Influence of Husking Machine Type, and its Clearance on the Factory Rice, Mashkhab (M-33) Cultivar

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Abstract. This study aims to know the impact of the peeling machine type and the clearances on some qualitative characteristics of the Mashkhab (M-33) cultivar rice production. It was observed from this study that the S-KB40 peeling machine was significantly superior to the Y-ST50 peeling machine in all the studied characteristics, while it achieved the highest results with a clearance of 0.9cm, except for the husking efficiency that achieved the highest results with the clearance 0.5 cm. The experiments were conducted in a factorial experiment under CRD with three replications. For S-KB40 the MP, PR, HE, BR and CR were 1.747t.hr^{-1}, 15.180Kw, 75.94 %,7.251% and 5.807% respectively. For 0.9cm clearance the MP, PR, HE, BR and CR ,were1.885 t.hr^{-1}, 14.625 Kw, 74.03%,6.754 and 5.173% respectively.

Keywords. Rice, Clearances, Peeling machines S-KB40,Y-ST50 , M-33 cultivar.

1. Introduction

Rice (Oryza sativa L) is of great importance in the human diet in terms of containing a high percentage of easily digestible carbohydrates that humans need in their diet, rice is also an important protein source, because rice has a balanced content of essential amino acids, especially Lysine compared to other grains[1,2]. In Iraq, rice is considered one of the strategic crops and comes after wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) in the cultivated and productive areas. In 2007, it was planted with a total area of approximately 124.350 hectares thousand, and produced approximately 392800 tons of raw rice with a productivity rate of 3.16 tons per hectare [3,4]. Amber rice is one of the most widespread varieties in Iraq, and other aromatic varieties have been introduced, such as the jasmine and the Euphrates. However, the amber variety is the well-known type, which is considered one of the highest quality rice in Iraq and the most productive because of its intense whiteness, distinctive aroma, high protein content and large seed size[5-7]. During the rice production process, some grains are subjected to cracking and broken, the reason for this is due to the forces exerted on the rice manufactured in the husking chamber. Therefore, all broken grains are removed before the marketing process. [8]. The mechanical damage that occurs to the rice grains during the husking

process depends not only on the husking machine design but also on the rice physical properties [9]. The husking process depends mainly on the crop type to be manufactured and the machine engineering design, which plays an important role in machine productivity, husking efficiency and breakage rates[10]. Rice husking is a process in which rice is converted into red rice by removing the outer layer dehusking shelling. The husking outturn of paddy depends on many factors as variety, percentage of matured grains, moisture content, drying methods and husking techniques [11], The process of removing rice husks is affected by the machine type used, the clearance between the cylinder and the concave in addition to the grains moisture that are subject to the hulling process[12], reported that the organizing of machine has a direct effect on the productivity of the machine. The machine led to more organizing whenever was the high productivity because of the low percentage of break-up and this was reflected positively on the increase machine productivity due to increased efficiency and operator's skill among other factors[13], effect of moisture content and shaft speed on the rice breakage experienced during husking operation using a rubber roll husker. It was reported that the interactive effect of shaft speed and moisture content significantly affected the hulling index but did not affect the amount of rice breakage [14]. The prime object of this study is to examine the impact of husking machines (S-KB40 and Y-ST50) on rice, Mashkhab (M-33) cultivar at various clearances among cylinders.

2. Material and Methods

This study was showed to examine the effectiveness of a two scaler machines (S-BK40 and Y-ST50) in 2022. The exams were thorough at three clearance ratio: 0.5, 0.7 and 0.9 mm cylinders. For the experimentations, the cultivar Mashkhab (M-33) were nominated and the models were taken by the investigation and calm in the form of a heap, the number heaps being nine and per-heap weight being 300 kg according to the system used [15]. JA cultivar rice was kept in an oven at a fever of 43° C and prudently monitored to regulate the wet content of grain at 13%-16%, then the models were taken and located in the precision divider to obtain a model weight of 300 g and then the samples were prudently sealed in polyethylene bags. The Satake type machine was adjusted to 0.6 mm clearance between cylinders and 4.7 m / s linear velocity and then the 300 g models were placed in the machine (Figure 1). The sample was then removed from the system and put in a Satake style cylindrical insulating unit with working period set to 2 min. The angle of inclination for per examines was 25° insolating the be divided and whole feed. In the same ways, I repeated on the peeling machine Y-ST 50 (Fig. 2). For each running test it was calculated the machineproductivity (MP), power required (PR) , huskingefficiency (HE) , breakageratio (BR) ,crackedratio (CR).

2.1. Machine Productivity (MP)

The MP was calculated as follow [16,17]:

$$q = \frac{W \times 60}{T \times 1000}$$

Where, q is MP (th^{-1}), W is production, (g), and T is time (min).

