EVALUATION OF SOME TECHNICAL INDICATORS OF THE LOCALLY MODIFIED SHELLER FOR CORN GRAIN

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ABSTRACT

This study was carried out during 2017, at the factory of shelling corn grains at Al-musayyib /Babylon governorate. The objective of this study was to evaluate some technical indicators of the locally modified sheller for corn grain by using sheller machine locally modified with different peripheral speed of shelling cylinder 900, 1100 and 1300 m/min, different clearance between shelling cylinder and concave 23 and 28 mm on some the properties, such as sheller productivity, quality productivity, power consumption and unshelled grains. This research was done by applying the split plot design experiment within RCBD using four replicates. The results showed the following: clearance between shelling cylinder and concave 28 mm indicated significant superiority up on the clearance between shelling cylinder and concave 23 mm with highest sheller productivity (2.474 ton/h) and quality (193.735 kg.h.kw^{-1}), while the clearance between shelling cylinder and concave 23 mm had lower power consumption 11.62 kw and lower percentage of unshelled grains 2.53%. The increasing in the peripheral speed of shelling cylinder from 900 to 1100 and 1300 m/min increased the sheller productivity, quality and power consumption. The peripheral speed of shelling cylinder (1300 m/min) indicated significant superiority up on the peripheral speed of shelling cylinder 900 and 1100 m/min in achieving higher sheller productivity 3.039 ton/h and higher quality productivity 205.061 kg.h/kw. while the peripheral speed of shelling cylinder 900 m/min achieving lower power consumption 11.78 kw and lower percentage of unshelled grains 2.37 %.

Keywords: Locally modified sheller, Sheller machine, Sheller productivity, Shelling cylinder.

تقييم بعض المؤشرات الفنية لمفرطة حبوب الذرة المحورة محليا"

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المستخلص

أجريت الدراسة بتاريخ 2017 في معمل تفريط الذرة الصفراء في منطقة المسيب / محافظة بابل. أن هدف البحث هو دراسة تأثير أستعمال ماكنة تفريط الذرة المحورة محليا" وبسرع محيطية مختلفة لأسطوانة التفريط 900 ، 1100 و 1300 م/دقيقة وأستخدمت خلوصات مختلفة بين أسطوانة التفريط والمقعر 23 و 28 ملم على المؤشرات الفنية التي تضمنت: أنتاجية المفرطة ، الأنتاجية النوعية القدرة المستهلكة و الحبوب غير المفرطة. طبق البحث بأستعمال تصميم الألواح المنشقة وفق تصميم القطاعات العشوائية الكاملة وبأربع مكررات بينت النتائج: تفوق الخلوص بين أسطوانة التفريط والمقعر 28 ملم على الخلوص بين أسطوانة التفريط والمقعر 23 ملم في تحقيق أعلى أنتاجية للمفرطة 2.474 طن/ساعة وأعلى أنتاجية نوعية بلغت 193.735 كغم . ساعة.كيلوواط $^{-1}$، بينما أعطى الخلوص بين أسطوانة التفريط والمقعر 23 ملم في تحقيق أقل مقدار للقدرة المستهلكة 11.62 كيلوواط وأقل نسبة للحبوب الغير مفرطة 2.53 % ، الزيادة في السرعة المحيطية لأسطوانة التفريط من 900 الى 1100 ثم الى 1300 م/دقيقة. أدت الى الى الزيادة في الأنتاجية والأنتاجية النوعية والقدرة المستهلكة. تفوقت السرعة المحيطية لأسطوانة التفريط 1300 م/دقيقة على السرعة المحيطية لأسطوانة التفريط 900 و1100 م/دقيقة في تحقيق أعلى أنتاجية للمفرطة 3.039 طن/ساعة وأعلى أنتاجية نوعية 205.061 كغم.ساعة.كيلوواط $^{-1}$، بينما السرعة المحيطية لأسطوانة التفريط 900 حققت أقل قدرة مستهلكة 11.78 كيلوواط وأقل نسبة للحبوب الغير مفرطة 2.37 %.

كلمات مفتاحية: المفرطة المحورة محليا"، الماكنة المفرطة، أنتاجية المفرطة، أسطوانة التفريط.

