DEVELOPMENT A PACKED VERTICAL DISK CORN SHELLER FOR RURAL DWELLER

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ABSTRACT

The main objective of this paper is to development of small corn Sheller for rural dweller at operated by using an electric motor. The effect of some parameter such as: operating speeds 229, 275 and 330 rpm and three sizes of corn cobs (less than 45mm, 45 -50 mm and more than 50 mm) at average moisture content 13.81 % on shelling efficiency, unshelled kernels percentage, damage kernels percentage, shelling productivity, power consumption and total cost (unit cost + criterion cost) . The results revealed that, with increase of operating speed shelling efficiency decreased and productivity, unshelled percentage, kernels damage percentage and power consumption with all sizes of corn cobs increased. The heights shelling efficiency and Sheller productivity of (99.65, 99.61 and 99.48%) and (94.38, 127.02 and 138 kg/h) at operating speed 229, 275 and 330 rpm respectively with all sizes corn cob. It is recommended that the operating of the corn Sheller was 275 rpm achieve average shelling efficiency of 99.35 %, unshelled kernels of 0.65 %, damage kernels of 5.25 % , productivity of 98.8 kg/h and average total cost (unit cost + criterion cost) of 112.40 L.E/ton for sum the sizes corn cob. The total cost (unit cost + criterion cost) of 382.72 L.E/Mg were high when operating the corn Sheller manually.

INTRODUCTION

Corn is considered as one of the most important cereal crops in Egypt. It used in human feeding, industrial aspects for producing corn oil, starch and dry food for animal, more recently, fuel. Shelling of corn in general is carried out by using three different methods: manual, semi-mechanical and mechanical. Up to now most of shelling corn in Egypt is essentially carried out manually.

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This operation is laborious and time consuming with low production.

Hand shelling of corn is very slow process and requires much time and labor, but it cases minimum losses and seed damage compared with mechanical shelling.

Traditionally, maize shelling is carried out as manual operation where maize kernels are separated from the cob by pressing on the grains with the thumbs. According to the operator's ability about 10 kg of maize grains are separated per hour. Another simple and common shelling methods are rubbing two ears of maize against each other. Threshing of maize with hand-held tools (wooden or slotted metal cylinders) output up to 20 kg / h can be achieved. The small disk shellers like hand- driven or powered machine, which commonly required two operators to obtain 150 to 300 kg / h . Another threshing methods followed in tropical countries involves putting cobs in bags and beating them with sticks, outputs achieved prove attractive but bags deteriorate rapidly (Vishwanatha 2005).

Hunt (1976) stated that the shelling of corn kernels from the cobs is significantly affected by cob moisture content. In this direction he found a linear relationship between the amount of kernels left on the cob and the cob moisture content for a picker- Sheller using the cylinder. He reported that losses became insignificant if shelling was delayed until the cob dried down to 30 % (w.b) .Also he explained that invisible losses occur, partly due to broken kernels tips that remain in the cob and partly due to unexplained dry matter losses .

Kepner et al. (1982) mentioned that a shelled corn loss at the snapping increased as the kernel moisture content decreased, especially below 20 %. They added also that by increasing forward speed losses with spiral-ribbed snapping rolls increased.

Metwalli et al. (1995a) compared between two maize shelling drums, triangle rasp-bar and triangle spike-tooth. Five drum speeds, four clearance ratios and five kernel moisture contents were tested to estimate grain damage and unshelled grain. Triangle rasp-bar drum is strongly recommended for its good performance . The grain damage, unshelled grain, and shelling efficiency were 3.86 % , 1.95 % and 96.2 % respectively. At 10.26 m/s drum speed, 1.8 to 2.1 (inlet clearance / outlet clearance) for 18 to 20 % moisture content as condition of the triangle rasp-bar drum.

Metwalli et al.(1995 b) manufactured and constructed a small suitable corn shelling machine from local materials to suit the demands of Egyptian farmers a comparison test of machine was carried out on the manufactured machine compared with another small French shelling machine. The test performance includes unshelled grain, grain damage and economical operating cost. The performance of the machines was influenced by both drum speed and concave clearance ratio at different moisture contents during shelling corn ears . The manufactured machine was developed to be suitable as possible for different grain crops with a minimum adjustments by using a rasp-bar cylinder . The manufactured machine was found to be better in shelling efficiency and grain damage .

