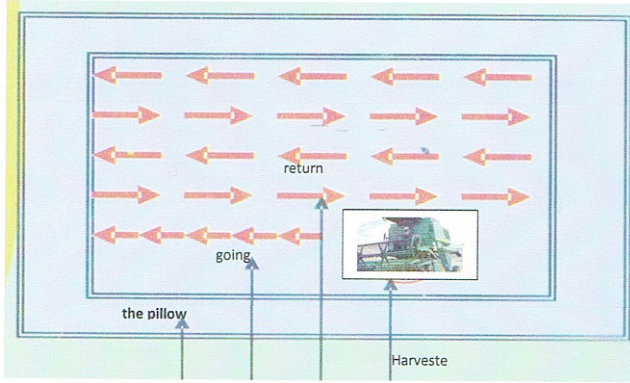


Fig. 3. Harvesting method by going and return

Second site, harvesting method by rotation oceanic

In this method, the field is harvested from outer borders and rotation to the right until the remaining spot is harvested in going and return as in first method. The advantage of this method is to reduce time and increase the productive efficiency of the harvesting machine as in Figure (4).

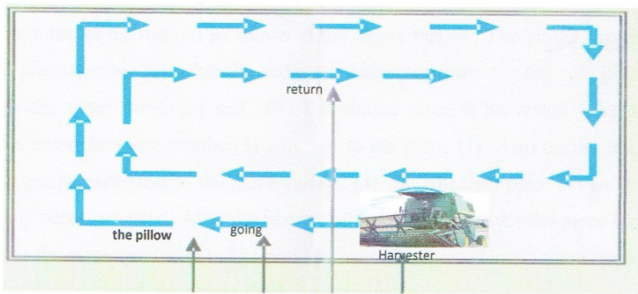


Fig. 4. harvesting method of rotation oceanic

Test of harvesting losses

Pre-harvesting lost:

Choose unharvested area within the field well in from the edges. Place a frame 1m² in the standing crop to evaluate weight of grains lying on the ground within the frame:

$$P_{HL} = \frac{G_{BH}}{T_Y} \times 100,$$

where: P_{HL} – pre-harvesting loss %, G_{BH} – grains on the ground before harvesting (Kg.m²), T_Y – total yield (kg.m²).

Cutting unit

The cutting unit loss was determined as (Issakhan et al, 2005):

$$C_{UL} = T_{LCg} - P_{HL},$$

where: C_{UL} – cutting unit %, P_{HL} – pre-harvest loss, T_{LCg} – total loss for cutting group kg.m².

Cleaning unit loss

After raising the straw on harvester machine line, and collect the fallen grains on the ground weighed and converted to a loss ratio for the cleaning unit.

Drum, straw walker and cleaning units are the percentage of detached and the percent of damaged seeds from threshing unit and separate the threshed seeds from straw (straw walker effectiveness) then to separate seeds from the chaff and other plant residues that have passed through the openings. The straw walker cleaning losses was calculated as follow (Alsharifi, 2018):

$$D + S_w + C_{Losses} = \frac{D + S_w + C}{T_Y} \times 100,$$

where: D – drum losses (km.m²), S_w – straw walker losses (km.m²), C – cleaning losses (km.m²).

Thresher losses

Thresher losses included damaged and un-threshed grains were calculated as follow (Alsharifi et al., 2019):

$$G_D = \frac{M_{GD}}{T_{MG}} \times 100,$$

where G_D – grain damage %, M_{GD} – mass of grain damage (kg.m²), T_{MG} – total mass of grains (kg.m²):

$$U_{THG} = \frac{M_{UG}}{T_{MG}} \times 100,$$

where: U_{THG} – un threshed grains%, M_{UG} – mass of un-threshed grains(kg.m²), T_{MG} – total mass of grains (kg.m²):

$$T_{GL} = D_G - U_{THG},$$

where T_{GL} – total grain losses, D_G – damaged grains, U_{THG} – un-threshed grains.

Packing unit

Collect the fallen grains on the ground from both sides, weighed and converted to a loss ratio for the packing unit.