2.2. Power Required (PR)

The PR for this research is calculated as [18,19]:

$$P_R = \frac{\sqrt{3}}{1000} \cdot v \cdot I \cdot \cos\varphi \cdot E_{FE}$$

Where, P: (kW), $V$is voltage (V) and I :Is the electric current A, and cos (φ) is the angle between the current and voltage while (E_{FE}) is the motor efficiency (85%).

2.3. Husking Efficiency (HE)

The HE was resolute as [20,21]:

$$H_E = \frac{W_S - W_{mU}}{W_S} \times 100$$

Where: E_E: (%)W_{mU}: mass unpeeled rice (g) andW_S mass of rice model used (g).

2.4. Breakage Ratio (BR)
The BR was determined as [22,23]:

$$B_{R=}\frac{W_{br}}{W_s}\times 100$$

Where: B_R: (%) , W_{br}: weighing of damage grain. (g) and W_s: weighing of rice model used (g).

2.5. Cracked Rice Ratio
It was calculated according to [10,24]:

$$P_{Cg=}\frac{W_{Cg}}{W_S}\times 100$$

Where, P_{Cg} is cracked rice (%), W_{Cg} is cracked grain weight (g).

Figure 1. The machine (S- KB40 type).

Figure 2. The machine (Y- ST 50 type).

The study results were analysed, according to the used method by [25],using the (CRD) in three replication.

3. Results and Discussion

3.1. MP

Table 1 shown effect of scaler machines (S- KB40 and Y-ST 50) and the machine clearance (0.5, 0.7and 0.9 cm) on the MP, as the highest result was obtained during the scaler phase (1.747 $t.hr^{-1}$) when using the peeling machine S- KB40, while the productivity values decreased with the peeling machine Y-ST 50. It was also found that by increasing the clearance, the MP increased, as shown 1.507, 1.684 and 1.885 $t.hr^{-1}$) .The reason for this is a decrease in the temperature inside the peeling chambers with an increase in the clearance, which caused an increase in the machine productivity [10,17] .The MP is shown in Figure 3 at different conditions for machine type, and machine clearance.

3.2. PR

Table 2 shown effect of scaler machine (S- KB40 and Y-ST 50) were results 15.180 and 16.419 Kw respectively, increase clearance between cylinders, gives the lowest result was obtained during the peeling phase (14.625 Kw) when the 0.9cm clearance, while the power values increased with the clearance 0.5 and 0.7cm [18]. The reason for this is a decrease in the temperature inside the scaler chambers with an increase in the clearance, which caused an decrease in the power required [19,12]. The interaction among the 0.9 cm clearance and peeling machine S- KB40 provided PR of 13.479Kw. The PR is shown in Figure 4 at different conditions for machine type, and machine clearance.

3.3. HE

The increase in the clearance leads to lowering the HE (80.28%, 76.74% and 74.03%, respectively). The low pressure on the grain in the peeling chamber lowering peeling efficiency with higher clearance of machine. [20,19], (Table 3). The scaler machine S-KB40 resulted in highest HE (78.94%). The lowest HE of (75.07%) were at husking machine Y-ST 50 . Depends on the scaler machine type and the way it is organized to suit the type of grain provided for makings[15,11],. The interaction among 0.5mm clearance , and peeling machine S-KB40 resulted in maximum HE of (81.87%). The HE is shown in Figure 5 at different conditions for machine type, and machine clearance.

3.4. BR

Table 4 shown effect of scaler machines (S- KB40 and Y-ST 50) and the clearance between cylinders (0.5, 0.7and 0.9 cm) on the BR, as the highest result was obtained during the scaler phase (7.251%) when using the scaler machine S- KB40 and 0.9cm clearance, while the BR values lowering with the peeling machine Y-ST 50. It was also found that by increasing the clearance, the BR lowering, as shown 8.787, 7.749 and 6.754 % respectively [23],. The reason for this is a decrease in the temperature inside the peeling chambers with an increase in the clearance, which caused an lowering in the rice broken ratio[13,19] . The BR is shown in Figure 6 at different conditions for machine type, and machine clearance.

3.5. CR

Table 5 shown effect of scaler machines (S- KB40 and Y-ST 50) and the clearance between cylinders (0.5, 0.7and 0.9 cm) on the CR, as the highest result was obtained during the scaler phase (5.807%) when using the scaler machine S- KB40 and 0.9cm clearance, while the BR values lowering with the peeling machine Y-ST 50. It was also found that by increasing the clearance, the BR lowering, as shown 6.989, 6.203 and 5.173 % respectively [24],. The reason for this is a decrease in the temperature inside the scaler chambers with an increase in the clearance, which caused an lowering in the rice broken ratio[10]. The CR is shown in Figure 7 at different conditions for machine type, and machine clearance.