***Received:27/2/2018, Accepted:23/4/2018**

INTRODUCTION

The maize crop is considered one of the pillars of the national economy because it's a strategic crop of economic importance, ranked third after wheat and rice crops. Some researchers concluded that the difference peripheral speed of shelling cylinder with the effect of concave it was main role for sheller productivity that reported by Abhijeet (1) and Dagninte (6). The Number of shelling factories (13) in different regions of Iraq governorates have a prominent role in shelling and drying of corn grains confirmed by El –Sharawy (7) and Maeida (13). The process of shelling considered one of the important processes in separating grains from ears taking into consideration the moisture of the grain when shelling should not exceed 25% indicated by Kedar (11) and Mohameed (14). In order to get better performance for sheller we should regulate the relationship between shelling cylinder and the clearance cylinder and concave this is consistent with what has been showed (15). The researchers Naveenkumar (16) showed that many studies have been conducted to improve the work of sheller by increasing shelling productivity, shelling efficiency and quality of product through installation baffles and rasps in the shelling cylinder. The researcher Pius (17) showed that the advantage from grains maize crop used 40% as feed for poultry and livestock in addition to that there are more food products is extracted from corn grains such as starch, oil and bread, Therefore, the increase in the production of maize grain has been directed through development and improvement machineries of shelling for grains. An expansion in the establishment of special factories of shelling for corn grains in agricultural areas characterized by their productivity of maize (19). The peripheral velocity of the feeder a proportional relationship with peripheral speed of shelling cylinder this is consistent with what has been pointed out by different researchers (21).

MATERIAL AND METHODS

The experiment was carried out in factory of shelling corn grain in Al-musayyib, Ministry of Agriculture at 2017. The grain was shelled at a moisture of 16%. The research conducted by using the split plot design within (RCBD) with four replications to study two factors:

1- peripheral speed of shelling cylinder: which included speeds of 900, 1100 and 1300 m/min, this was done through a cylinder with a diameter of 150 mm and a length of 950 mm and installed on it plates shaped radially with 6 panels and a distance 25 mm between a plate and another. The speed is controlled by electric motor (Leroy Somer), which is characterized by (three phase - variable speed) and power 20 hp.

2- clearance between shelling cylinder and concave: which included 23 and 28 mm used for this type slotted grate concave with a length 970 mm manufactured from AISI 1045 steel).

Indicators studied:

1- Sheller productivity: this is done through weighing bags collected at a certain time according to the following equation (8,18):

$$P_s = \frac{W_o}{T} * \frac{60}{1000} \; \ldots\ldots \left(\frac{ton}{h}\right)$$

P_s-Sheller productivity, (kg/h)

W_o -Weight output, (kg)

T-Time, (min)

2- Quality productivity: this is calculated according to the following equation (2):

$$P_Q = \frac{P_s}{P_w} \; \ldots\ldots (kg.h.kw^{-1})$$

P_Q − Quality productivity, $(kg.h)$

P_s − Power consumption, (kw)

3- Power consumption: the power consumption was calculated by using device (Clamp meter), Chinese-made done by that device calculated the current and voltage values for electric motor, the power consumption was calculated from the following equation (19):

$$P_w = \frac{\sqrt{3}}{1000} * V * I * \cos\theta * E_{ff} \; \ldots\ldots (kw) =$$

$P_w - Power\ consumption, (kw)$

$V - Voltage, (Volt)$

$I - Current, (Ampere)$

$\cos\theta - The\ angle\ between\ the\ current\ and\ voltag$

$E_{ff} - Motor\ efficiency\ \%$

4-Percentage of unshelled grains: this was calculated by taking different samples of bags which were collected and then detach unshelled grain from cobs manually. Then the grain was weighed and calculating the percentage of unshelled grain from the following equation (3):

$$U_g = \frac{W_{un}}{W_o} * 100 \quad (\%)$$

U_g − Percentage of unshelled grain , (%)
W_{un} − Unshelled grain , (kg)
W_o − Weight output, (kg)

RESULTS AND DISCUSSION

The Table 1 shows the effect of clearance between shelling cylinder and concave (mm) on indicators studied. There is a significant effect at the level of 0.05%. The clearance between shelling cylinder and concave 28 mm indicated significant superiority up on the clearance between shelling cylinder and concave 23 mm by achieving higher sheller productivity 2.474 ton/h and quality productivity 193.735 $kg.h.kw^{-1}$, while the clearance between shelling cylinder and concave 23 mm achieved lower power consumption 11.62 kw and lower percentage of unshelled grains 2.53 %. The reason due to increasing the clearance between shelling cylinder and concave, this allowed to increase in the quantity of unshelled ears which entering between clearance shelling cylinder and concave, consequently an increasing in sheller productivity as indicated by other researchers (5,16)

