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Measuring Losses of Wheat Harvester Units at Different Speeds and Cutting Heights

Zhyar Burhan Abdulla [1] **Saefaddin Hassan Mohammed**[2]
Abdulla Fathi Youns [3] ***Momtaz Isaak*** [4]

[1]*Department of Biotechnology and Crop Science, College of Agricultural Sciences, University of Sulaimani, Sulaimani, IRAQ.*
[2]*Department Of Flied crop & Medicinal plant , College of Agricultural Engineering Sciences, University of Salahaddin , IRAQ.*
[3]*Department Of Flied crop & Medicinal plant, College of Agricultural Engineering Sciences , University of Salahaddin , IRAQ.*
[4]*Department Agriculture Machinery and Equipment / College of Agriculture ,Tikrit University ,IRAQ.*

*Corresponding Author: zhyar.abdulla@univsul.edu.iq.

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ABSTRACT

Factorial experiment used randomized complete block design with three replication conducted in the wheat field in the Qoritan region of Erbil State, Kurdistan, Iraq, for the study the effect of cutting, threshing, separation and cleaning units, also measuring the total losses and combine performance efficiency under two speed 2.5 and 3.5 km.h^{-1} and two higher cutting 10 and 20 cm. combine speed 2.5 km.h^{-1} recorded lower losses in threshing, separation, cleaning units and total harvester loss. While cutting unit and efficiency were higher. Increasing higher cutting gave losses 3.60%, 2.99%, 0.24% for cutting, threshing, separation and cleaning, respectively. Combine total losses was 6.83% while combine efficiency was reduced with speed harvester. Increasing higher cutting from 10 cm to 20 cm causes increase threshing unit loss 2.25% to 3.72% , and separation unit loss 0.20% to 0.35%. more than, increasing the total losses from 6.32% to 7.42% while the rest of parameters study were reducing.

***Keywords*:** Combine, Reel, Wheat, threshing, Cleaning, losses.

INTRODUCTION

The most important commodity is wheat (*Triticum aestivum*), one of the main cash crops and a staple diet for people [1]. Since losses are proportionate to the harvester's speed because of its effect on the feeding rate and operational units, forward speed is crucial in determining the percentage of harvest losses incurred throughout the harvest process [2]. The percentage of losses increased when the reel's rotating speed decreased relative to the harvester's forward speed, pushing dry spikes forward and shattering them, some of which fell to the ground [3]. Demonstrated that as reel rotation speed rose, head grain loss also increased [4]. Header loss rose as ground speed increased, according to research on the relationship between forward speed and header loss [5]. Examined the impact of advance and ground speeds on corn grain loss and optimized corn grain harvest losses using the response surface methodology using a corn picker-stripper system. According to the work's findings, the best ground and forwarding speeds to minimize grain loss were 3 km/h and 600 r/min, respectively [6]. Created a plot wheat seed harvester that successfully decreased the burden on the threshing and cleaning system while achieving the harvest of wheat spikes. The essential tools for achieving efficiency in grain harvesting are self-propelled harvesting combines [7]. Grain crop harvesting is one of the most crucial tasks among all agricultural job operations. Depending on the crop, weather, field circumstances, and post-harvest technologies, combine harvesters must be built or designed to meet specific technical and technological requirements [8]. The goal of the current study was to assess the impact of combine harvester forward and reel speed on wheat harvesting losses (total header, processing, and total machine losses) at the Massaid Technology Transfer Center demonstration farm in Gezira State between 2016 and 2017 [9]. One of the primary concerns regarding waste and loss reduction is grain losses from combine harvesting. One of the key and fundamental steps in reducing combine losses is the decrease of losses resulting from the cutting platform of the combine, which accounts for about 50% of all harvesting losses [10]. Matching the combine forward speed to the greatest harvested net income per acre was the aim of an econometric simulation model for combine harvesters [11]. For combine harvesters, throughput is a crucial performance metric that serves as the foundation for managing the machine's speed and loss rate. The shortcomings of current throughput monitoring techniques include poor application, low accuracy, and weak stability [12]. provides the findings of an experimental study conducted on a middle-sized combine harvester under heavy harvest conditions for the harvest of spring barley and winter wheat. According to the findings, it was feasible to determine how field circumstances affected the combine harvester's crop mass flow, grain losses, fuel consumption, and combine harvester field performance [13]. A combine harvester must be used under a variety of field conditions, which can result in different feeding rates. For maximum efficiency, the forward speed is a key factor in regulating the combine harvester's feeding rate. An optimal threshing power consumption model-based control approach was created in this study and included in a speed control system for automating combine harvesters [14]. The goal: Using optimization studies, a model was developed to enhance the cutting performance of combine harvesters at greater forward speeds. The model was then validated in the field on a commercially available combine harvester [15]. Modern agriculture depends on combine harvesters since they can greatly improve the efficiency of the grain harvesting process. They incorporate within a single machine a number of crucial harvesting process operations. Typically, these tasks involve chopping the crop, gathering and feeding the cut crop into the machine, threshing and separating the grains from the material other than cleaning them, and then moving the cleaned grains to a temporary storage bin [16]. The objectives of studying the cutter height and combine harvester speed in relation to the wheat crop loss ratio are centered around optimizing harvesting efficiency, minimizing losses, and improving profitability.