Abd EL-Maksoud(1996) studied some factors affected the performance of new established small corn Sheller at three levels of kernels moisture content and four corn varieties. He found that, the optimum shelling efficiency was 97.5 % at kernels moisture content 18 % (w.b) and speed 280 - 320 rpm for all varieties. The minimum total losses (6 – 10 %) was obtained when speed ranged from 280 to 600 rpm) and the same kernel moisture content for most corn varieties. The main objective of this study was performance evaluation a small corn Sheller to shell satisfactorily, also to suit the rural dweller.

MATERIALS AND METHODS

This study was carried out at the Agricultural power and machinery Engineering Department, Faculty of Agricultural Engineering Al-Azhar University, during the year 2013.

1- Material.

1.1 Variety of corn :

The variety yellow corn hybrid 352.

1.2 Corn shelling machine:

The most important functions of the corn shelling machine is separate kernels from corn ears.

The shelling disk of the corn Sheller, which rotated in vertical plane, had four concentrate row of iron projections, which performed the shelling operation.

The distance between two iron projections rows 10 mm. The outermost row was at 75 mm distance from the center of the disk.

The ears enter for shelling through a feeding hole on the disk when are pushed by worker. When the shelling machine is in operation ears are drawn in by the projections on the rotating disk.

The corn is shelled due to the friction between ear and face of the disk and also due to the circulate movement of the ear itself down in conical hole.

The shelled kernels fall down bottom machine and cobs are drawn delivered from a special hole as shown in fig. (1)and (2). The shelling machine and motor is fixed on base. It can be either operated manually or by using an electric motor 0.25 kW 1420 rpm. The speeds can be obtained by changing pulleys.

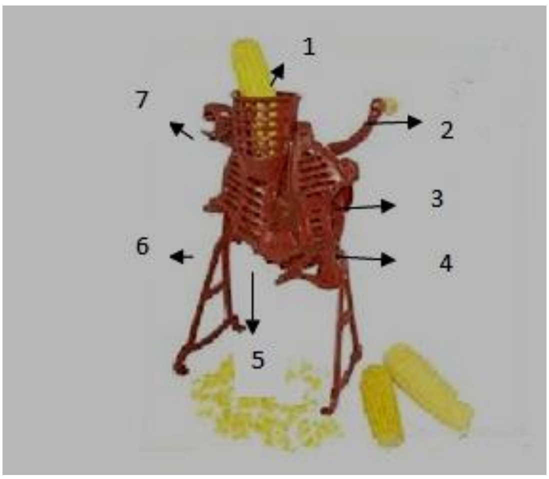

Fig. (1) : Corn Sheller.

1- Cob inlet 2- Handle 3- Shelling disc 4- Cob outlet
5- Outlet for kernels 6- Frame 7- spring

Fig. (2) Photo corn Sheller .

1-3 Measurement of physical properties of corn ears :

Fifty cobs were randomly selected and their physical properties such as weight, length, largest diameter (measured at the base of the cob) and smallest diameter (measured at apex of the cob, excluding the portion having no kernels) were measured. Frequency distribution of cobs for different diameters was determined on the basis of largest diameter. Based on frequency distribution of the cobs, the cobs were grouped into three sizes on the basis of largest diameter. The whole lot of corn cobs was thus sorted into three sizes viz. small diameter (less than 45 mm), medium diameter (45 to 50 mm) and large diameter (more than 50 mm) .

2-Evaluation of corn Sheller

-Shelling efficiency:

Shelling efficiency of the mechanical Sheller was estimated according to the following formula:

$$\text{Shelling efficiency} = \frac{W1}{W1+W2} x100 \text{ ----------------------- } (1)$$

Where :

W1 = mass of separated kernels , g.

W2 = mass of non-separated kernels , g

The Un-shelling percentage :

The total count output of the un-shelling percentage of each one was calculated by the following formula:

$$\text{Un- shelling percentage} = \frac{W2}{W1+W2} x100 \text{ ------------------ } (2)$$

Where :

W1 = mass of separated kernels, g.