Table 1. The impact of scaler machine and clearances on MP.

Machines	Clearances Cm			Median of machines
	0.5	0.7	0.9	
S-KB40	1.517	1.731	1.991	1.747
Y-ST50	1.497	1.637	1.778	1.637
Median of clearances	1.507	1.684	1.885	
LSD= 0.05	M	0.022		
	C	0.025		
	M*C	0.029		

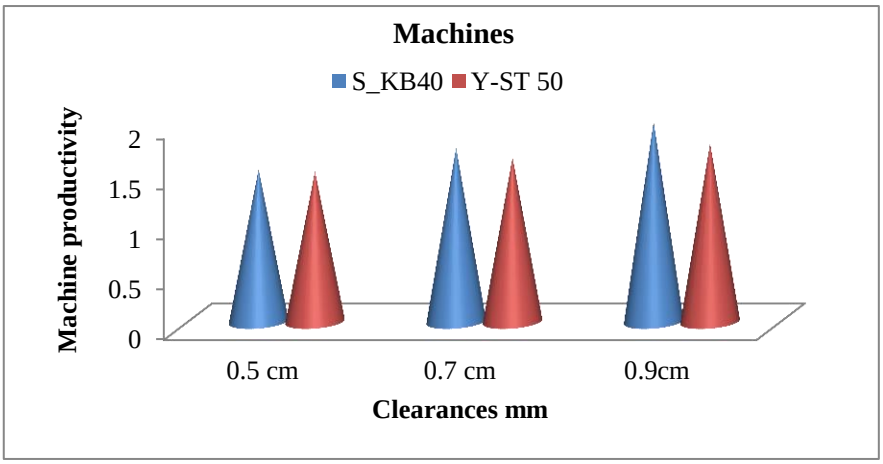

Figure 3. The impact of scaler machine and clearances on MP.

Table 2. The impact of scaler machine and clearances on PR.

Machines	Clearances Cm			Median of machines
	0.5	0.7	0.9	
S-KB40	16.476	15.433	13.479	15.180
Y-ST50	17.173	16.315	15.770	16.419
Median of clearances	16.824	15.874	14.625	
LSD= 0.05	M	0.214		
	C	0.272		
	M*C	0.308		

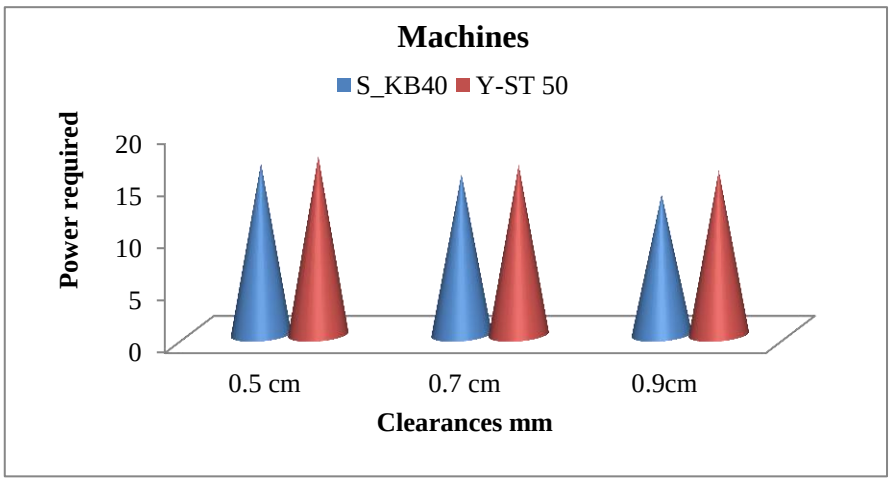

Figure 4. The impact of scaler machine and clearances on PR.

Table 3. The impact of scaler machine and clearances on HE.

Machines	Clearances cm			Median of machines
	0.5	0.7	0.9	
S-KB40	81.87	79.47	75.48	78.94
Y-ST50	78.68	74.01	72.57	75.07
Median of clearances	80.28	76.74	74.03	
LSD= 0.05	M	0.302		
	C	0.367		
	M*C	0.428		