Materials And Methods

Location of the experiment

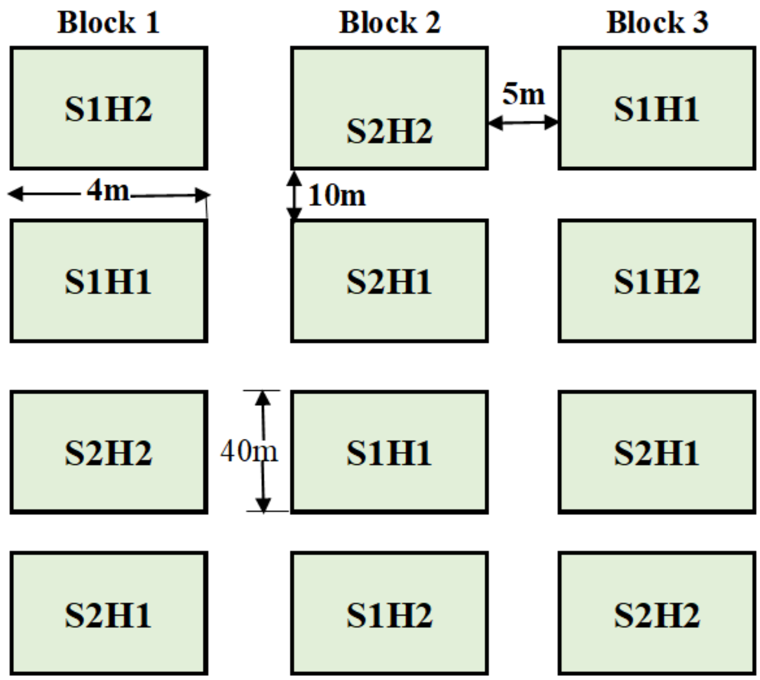
The experiment site was prepared and supplied by a seasoned volunteer farmer who has been cultivating wheat for many years. It was in the Iraq-Kurdistan Region's Qoritan region in Erbil State. The kind of soil was silt clay loam. The total area allotted for the experiment was around 4400 m^2, of which 1920 m^2 was used for cultivation. The remaining area was used for headlands for tractor or combine harvester rotations, replications, and the intervals between the experimental plots. Moldboard was used to plowing the soil depth of 20 to 25 cm on October 15, 2023. Five days later, secondary tillage began with a disc harrow to soften and get the ground ready for seeding. After that a variety of seed wheat was selected which was a type of flour wheat this name called (HASAD), with quantity needed of (35 kg), On November 2, 2023, seed drill was used for seeding the wheats; the equipment was set up to seeded the grains by 45 kilograms per dunam(the dunam is the unit of measurement for the area of fields in Iraq, equal to 2500 square meters), and the yield of the crop was (1450 kilogram per dunam), so moisture content for crops (9.43%) and average number spikes per mater square (282 spikes) and weight grain in meter square before harvested (0.574kg. m^{-2}). Used the implementation of the experiment composite harvester type New Holland shown the Table 1. The grains were sown at a depth of 10 cm. after sowing the grains. Until the crop reached the harvest stage, all service operations were completed for the developing crop and in accordance with the suggestions for applying fertilizer and controlling weeds. To calculate the cross-sectional area of the harvesting location, two pieces of wood measuring one by one meter were used. On June 21, 2024, the machine's various factors used a combine harvester.