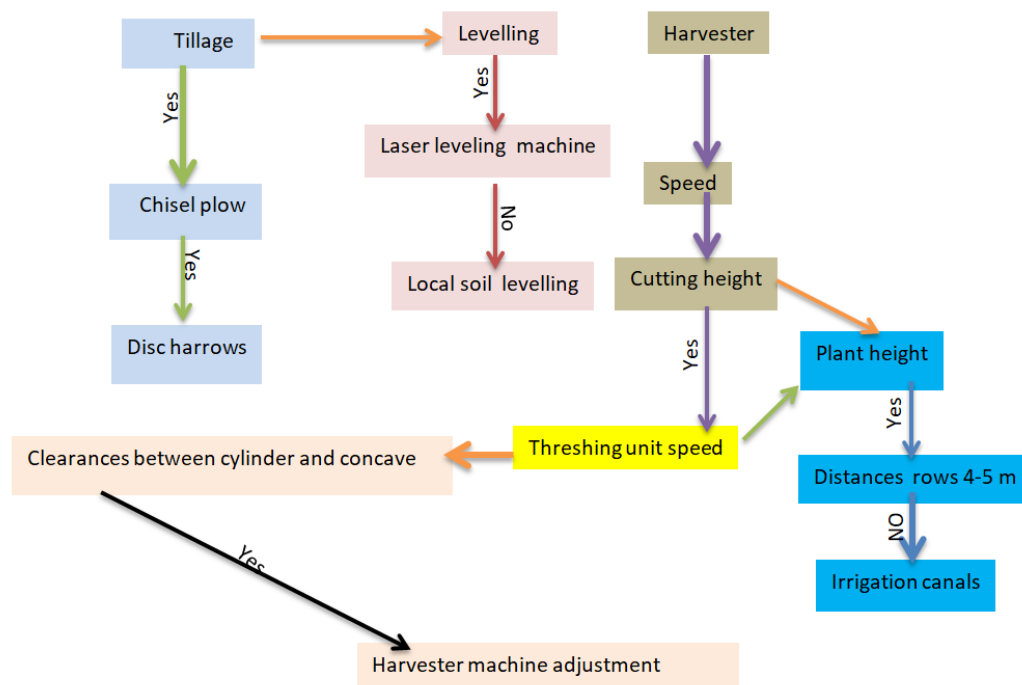


Fig. 5. Soil preparation and reduction of harvest losses

Reduce losses of the wheat during harvest

Soil preparation, reduction of harvest losses

Reduce harvest losses for the wheat crop with step by step tillage, leveling and all stages of cultivation, the leveling processes from the important processes for reduce the grains losses, because it has a direct impact on the harvester calibration from cutting unit, threshing, cleaning, all these stages affected by the nature the field that work it the harvester (Figure 5).

The results were analyzed statistically by using the randomized complete block design RCBD and the difference among treatments for each factor was tested according to the least significant difference L.S.D test (Oehlent, 2010).

Results and Discussion

The first site, Alshamia area, harvesting method by rotation oceanic

The influence of machine type, harvester speed and wheat grain moisture content on the harvest losses %: The harvester speed of 2.500 km.h⁻¹ had the lowest harvester losses of 3.147%, while the highest harvest losses of 3.745% was at harvester speed of 4.24 km.h⁻¹. The scattering of spikes and stems and increased losses was when increasing the speed of harvester (Asadullah et al., 2014).

From Table 1 it is clear that the New Holland-TC54 machine type was significantly better than the Claas 68s machine type and results were 3.281 and 3.576% respectively, due to the efficiency and engineering design of the machine and finishing the work with less time. These results are consistent with the results from (Begum et al., 2012). The increasing of the grain moisture led to the increase of the grains losses in first site Alshamia area, and the results were 3.315, and 3.542% respectively, for all units harvest at different grain moisture contents. This is due to the increased Damocles effort on grains during the harvest and threshing process, hence increases the harvest losses with the increasing grains moisture content. This is also in accordance with Mirasi et al. (2013). The cutting unite, threshing unite, cleaning unite and packing unite were recorded 4.8365%, 4.031%, 2.001% and 1.094% respectively, when interactions among parameters of New Holland -TC 54, 2.5 km h⁻¹ harvest speed and 11–13% grain moisture under the same operating conditions in first site Alshamia area. The pre-harvest losses in this site were 6.3%.

The second site, Alhamza west area, harvesting method by going and return

Table 2 shows the influence of machine type, speed of harvester and grains moisture content on the harvest losses (%). The results indicated that increasing the speed of harvest led to increase the harvest losses in second site Alhamza

Table 1. The effect of machines types, speed of the harvester and grain moisture on harvest losses units %