W2 = mass of non-separated kernels, g

The damaged percentage:

The total count output of the damaged percentage of each one was calculated by the following formula:

$$\text{Damaged percentage} = \frac{W_3}{W_1} x100 \text{ -------------------------- } (3)$$

Where :

W1 = mass of separated kernels , g.

W3 = mass of damaged kernels , g.

Total mass of the sample (W_t) :

W_t = W1 +W_2 + W_c

Where :

W_c = mass of cobs , g.

-Estimation of power consumption and energy requirement:

Both ammeter and voltmeter were used for measuring current strength and potential difference respectively, before and during shelling.

The total costumed electric power under machine working load (P) and no load was calculated according (Iockwood and Dunstan, 1971)by the following equation.

$$\text{Total consumed power (load power)} = \frac{I.V.\mu .\cos\theta}{1000} \text{ kW - --------- } (4)$$

Useful power = (load- no load)

Where:

I=line current strength in amperes

V= potential difference voltage being equal to 220 V

Cos Ө= power factor (being equal to 0.85)
μ= efficiency (0.95)

Productivity

Machine production: time of shelling was measured by means of a stopwatch to determine the machine production in kg/h .

$$\text{Productivity} = \frac{\text{Mass of corn kernels}}{\text{time of shelling}} \quad \text{--------------------} \quad (5)$$

- **Cost analysis**:

The mechanical shelled economical and financial analysis were carried out calculating the following parameters, The methodology of estimating spraying costs (LE/h) was as follow (**Hunt,1983**).

Total cost (LE/h) = Fixed cost (LE/h) + Variable cost (LE/h) ………(6)

1 - Fixed costs:
Depreciation:
Declining balance method was used for estimating the depreciation (Hunt, 1983). In this method the value of depreciation was different for each year of the machine's life.

$$D = V_n - V_{n+1} \text{------------------------------} \quad (7)$$

$$V_n = P\left(1 - \frac{X}{L}\right)^n \quad \text{-----------------------------} \quad (8)$$

Where:

D = Value of depreciation charged for year (n + 1).

P = Purchase price in L.E.

L = Time between buying and purchasing, year.

n = Number representing age of the machine in years at beginning of year (n+1)

V= remaining value at any time .

X = Maximum rate depreciation =1.5

Interest on investment, Sheller, taxes and insurance:

Interest on investment, shelter, taxes and insurance (ISTI) was estimated to be 17.5% oil the remaining value (Hunt, 1983).

ISTI = V x 0.175 LE/Yr---------------------------- (9)

2. Operating costs:

- Repairs and maintenance (R+M)

For machinery is about 5.77% of purchase price

- Total unit costs by using electric motor were based on the following :-.

1- The operational cost as suggested by Hunt, (1983).

2- The minimum rate tariffs of kW.h electricity allowed in Egypt.

3- The optimum average values of power requirement at all shelling operating speed of 229, 275 and 330 rpm for the sizes corn cob .

4- Total units (L.E/Mg) =

Electricity costs L.E/Mg + Costs per unit mass L.E/Mg

$$\text{Operation } cost \frac{\text{LE}}{\text{kg}} = \frac{\text{machine cost} \frac{\text{LE}}{\text{h}}}{\text{actual machine production} \frac{\text{Kg}}{\text{h}}} \quad \text{-----------} \ (10)$$

The criterion function cost (Cf) was calculated to determine the optimum operating parameter for the used machine . This function can be calculated as the sum of machine operation cost (Uc, L.E/ Mg) plus the losses cost (Lc, L.E/Mg) (Awady et.al., 1982) .

$$C_f = U_c + L_c$$

Where :

$Lc = 10^{-2} C_{pw} (U_{nshe.} + 0.33 T_{KD})$

C_{pw} = Current price of one ton of corn kernels (1880 L.E/Mg).

U_{nshe} = Unshelled kernels, %

T_{KD} = Total kernels damage, %

- Current price of one ton of broken corn kernels = $0.33 C_{pw}$.