Table 1: Some specifications of New Holland CSX7060 combine harvester.

Characteristics	Values/Types	Unit
Engine Power	223	kw
Fuel tank Engine capacity	400	Liters
Transmission	Hydraulic	………………….
Speed Combine Harvester	25-29	Km/h
Cutting Unit's Working Width	457	cm
Combine length	8.49	m
Combine width	3.64	m
Combine height	3.95	m
Grain tank capacity	7.500	ton
Combine weight	12.65	tons
Header height	1	m
Header length	4	m
No. straw walker	5	Straw walker

Experimental Design

Factorial experiment used randomized complete block design RCBD with three replication. The plots was divided into three blocks, each block was four plots for forward speed (2.5 $Km.h^{-1}$) as S1, (3.5 $Km.h^{-1}$) as S2, with cutter bar height (10cm) as H1, (20cm) as H2, each plot was 4 m by 40 m, distance between two plots (10m), so space between two blocks (5m). Therefore, the sum of the experimental plots for this study was 12. Three samples were randomly taken from each plot at patches of 1.00 m by 1.00 m. Show the figure number (1). Later on, the results were compared with Duncan's Multiple Range Test at a portability level of 5% with different lettering, A and B.



Methodology Outline

1. The weight of grain was taken from an area of one square meter. three times for the field before using a combine harvester to determine yield production that was equal to (0.574kg. m^{-2}).
2. A weight grain of losses by wind, birds, or another thing was randomly taken from an area of one square meter. three times for the field before using a combine harvester to determine losses of grain that were equal to (0.0185kg. m^{-2}).
3. Each sample was randomly taken from an area of one square meter. three times for each plot
4. Weighting grain for each character. Weight of the grain loss cutter bar unit.
5. Weight of grain losses threshing unit, losses cleaning and separation unit.
6. Weighting all losses combine harvester, the summation of the losses cutter bar unit, threshing unit, losses cleaning and separation unit.
7. Measuring the performance efficiency combine harvester used for each factor in each plot, length of 40m.

Ratio of the characters in each sub-unit is in kilograms per hectare

The weight of the lost grain for each unit is in kilograms for each hectare.

Ratio of (L_c, L_{th}, L_{sc}, A_l) in the one sample (kg. ha^{-1}) =

$$\frac{\text{weight in sample}\ \frac{g}{1000}}{area\ \text{of sample}\ \frac{100\ \text{cm x}\ 100\text{cm}}{10000}} \times 1000 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where:

$$\text{Change gram to kilogram} = \frac{gram\ (g)}{1000} \ldots\ldots\ldots\ldots\ldots\ (2)$$

$$\text{Change unit aera}\ (\text{cm}^2)\ \text{to}\ (\text{m}^2)\text{divded into}\ (10000) = \frac{150\ \text{cm x}\ 150\ \text{cm}}{10000} \ldots\ldots\ (3)$$

$$\text{Change unit area}\ (\text{m}^2)\ \text{to (hectare) divided by}\ (10000) = \frac{\frac{100\ \text{cm x}\ 100\ \text{cm}}{10000}}{10000} \ldots\ldots\ldots\ldots(4)$$