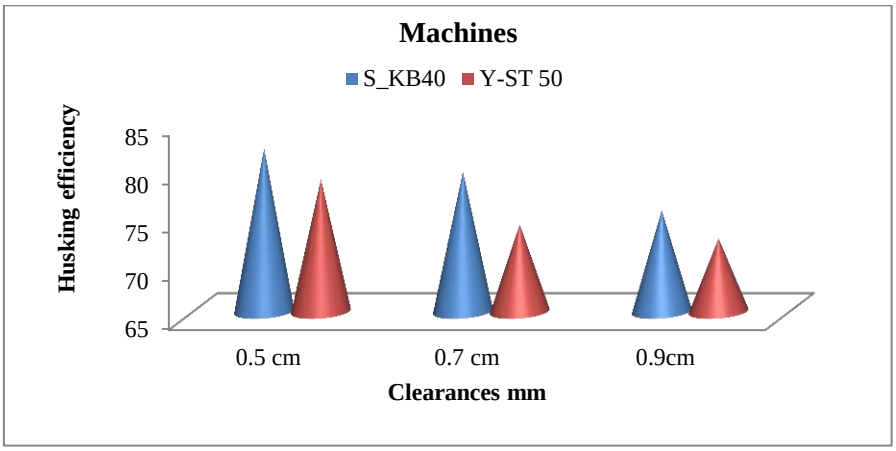

Figure 5. The impact of scaler machine and clearances on HE.

Table 4. The impact of scaler machine and clearances on BR.

Machines	Clearances cm			Median of machines
	0.5	0.7	0.9	
S-KB40	8.257	7.151	6.347	7.251
Y-ST50	9.318	8.347	7.162	8.277
Median of clearances	8.787	7.749	6.754	
LSD= 0.05	M	0.152		
	C	0.183		
	M*C	0.214		

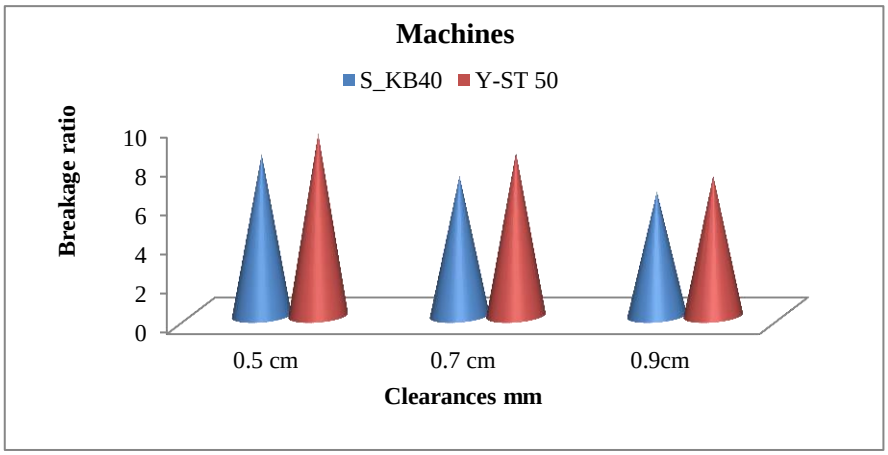

Figure 6. The impact of scaler machine and clearances on BR.

Table 5. The impact of scaler machine and clearances on CR.

Machines	Clearances cm			Median of machines
	0.5	0.7	0.9	
S-KB40	6.841	5.877	4.701	5.807
Y-ST50	7.137	6.528	5.645	6.438
Median of clearances	6.989	6.203	5.173	
LSD= 0.05	M	0.162		
	C	0.173		
	M*C	0.214		

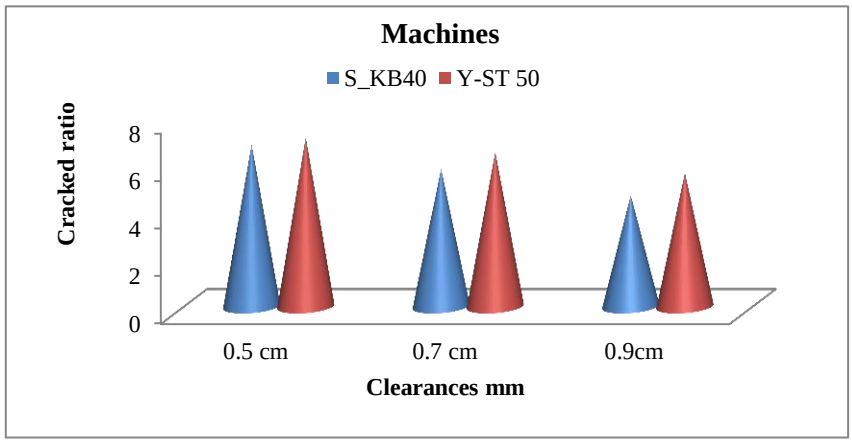

Figure 7. The impact of scaler machine and clearances on CR.

Conclusions

The 0.9 cm clearance was prime influence than two other 0.7 and 0.5 cm . Also, the S-KB40 peeling machine was superior significantly Y-ST50 peeling machine, in all studied properties. Well results procure to from the overlap among clearance of 0.9cm and the S-KB40, in all studied parameter .

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