RESULTS AND DISCUSSIONS

Physical properties of corn cob:

Table (1) shows the physical properties of the three sizes (less than 45, 45 to 50 and more than 50 mm) of corn cobs. The average kernel moisture content was 13.81% (db). The average weight of 1000 kernel was 250 g. The average number of cobs in 10 kg sample decreased from 72, 56 to 43 as the maximum cob diameter increased from less than 45 mm to more than 50 mm. The average cob lengths were 140.7, 161.3 and 178.3 mm for the cobs with maximum diameters less than 45, 45 to 50 and more than 50 mm respectively. The average maximum diameter of cobs (measured at base end) were 42.8 ,46.9 and 51.8 mm for in the sizes of less than 45 , 45 to 50 and more than 50 mm respectively. The minimum diameter of corn cobs (measured at head end) an important physical property affecting the cob feeding did not change much (40.2 to 35.2 mm) for different sizes of corn cobs. The average weight of a single cob was 137.4, 178.4 and 230 g in sizes of less than 45, 45 to 50 and more than 50 mm respectively.

Shelling efficiency:

The results indicated that manual shelling gave 8.23, 8.67 and 12.45 kg. kernel/ h at sizes of less than 45 , 45 to 50 and more than 50 mm respectively with shelling efficiency 100 % .

Table (2) show the shelled, unshelled, productivity from kernel and shelling efficiency of corn for the corn Sheller operated manually gave 50.12, 61.74 and 48.52 kg. kernel / h at sizes of less than 45 , 45 to 50 and more than 50 mm respectively, with shelling efficiency 84.62, 83.33 and 88.57 % at sizes of less than 45 , 45 to 50 and more than 50 mm respectively, un-shelling percentage (losses kernel) and damaged percentage gave (15.38, 16.67 and 11.43 %) and (1.2, 1.3 and 1.5 %) at sizes of less than 45 , 45 to 50 and more than 50 mm respectively with average manual operating speed 156 rpm.

The percentage of unshelled kernels increased with operating the corn Sheller manually because of forward movement of cobs, which impeded the rotation of cob while passing through the machine. It was observed that some the cobs passed through the machine without full rotation.

Table (1) physical properties of corn cob.

Parameter	Cob size, mm.		
	Less than 45	45 to 50	More than 50
Cob length, mm.	140.7	161.3	178.3
Maximum cob diameter at base end, mm.	42.8	46.9	51.8
Minimum cob diameter at head end, mm.	35.2	37.8	40.2
Weight of single, g.	137.4	178.4	230
Average number of cobs in 10 kg sample.	72	56	43
Average kernel moisture content, % (db)	13.81	13.81	13.81

Table (2): shelled corn kernel (kg/h), unshelled percentage (%) and shelling efficiency (%) for corn Sheller operated manually.

Parameter	Cob size, mm.		
	Less than 45	45 to 50	More than 50
Av. manual operating speed, rpm	156	156	156
Productivity from kernel, kg / h	50.12	61.74	48.52
Shelling efficiency, %	84.62	83.33	88.57
Un-shelling percentage (losses kernel), %	15.38	16.67	11.43
The damaged percentage, %	1.2	1.3	1.5

The results in fig. (3) indicated that corn Sheller operated power (an electric motor) to shelling efficiency.

The variation in shelling efficiency with operating speed of corn Sheller for different sizes of corn cobs is presented in fig.(3) which shows that shelling efficiency of corn Sheller for given all sizes of corn cobs increased with 229 rpm and thereafter it decreased with increase in operating speed. However this change in shelling efficiency was marginal (95.74 to 99.74 %) .

On the other hand, shelling efficiency at given operated speed was lower for cobs with maximum diameter of less than 45 mm than the other two sizes of corn cobs .

The highest shelling efficiency of corn Sheller was for cobs maximum diameter between 45-50 mm which was 99.65, 99.61 and 99.48 % at operating speed 229, 275 and 330 rpm respectively

The shelling efficiency decreased from 99.74 to 96.15 % with increase in operating speed from 229 to330 rpm for cobs with maximum diameter more than 50 mm.

The Un-shelling percentage:

The percentage of unshelled kernels increased with increase operating speed of forward movement of cobs, which impeded the rotation of cob while passing through the machine. It was observed that some of the cobs passed through the machine without full rotation.