The losses cuter bar unit: by collecting the grains and spikes falling on the ground and weighing them, converting

them into a percentage after subtracting the grain weight before harvest.
$L_c = W_g - Y_{lb}$ ………………(5)
W_g: weight of grain or spike on the ground after the harvester per square meter
Y_{lb}: yield losses before harvest
L_c = Losses Cutter bar unit
Losses of threshing unit: by collecting the spike or grain unthreshed upper straw line after harvesting, then weighing the losses threshing unit and converting it into the percentage of losses.
L_{th} = Losses of the Threshing unit
Loss rate separation and cleaning unit: after lifting the straw, the gains falling on the ground are collected under the straw line and turn percentage of losses of the separation and cleaning unit.
L_{sc} = Losses of Separation and Cleaning unit
All losses combine harvester:
$A_L = L_c + L_{th} + L_{sc}$………………..(6)
A_L= All Losses combine harvester
Total yield Combine harvester:
$T_Y = N_{YT} + Y_{LH} + Y_{LB}$…………….(7)
T_Y: total yield
N_{YT}: Net yield in the harvester tank
Y_{LH}: Yield losses during harvest
Y_{LB}: Yield losses before harvest
$$\textbf{Performance efficiency} = \frac{\text{NYT}}{NYT+AL} * 100 \text{……………..(8)}$$

Result And Discussion
The effect of the Combine harvester Forwarding speed on the studied characters:
The table of variance analysis (2) makes this evident. that the influence of a speed factor causes notable variations in all characters under study, as follows:

Losses cutter bar unit
The data in Table (2) and column 3 indicate that the second speed (3.5 km.h^{-1}) achieved better morale the results for this character compared to the first speed, as they scored the highest percentage of losses of cutter bar unit in the first speed (2.5 km.h^{-1}), amount of 3.34% kg. $ha^{-1.}$ While the second speed scored (3.5 km h^{-1}), the lowest percentage of losses cutter bar unit, 3.23% kg. ha^{-1}. A weight difference of 0.11% kg. $ha^{-1.}$ The relationship between the study combine harvester forwarding speed and the cutter bar unit makes a little difference. According to this study, the speed of (2.5 km h^{-1}) is higher than the losses of the speed (3.5 km h^{-1}), because the percentage of the grain on the plant caducous or the plant falling on the ground causes a reduced speed of the combine harvester.

Losses of the threshing unit
As shown in Table 2, the first speed (2.5 km.h^{-1}) produced the best results for this characteristic by recording the lowest percentage of threshing unit weight losses (2.19 % kg/ha^{-1}), while the second speed (3.5 km.h^{-1}) recorded the highest percentage of threshing unit weight losses (3.22% kg. ha^{-1}), with a weight difference of (1.03% kg. $ha^{-1)}$. This shows that by increasing the speed of the combine harvester, the rate of threshing unit losses increased. Because it cannot thresh many plants harvested at the time [15].

Losses of separation and the cleaning unit
Table 3 shows that the initial speed (2.5 km.h^{-1}) produced the greatest results for this characteristic, with the lowest percentage of separation and cleaning unit weight losses (0.16 % kg. ha^{-1}). with a difference in weight of (0.08 % kg. ha^{-1}). While the highest percentage of the grain losses was recorded at the third speed (3.5 km h^{-1}), which reached a weight of grains (0.24 % kg. ha^{-1}). The proportionate association between the percentages of the grains lost and the combine harvester's front speed may be the cause of the decline in this characteristic's percentage as forward speed increases. When increasing the speed combine harvester, the ratio of losses separation and cleaning unit increased, causing a large number of grains to remain unthreshed, and A lot of the plant debris comes into the separation and cleaning unit [9].