Machines	Grain mois- ture%	Machine speed ground km h ⁻¹	The first site, Alshamia				Average		
			Harvester unit						
			Cutting unit	Threshing unit	Cleaning unit	Packing unit			
<u>New Holland –TC54</u>	11-13%	2.500	4.836	4.031	2.001	1.094	Average of grain moisture		
		3.0	5.093	4.165	2.194	1.123	11-13	13-15	
		4.24	5.911	4.688	2.201	1.200	3.315	3.542	
	13-15%	2.500	4.938	4.196	2.111	1.131	Average of speed		
		3.0	5.213	4.402	2.362	1.248	2.5	3	4.24
		4.24	6.002	4.966	2.415	1.296	3.147	3.394	3.745
<u>Claas -68s</u>	11-13%	2.500	5.001	4.191	2.166	1.121	Average of machine		
		3.0	5.526	4.455	2.312	1.302	New Holland –Tc54	Claas-68s	
		4.24	6.298	4.822	2.506	1.413	3.281	3.576	
	13-15%	2.500	5.441	4.311	2.210	1.566	Average of machine		
		3.0	5.903	4.905	2.469	1.724	N.S	Moisture	
		4.24	6.529	5.001	2.688	1.986		*speed	
		Machine	0.542	Machine *	0.63	Machine*			
		speed	0.416	speed		moisture			
		moisture	0.489	Machine * moisture *speed			0.834	0.63	
<u>LSD = 0.05</u>									

Table 2. The effect of machines types, speed of the harvester and grain moisture on harvest losses units %

Machines	Grain moisture%	Machine speed ground km h ⁻¹	The second site, Alhamza west				Average		
			Harvester unit						
			Cutting unit	Threshing unit	Cleaning unit	Packing unit			
<u>New Holland –TC54</u>	11-13%	2.500	5.101	4.213	2.109	1.115	Average of grain moisture		
		3.0	5.461	4.442	2.246	1.241	11-13	13-15	
		4.24	5.698	4.889	2.310	1.388	3.428	3.734	
	13-15%	2.500	5.556	4.596	2.213	1.193	Average of speed		
		3.0	5.901	4.992	2.466	1.406	2.5	3	4.24
		4.24	6.003	5.004	2.601	1.680	3.347.	3.592	3.803
<u>Claas -68s</u>	11-13%	2.500	5.213	4.422	2.212	1.193	Average of machine		
		3	5.608	4.688	2.316	1.402	New Holland –Tc54	Claas-68s	
		4.24	5.811	5.009	2.488	1.689	3.493	3.669	
	13-15%	2.500	5.933	4.882	2.396	1.210	Average of machine		
		3.0	6.004	5.008	2.577	1.613	N.S	Moisture	
		4.24	6.182	5.203	2.992	1.902		*Speed	
		Machine	0.64	Machine *	N.S	Machine*			
		speed	0.51	speed		moisture			
		moisture	0.48	Machine * moisture *speed			0.607	N.S	
<u>LSD = 0.05</u>									

west area, and the results were 3.347%, 3.592% and 3.803% respectively for all units harvest with different levels of harvest speed. This is due to complicated harvesting method in this site and no good leveling the field, hence harvest losses increased for all harvest units. These results are consistent

with the results from Muhammad et al. (2015) were surveyed at different wheat grains moisture of 11-13%, the result indicated the lowest harvest losses of 3.428%. Moreover, the grain moisture of 13-15% presented the highest harvest losses of 3.734%. This is due to fragility of the wheat grains

with increasing grain moisture. These results are in accordance with Mostofi (2011). However, the New Holland -C54 machine type was significantly better than the Claas 68s machine type for the results of 3.493% and 3.669%. This is due to the efficiency and engineering design of the machine and finishing the works with less time as compared with the Claas 68s machine type (Veerangouda, et al., 2010). The cutting unit, threshing unit, cleaning unit and packing unit were recorded 5.101%, 4.213%, 2.109% and 1.115% respectively, when interactions among parameters New Holland -TC 54, 2.5 km h harvest speed and 11-13% grain moisture under the same operating conditions in second site Alhamza west area. The pre-harvest losses in this site were 6.9%.

Conclusions

The New Holland-TC54 machine type is significantly better than the Claas 68s machine type. The grains moisture content 11-13% was superior significantly to the other level - 13-15%. Additionally, the speed of harvester of 2.500 km hr⁻¹ was superior significantly on than the other two speeds of harvester 3 and 4.24 km hr⁻¹ in all studied properties. The overlap between the New Holland -TC54 machine type and grains moisture content - 11-13% was also superior significantly. The overlap between the New Holland -TC54 machine type and the speed of harvester was 2.500 km hr⁻¹ compared with the overlap of the Claas 68s machine type with moisture content and speed of harvester in all studied properties. The best results were obtained from the interaction among New Holland -TC54 machine type, grain moisture 11-13%, and speed of harvester in all studied properties.

Recommendations

The present study recommends carrying out future studies using other machinery types and other harvest speed, or conducting other organizations on machine and the moisture content of grain to know their effect on the harvesting losses of wheat.

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