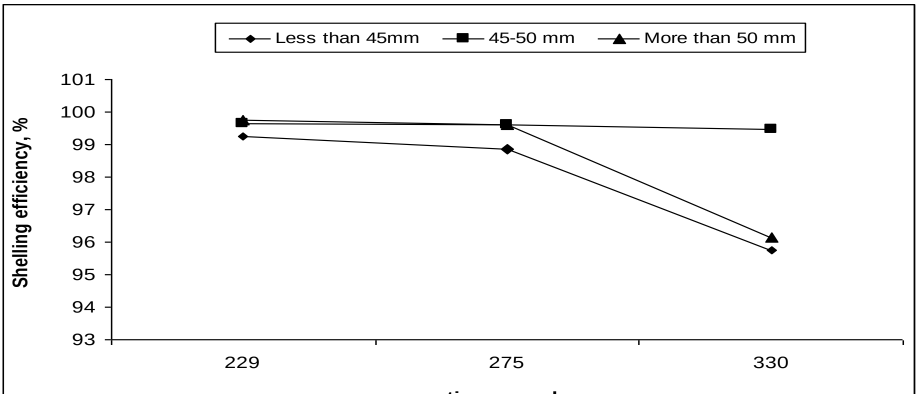

Fig.(3) variation in shelling effficiency of corn Sheller with operating speed for different sizes of corn cob.

While, the decrease in percentage of unshelled kernels as the corn Sheller the removal of kernels was by rubbing action, which was more effective when the cobs were rotated by 360 degrees before reaching the machine exit and all kernels were exposed to rubbing action of the teeth on shelling plate (Singh, 1977).

The damaged percentage :

The variation in percent of damaged kernels with operating speed of corn Sheller for different sizes of corn cobs is presented in fig

(4) which shows that percent of damaged kernels of corn Sheller for given sizes of corn cob increased with increase in operating speed for sizes cob with maximum diameter of less than 45 mm and between 45- 50 mm. While the percent of damaged kernels with maximum diameter of more than 50 mm were 6.77, 6.76 and 6.36 % at operating speeds 229, 275 and 330 rpm respectively.

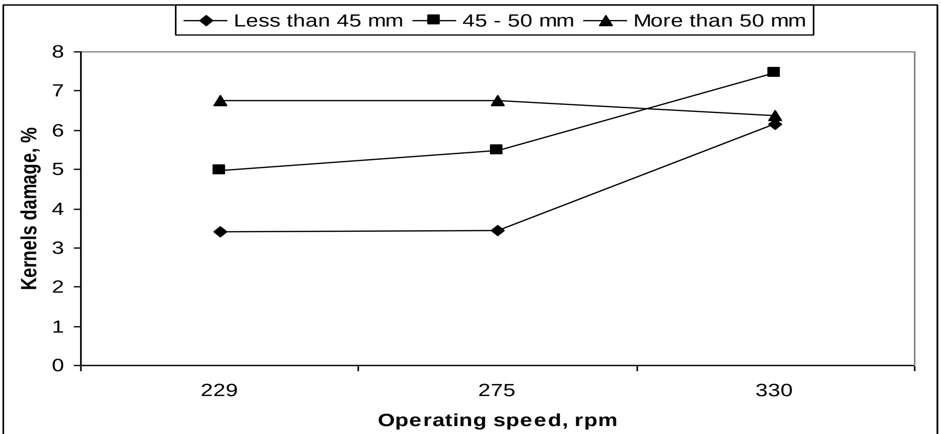

Fig (4) variation in kernels damage of corn Sheller with operating speed for different sizes of corn cob.

Sheller productivity :

Fig. (5) shows the variation in shelling productivity of corn Sheller with operating speed for three sizes of corn cobs, which indicates that the shelling productivity of the corn Sheller for all sizes of cobs increased with increase in operating speed.

The highest shelling productivity (138 kg kernel/ h) for corn cobs with maximum diameter between 45-50 mm occurred at operating speed 330 rpm.

The shelling productivities at operating speed of 229, 275 and 330 rpm were (59.92, 67.46 and 77.92), (94.38,127 and 138.4 kg/h) and (58.11,102.11 and 108 kg/h) at sizes less than 45 mm, 45-50 mm and more than 50 mm respectively.