All losses of the combine harvester
Table 2 makes it evident that, as compared to other forward speeds, applying the first forward speed of (2.5 km h-

[1]) produced the best results for this feature. Using the second forward speed, which came to (6.69 kg. ha^{-1}), the combine harvester's total losses were highest. When the first forward speed (2.5 Km h^{-1}) was applied, the lowest value of all losses of the combine harvester was scored (5.69 kg ha^{-1}). By increasing the speed of the combine harvester, and increases losses of (threshing unit, separation unit, and cleaning unit, but reduces losses of the cutter bar unit so which is why it increases all losses combine harvester [15].

Performance efficiency

The results of the ANOVA analysis, which are displayed in Table 2, indicate that the first speed (2.5 km.h^{-1}) produced the best results for this characteristic when compared to the second speed. The second speed (3.5 km h^{-1}) produced the lowest percentage of performance efficiency, which was 93.85%, while the first speed (2.5 km h^{-1}) produced the highest percentage of performance efficiency for the combine harvester, which was 94.42%. Increasing the ground speed of the combine harvester will increase the all losses of the combine harvester, therefore, the performance efficiency harvester is opposed by increased forward speed combine harvester, by increased speed harvester but reduce in performance efficiency of the combine harvester.

Table 2: Effect of Combine harvester speed % on the studied characters

Speed of the combine	Characters Unit	Studied characteristics				
		Losses of the cutter bar unit *	Losses of the threshing unit *	Losses of separation and cleaning unit *	All losses of the combine harvester *	Performance efficiency
2.5	Kg. h^{-1} %	3.34 a	2.19 b	0.16 b	5.69 b	94.42 a
3.5	Kg. h^{-1} %	3.23 a	3.22 a	0.24 a	6.69 a	93.85 a

*** Least is the best**

-Different letters on the means, there is a significant difference between them. By using Duncan's test at the level (0.05)

Effect of Cutter bar heights on the studied characteristics:

The variance analysis table, Table 3, makes this evident. That all of the personalities under study differ significantly as a result of the Cutter bar heights component, as follows:

Losses of the cutter bar unit

The first cutter bar height (10 cm) produced better significant results for this trait than the second cutter bar height (20 cm), which recorded the highest percentage of cutter bar unit losses 3.60% weight of grains (kg) per area (hectare), which is the symbol of (kg. ha^{-1}). This is shown in Table 2. While the second cutter bar height (20 cm) gave the lowest percentage of losses of the cutter bar unit by (2.98 % kg. ha^{-1}). A weight difference between the highest rate and the lowest rate was (0.62% kg ha^{-1}). Decreasing the height of the cutter bar from 20 cm to 10cm leads to a decrease in losses of the cutter bar unit because of the height and the low of spikes. vary, so the lower cutter bar unit has the highest ratio of spikes harvested.

Losses of the threshing unit

Table 3 demonstrated how cutter bar heights affected threshing unit losses, with the first height (10 cm) yielding noticeably better results for these characteristics than the second height (20 cm). as the lowest percentage of losses grains was recorded at the first height (10cm), reached (2.42% kg ha^{-1}), So the second height (20cm) recorded the highest percentage of losses grains the weight of (2.99% kg ha^{-1}), a difference in weight more by (0.47 % kg ha^{-1}). when using the cutter bar height (20cm) on the combine harvester. It increases losses in the threshing unit because the percentage of plant residues with spike decreased, her-upon a lot of spikes contacting parts of the threshing unit (concave and drum) while increasing losses of grain at the same time[3].

Losses of separation and the cleaning unit

Table 3 showed how threshing unit losses were impacted by cutter bar heights; the first height (10 cm) produced notably better outcomes for these features than the second height (20 cm). Since the first height (10 cm) had the lowest percentage of grain losses (0.17% kg. ha^{-1}), the second height (20 cm) had the highest percentage of grain losses (0.24% kg. ha^{-1}), with a weight differential of 0.07 percent. decreasing the height cutter bar unit of raising the spikes, accompanied by lifting a greater amount of plant residues her-upon the grain is best separated from the spike in the threshing unit. And then in the separating unit and cleaning unit, it's cleaned up thoroughly to reduce losses.