Table 1. Effect of clearance between shelling cylinder and concave (mm) on indicators studied

clearance between shelling cylinder and concave (mm)	Sheller productivity $(\frac{ton}{h})$	Quality productivity $(kg.h.kw^{-1})$	Power consumption (kw)	Percentage of unshelled grains (%)
23	**2.085**	**179.432**	**11.62**	**2.53**
28	**2.474**	**193.735**	**12.77**	**3.27**
L.S.D (0.05)	**0.048**	**3.63**	**0.181**	**0.078**

Table 2 shows the effect of peripheral speed of shelling cylinder on indicators studied, and that there is a significant effect 0.05%. Increasing of the peripheral speed of shelling cylinder 900 to 1100 and 1300 m/min caused an increase in the sheller productivity, quality productivity and power consumption. The results showed the following: the peripheral speed of shelling cylinder 1300 m/min indicated significant superiority up on the peripheral speed of shelling cylinder 900 and 1100 m/min in achieving higher sheller productivity 3.039 ton/h, and quality productivity 205.061 $kg.h.kw^{-1}$. The reason for the positive relationship between the speed of shelling cylinder and productivity (9), while the peripheral speed of shelling cylinder 900 m/min achieving lower power consumption 11.78 kw and lower percentage of unshelled grains 2.37 %, due to increase the speed of the cylinder causes an increase in the power required from electric motor to rotate the shelling cylinder (12,22).

Table 2. Effect of peripheral speed of shelling cylinder on indicators studied

peripheral speed of shelling cylinder (m/min)	Sheller productivity $(\frac{ton}{h})$	Quality productivity $(kg.h.kw^{-1})$	Power consumption (kw)	Percentage of unshelled grains (%)
900	**2.157**	**183.107**	**11.78**	**2.37**
1100	**2.694**	**197.363**	**13.65**	**2.84**
1300	**3.039**	**205.061**	**14.82**	**3.25**
L.S.D (0.05)	**0.048**	**3.77**	**0.195**	**0.082**

The Table 3 shows the interaction between the clearance between shelling cylinder and concave (mm) with peripheral speed of shelling cylinder m/min on indicators studied. There was a significant effect at 0.05%. The interaction between the clearance between shelling cylinder and concave 28 mm with peripheral speed of shelling cylinder 1300 m/min indicated significant superiority up on the interaction between the clearance between shelling cylinder and concave 23 mm with peripheral speed of shelling cylinder 900 m/min in achieving higher sheller productivity 3.125 ton/h, and quality productivity 218.838 $kg.h.kw^{-1}$.While the clearance between shelling cylinder and concave 23 mm with peripheral speed of shelling cylinder 900 m/min, indicated significant superiority on the interaction between the clearance between shelling cylinder and concave 28 mm with peripheral speed of shelling cylinder 1300 m/min in achieving lower power consumption 11.74 kw, and lower percentage of unshelled grains 2.62 %. The reason was due to interaction between clearance and cylinder speed, whenever the centrifugal speed of cylinder that increased collision speed of ears with cylinder plates and sheller walls and, therefore, leads to high production value, and obtaining percentage of unshelled grains (4,10).

Table 3. Effect the interaction between the clearance between shelling cylinder and concave (mm) with peripheral speed of shelling cylinder m/min on indicators studied

clearance between shelling cylinder and concave (mm)	peripheral speed of shelling cylinder (m/min)	Sheller productivity $(\frac{ton}{h})$	Quality productivity $(kg.h.kw^{-1})$	Power consumption (kw)	Percentage of unshelled grains (%)
23	**900**	**2.064**	**175.809**	**11.74**	**2.62**
	1100	**2.381**	**185.148**	**12.86**	**3.48**
	1300	**2.906**	**210.732**	**13.79**	**3.77**
28	**900**	**2.113**	**172.209**	**12.27**	**2.86**
	1100	**2.672**	**204.594**	**13.06**	**3.75**
	1300	**3.125**	**218.838**	**14.28**	**4.12**
L.S.D (0.05)		**0.049**	**2.85**	**0.163**	**0.091**

It can be concluded that the peripheral speed of shelling cylinder 1300 (m/min) with clearance between shelling cylinder and concave 28 (mm) led to an increase in the sheller productivity and quality productivity. The peripheral speed of shelling cylinder 900 (m/min) with clearance between shelling cylinder and concave 23 (mm) led to less power consumption and Percentage of unshelled grains.

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