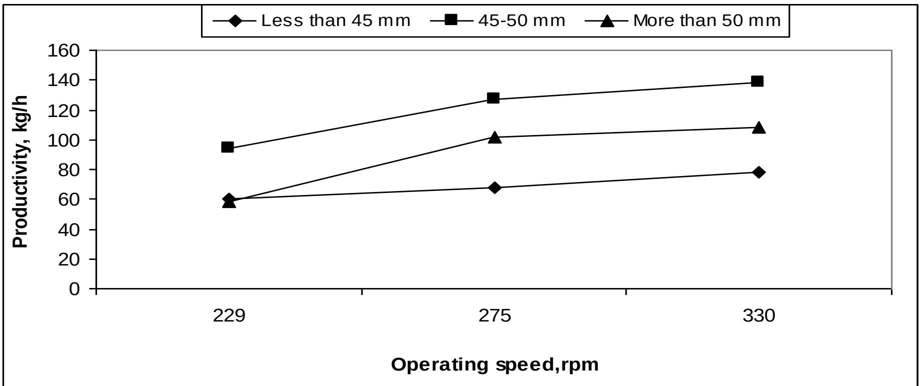

Fig. (5) variation shelling productivity of corn Sheller with operating speed for different sizes of corn cob.

Power consumption:

The variation in power consumption to operate the corn Sheller at different operating speed for different sizes of corn cobs is shown in fig.(6) which indicates that the power consumption for operating the corn Sheller increased with increase in operating speed from 229, 275 330 rpm for all sizes of corn cobs .

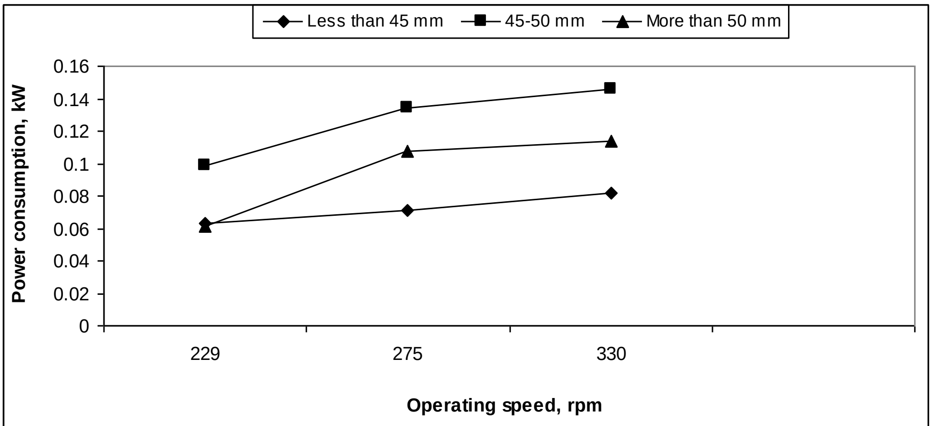

Fig. (6) variation power consumption of corn Sheller with operating speed for different sizes of corn cob .

On the other hand, the power consumption at given operated speed was lower for cobs with maximum diameter of less than 45 mm than the other two sizes of corn cobs .The operating power required with corn cobs having maximum diameter between 45 -

50 mm was highest (0.099, 0.134 and 0.146 kW) at operating speed of 229, 275 and 330 rpm respectively .

Cost evaluations :

The operational costs were calculated for operating the corn Sheller manually and with an electric motor compared with shelling handly without machine .

The corn Sheller and operating costs were combined with experimental performance data to compute total unit cost in L.E/ton .

The total unit costs by operating corn Sheller manually was computed depending on the manual operating performance of the corn Sheller as indicated in table (3) considering following :

1- The hourly costs were about 5.39 L.E/h without electric motor
2- The average manual operating speed 156 rpm .