All losses of the combine harvester

It is clear from Table 3 that using the initial height of 10 cm yielded the greatest results for this characteristic when compared to alternative cutter bar heights. Using the second height, the combine harvester's overall losses were highest at (6.83 kg. ha^{-1}). The combine harvester earned the lowest of all losses (5.57 kg. ha^{-1}) when the initial height (10 cm) was used. The combine harvester's cutter bar heights raise all unit increases losses, including those of the cutter bar unit, threshing unit, separation unit, and cleaning unit, all losses of the combine harvester are increased [3].

Performance efficiency

The ANOVA analysis's findings, which are shown in Table 3, show that, in comparison to the second height, the initial height (10 cm) yielded the greatest results for this attribute. The first height (10cm) yielded the maximum percentage of performance efficiency for the combine harvester, 94.69%, while the second height (20 cm) yielded the lowest percentage, 93.58%. The performance efficiency of a combine harvester is inversely correlated with its cutter bar height; increasing the cutter bar height will increase the harvester's overall losses, by a harvester that is faster but has a lower performance efficiency.

Table 3: Effect of Cutter bar heights %on the studied characters

Cutter bar heights	Characters Unit	Studied characteristics				
		Losses of the cutter bar unit *	Losses of the threshing unit *	Losses of separation and cleaning unit *	All losses of the combine harvester *	Performance efficiency
10 cm	Kg. h^{-1} %	2.98 b	2.42 a	0.17 b	5.57 b	94.69 a
20 cm	Kg. h^{-1} %	3.60 a	2.99 a	0.24 a	6.83 a	93.58 b

*** Least is the best**

-Different letters on the means, there is a significant difference between them. By using Duncan's test at the level (0.05)

Effect of interaction between forward speed and cutter bar heights:

The following significant variations for some of the characters under study occur when this interference impacts them, as can be shown from the analysis of variance table 4:

Losses of the cutter bar unit

The averages in Table 4 make it evident that the way the forward speed and cutter bar heights interact in the losses cutter bar unit characteristic varies significantly. The highest percentage of losses cutter bar unit resulted from applying the first forward speed (2.5 km h^{-1}) at the second cutter bar height (20cm), which reached a weight was (3.87% kg ha^{-1}). While the lowest percentage of losses cutter bar unit was recorded in the second forward speed (3.5 km h^{-1}) with the first cutter bar height (10cm), which is equal to (2.61 kg h^{-1}). The difference between the highest rate and lowest rate in weight of grain wheat was (1.26 % kg ha^{-1}). As shown in Table 4, the second forward speed (3.5 km h^{-1}) with the two studied cutter bar heights (10 and 20 cm) recorded the best results for the losses cutter bar unit when it gave (2.61 % and 3.35% kg. ha^{-1}). While the first forward speed (2.5km. h^{-1}) with the two cutter bar heights (10 and 20cm) recorded losses cutter bar unit of (3.33 % and 3.87 % kg. ha^{-1}). Using a speed of (3.5 km h^{-1}) increases the harvested number of spikes in wheat, which leads to reduce unharvested wheat, thus, the losses cutter bar unit will decrease. In general, it can be observed that the percentage of losses of the cutter bar unit increases when the forward speed of the combine harvester decreases for both of the cutter bar heights.