Conclusively, as indicated from tables (3) and (4) operating the corn Sheller manually with an average operating speed 156 rpm did not decrease the total unit cost . It average unit cost (for every speed with all sizes corn cob) ranged between 92.25 and 60.78 L.E/ton by using electric motor, while it averaged cost unit (for every sizes corn cob) was 101.97 L.E/ton manually. Furthermore, tables (3),(4) when operating the corn Sheller by using the electric motor and manually . As indicated in the same table and it can be noticed that the average total cost (unit cost + criterion cost) in the first case (for every speeds with all sizes corn cob) ranged between 112.02 and 132.78 L.E/Mg where it was 382.72 L.E/Mg when operating manually (for all sizes corn cob). While it averaged cost (for every sizes corn cob) was 525 L.E/Mg kernels shelling handly without machine .

Table (3) the economical unit cost , criterion function and total cost for manual operation for corn Sheller .

Sizes corn cob, mm	Shelling manually at average speed 156 rpm							
	Hourly cost, L.E/h	Productivity Mg/h	Unit cost L.E/h	Unshelled %	Damaged kernels %	Criterion cost, L.E/Mg	Total cost L.E/Mg	Average cost L.E/Mg
< 45	5.39	0.0501	107.54	15.38	1.2	296.59	404.13	382.72
45 - 50		0.0617	87.30	16.67	1.3	321.46	408.67	
>50		0.0485	111.09	11.43	1.5	224.19	335.28	
			101.97					

Table (4) the economical unit cost , criterion function and total cost for electrical operation for corn Sheller .

Sizes corn cob, mm	Operating speed, rpm	Shelling with an electric motor							
		Hourly cost, L.E/h	Productivity Mg/h	Unit cost L.E/h	Unshelled %	Damaged kernels %	Criterion cost, L.E/Mg	Total cost L.E/Mg	Average cost L.E/Mg
< 45	229	6.22	0.0599	103.80	0.74	3.40	29.93	133.73	130.34
45-50			0.0944	65.90	0.35	4.96	37.35	103.35	
>50			0.0581	107.04	0.26	6.77	46.89	153.93	
Mean			0.0708	92.25	0.45	5.04			
< 45	275	6.22	0.0675	92.20	1.16	3.45	34.21	135.41	112.04
45-50			0.1270	48.97	0.39	5.49	41.39	90.36	
>50			0.1020	60.91	0.40	6.76	49.45	110.36	
Mean			0.0988	67.36	0.65	5.25			
< 45	330	6.22	0.0780	79.82	4.26	6.14	48.18	128	132.78
45-50			0.1384	44.94	0.52	7.45	55.99	100.93	
>50			0.1080	57.59	3.85	6.3	111.83	169.42	
Mean			0.1081	60.78	2.87	6.63			

CONCLUSION

1- The shelling productivity of the corn Sheller increased with increase in operating speed for sizes of corn cobs .

2- The shelling efficiency increased with operating speed of 229 rpm thereafter it decreased with increase in operating speed .

3- Operating power of corn Sheller increased with increase in operating speed .

4- It is recommended that the operating of the corn Sheller was 275 rpm achieve average shelling efficiency of 99.35 %, unshelled kernels of 0.65 %, damage kernels of 5.25 % , productivity of 98.8 kg/h and average total cost (unit cost + criterion cost) of 112.40 L.E/Mg for sum the sizes corn cob .The total cost (unit cost + criterion cost) of 382.72 L.E/Mg were high when operating the corn Sheller manually.

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الملخص العربى

تطوير آلة تفريط ذرة ذات قرص رأسي مدبب للمنزل الريفي

د . أشرف كامل زعلوك *

تعتبر عملية تفريط الذرة من أهم العمليات للمنزل الريفي بصفة خاصة و التفريط اليدوي يعطي أقل فقد و تلف من الحبوب وقد يكون منعدم ولكنها بطيئة و تحتاج إلي وقت أطول مقارنة بطرق التفريط الميكانيكية .

ولهذا فقد تم أجراء هذا البحث بهدف تطوير آلة تفريط ذرة صغيرة منزلية تستخدم في تفريط كيزان الذرة الفردية و تدار باليد عن طريق امدادها بموتور كهربائي ٢٥و٠ كيلوات كما تستخدم سيور وطارات لتغير سرعة التفريط .