Losses of the threshing unit

The influence of forward speed on the height cutter bar of the combine harvester on the losses of the threshing unit is shown in Table 4. The highest percentage of losses of grain wheat was recorded at the second speed (3.5 km h^{-1}) of the second height (20cm), reaching a weight of grain wheat (3.72% kg. ha^{-1}). While the lowest percentage of grain wheat was recorded in the first speed (2.5 km h^{-1}) at the first height (10cm), which reached of (2.12% kg ha^{-1}). The difference in weight of grain wheat was (1.5 % kg. ha^{-1}). Also, Table 4 refers to the best results for the losses threshing unit is obtained from using the first speed (2.5km. h^{-1}) at any of the two heights (10 and 20cm), resulting in (2.12 % and 2.25% kg. ha^{-1}). The second speed (3.5 km h^{-1}) with the two cutter bar heights (10 and 20cm) gave weights of grain wheat were (2.73% and 3.72 % kg. ha^{-1}). As observed from Table 4, the percentage of losses threshing unit of grain wheat increases when the forward speed of the combine harvester increases with both cutter bar heights. thus, with the increase of forward speeds, the number of wheat plants harvested increases, but on the rotating drum, the same doesn't change. Because the threshing unit doesn't work best threshing unit.

Losses of separation and the cleaning unit

Table 4 illustrates how the height of the combine harvester's cutter bar and forward speed affect the cleaning and separation unit's losses. The second height (20 cm) and second speed (3.5 km h^{-1}) had the largest percentage of grain wheat losses, reaching a weight of (0.35% kg. ha^{-1}). The initial speed (2.5 km.h^{-1}) at the first height (10 cm) had the lowest percentage of grain wheat, reaching (0.12% kg. ha^{-1}). The weight-grain wheat difference was (0.23% kg. ha^{-1}). Table (4) shows that as the combine harvester's forward speed increases with both cutter bar heights, the proportion of losses from the cleaning and separation unit of grain wheat increases as well. Because with the increase in forward speeds, the number of wheat plants harvested increases. Thus, a large ratio of residue plant output from the threshing unit, after that some grain wheat with a large straw is output on a back combine harvester.

All losses combine in the harvester

The influence of forward speed with the height cutter bar of the combine harvester on the all losses combine harvester is shown in Table 4. The highest percentage of losses of grain wheat was recorded at the second speed (3.5 km.h^{-1}) of the second height (20cm), reaching a weight of grain wheat (7.42% kg. ha^{-1}). While the lowest percentage of grain wheat was recorded in the first speed (2.5km. h^{-1}) at the first height (10cm), which reached of (5.57% kg. ha^{-1}). The difference in weight of grain wheat was (1.95 % kg. ha^{-1}). Also, Table 4 refers to the best results for all losses combine harvester is obtained from using the first speed (2.5km. h^{-1}) at any of the two heights (10 and 20cm) were (5.57 % and 6.32% kg ha^{-1}). The second speed (3.5 km.h^{-1}) with the two cutter bar heights (10 and 20cm) gave weights of grain wheat were (5.48% and 7.42 % kg. ha^{-1}). As observed from Table 4, the percentage of all losses of the grain wheat increases when the forward speed of the combine harvester increases with both of the cutter bar heights. because it increases losses of threshing, cleaning, and separation unit, hereupon all losses of the combine equal to summation of losses of (cutter bar, threshing, cleaning, and separation) units.

Performance efficiency

The averages in Table 4 make it evident that the way the forward speed and cutter bar heights interact in the performance efficiency characteristic varies significantly. The highest percentage of performance efficiency resulted from applying the first forward speed (2.5 km h^{-1}) at the first cutter bar height (10cm), which reached 94.80%. While the lowest percentage of performance efficiency was recorded in the second forward speed (3.5 km h^{-1}) with the second cutter bar height (20cm), which is equal to (92.90%). The difference between the highest rate and lowest rate performance efficiency was 1.90 %. As shown in Table 4, the second forward speed (3.5 km.h^{-1}) with the two studied cutter bar heights (10 and 20 cm) recorded the worst results for the performance efficiency when it gave 94.57 % and 92.90%, respectively. While the first forward speed (2.5 km h^{-1}) with the two cutter bar heights (10 and 20cm) recorded the best performance efficiency of (94.80 % and 94.27 %). In general, it can be observed that the percentage of performance efficiency combine harvester increases when the forward speed of the combine harvester and cutter bar heights decrease, because at the time reduces all losses of the combine harvester.

Table 4: The interaction effect of Combine speed and Cutter bar heights %on the studied characters

Speed of combine	Cutter bar heights	Characters Unit	Studied characteristics				
			Losses of the cutter bar unit *	Losses of the threshing unit *	Losses of separation and cleaning unit*	All losses of the combine harvester *	Performance efficiency
2.5	10 cm	Kg h^{-1} %	3.33 a	2.12 b	0.12 b	5.57 b	94.80 a
	20 cm		3.87 a	2.25 b	0.20 b	6.32 b	94.27 a
3.5	10 cm	Kg h^{-1} %	2.61 b	2.73 b	0.14 b	5.48 b	94.57 a
	20 cm		3.35 a	3.72 a	0.35 a	7.42 a	92.90 b

*** Least is the best**

-Different letters on the means, there is a significant difference between them. By using Duncan's test at the level (0.05)

Conclusion

1. Decreasing the forward speed resulted lowest percentage losses for studied traits, namely, threshing unit, separation and cleaning unit, all losses combine harvester, while the losses cutter bar unit and performance efficiency gave higher values.

2. By increasing the cutting height, losses of the cutter bar unit, threshing unit, separation and cleaning unit, all losses combine harvester increased, while performance efficiency reduced.
3. At each forward speed combine harvester, as the cutting height increased, the losses of the cutter bar unit, threshing unit, separation and cleaning unit, all losses combine harvester increased, while performance efficiency decreased.

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حساب خسائر وحدات حاصدة القمح عند سرع وارتفاع قطع مختلفة

ژيار برهان عبد الله [1] **سيف الدين حسن محمد[2]**
عبد الله فتحي يونس[3] **ممتاز إسحاق[4]**
قسم التقنيات الحياتية وعلم المحاصيل الحقلية، كلية علوم الهندسة الزراعية، جامعة السليمانية، العراق.
قسم المحاصيل الحقلية والنباتات الطبية، كلية علوم الهندسة الزراعية، جامعة الصلاح الدين، العراق.
قسم المحاصيل الحقلية والنباتات الطبية، كلية علوم الهندسة الزراعية، جامعة الصلاح الدين، العراق.
قسم الآلات والمعدات الزراعية، كلية الزراعة، جامعة تكريت، العراق.

الخلاصة

نفذت تجربة عاملية واستخدم تصميم القطاعات العشوائية الكاملة وبثلاث مكررات في حقل قمح في منطقة (قوريتان) في مدينة اربيل– كردستان العراق، لغرض دراسة حساب خسائر وحدات حاصدة القمح متمثلة بودات القطع والدياسة والفصل والتنظيف وكذلك حساب الخسائر الكلية وكفاءة الآداء تحت تأثير سرعتين للحاصدة 2.5 و3.5 كم. ساعة$^{-1}$ و أرتفاعين للقطع 10 و20 سم. سجلت سرعة الحاصدة 2.5 كم . ساعة$^{-1}$ أقل معدل للخسائر في وحدات الدياسة والفصل والتنظيف والحسائر الكلية، بينما وحدة القطع وكفاءة الاداء كانتا عالية. زيادة أرتفاع القطع من 10 الى 20 سم أعطى معدل خسائر 3.60 % و 2.99 % و0.24 % لكل من وحدة القطع والدياسة والفصل والتنظيف على التوالي. الخسائر الكلية للحاصدة 6.83 % وكفاءة الاداء أنخفضت مع انخفاض سرعة الحاصدة. زيادة ارتفاع القطع من 10 الى 20 سم ادى الى زيادة خسائر وحدة الدياسة من 2.25 % الى 3.72 %، وخسائر وحدة الفصل من 0.20 % الى 0.35 %، أضافة الى ذلك زيادة الخسائر الكلية من 6.32 % الى 7.42 % بينما بقية الصفات المدروسة أنخفضت.

الكلمات المفتاحية: حاصدة، مرواح، قمح، فصل، تنظيف، خسائر.