تم أجراء اختبارات الأداء باستخدام ثلاثة سرعات للآلة (٢٢٩ ، ٢٧٥ ، ٣٣٠ لفة/ دقيقة) و ثلاث مقاسات من قطر قاعدة كيزان الذرة وهي أقل من ٤٥ مم ، ٤٥ إلي ٥٠ مم ، أكثر من ٥٠ مم . و تأثير هذه العوامل علي أداء آلة التفريط المنزلية من خلال كفاءة التفريط ، نسبة التالف ، نسبة الفاقد ،و القدرة المستهلكة في تفريط طن واحد من الحبوب و أيضا حساب تكاليف تفريط طن واحد من الحبوب مقارنه بدوران الآلة يدويا و التفريط اليدوي .

***أستاذ مساعد – قسم هندسة الآلات و القوي الزراعية – كلية الهندسة الزراعية – جامعة الأزهر بالقاهرة .**

و كانت النتائج كالآتي :-

أولا : التفريط اليدوي كانت الأنتاجيه ٢٣و٨ – ٧٦و٨ – ٤٥و١٢ كجم / ساعة عند أحجام كيزان أقل من ٤٥ مم ، ٤٥- ٥٠ مم ، أكبر من٥٠ مم و كفاءة التفريط ١٠٠ % . وتكلفة التفريط اليدوي كانت ٥٢٥ جنية / ميجا جرام .

ثانيا : التفريط بالآلة و تدار يدويا كانت الإنتاجية و كفاءة التفريط و نسبة الحبوب الغير مفرطة (المفقودة) و نسبة الحبوب التالفة (١٢و٥٠- ٤٧و٦١ – ٢٥و٤٨ كجم /ساعة) ، (٦٢و٨٤ – ٣٣و٨٣ – ٥٧و٨٨ %) ، (٣٨و١٥ – ٦٧و١٦ – ٤٣و١١ %) ، (٢و١ – ٣و١ – ٥و١ %) علي الترتيب عند أحجام كيزان أقل من ٤٥ مم ، ٤٥- ٥٠ مم ، أكبر من٥٠ مم . و يرجع ذلك بسبب عدم دوران الكوز حول نفسه بطريقة كاملة قبل خروجه من الآلة . و متوسط تكاليف الآلة ٧٩و١٠١ جنية/ ميجا جرام و متوسط تكاليف المعايرة (تكاليف التشغيل مضافا إليها تكلفة الفاقد) ٢٧و٣٨٢ جنية/ ميجا جرام مع كل أقطار كيزان الذرة.

ثالثا: التفريط بالآلة مع استخدام موتور كهربائي :

- أعلي كفاءة تفريط مع كل أحجام الكيزان عند سرعة ٢٢٩ لفة /دقيقة بينما تنخفض كفاءة التفريط مع زيادة سرعة التشغيل ، بينما أقل كفاءة تفريط كانت مع كيزان ذات قطر أقل من ٤٥ مم من الأقطار الأخرى . و كانت أعلي كفاءة تفريط مع كيزان ذات قطر ٤٥-٥٠ مم .
- نسبة الحبوب الغير مفرطة (المفقودة) تزداد بزيادة سرعة التشغيل مع كل أقطار كيزان الذرة ، وذلك نتيجة لعدم دوران بعض كيزان الذرة حول نفسها خلال مرورها بالآلة. كما ان نسبة الحبوب التالفة و إنتاجية الآلة و القدرة المطلوبة تزداد بزيادة سرعة التشغيل .
- متوسط تكاليف التشغيل للآلة مع كل أقطار الكيزان لكل سرعة كانت ٢٥و٩٢ – ٣٦و٦٧ – ٧٨و٦٠ جنية / ميجا جرام عند سرعات ٢٢٩ – ٢٧٥ – ٣٣٠ لفة / دقيقة .
- متوسط تكاليف الكلية (تكاليف التشغيل مضافا إليها تكلفة الفاقد) مع كل أقطار الكيزان لكل سرعة كانت ٣٤و١٣٠ – ٠٤و١١٢ – ٧٨و١٣٢ جنية /ميجا جرام عند سرعات ٢٢٩ – ٢٧٥ – ٣٣٠ لفة/ دقيقة .

نوصي عند استخدام الآلة المطورة :

استخدام سرعة ٢٧٥ لفة/ دقيقة . حيث كان مجموع متوسط نتائج كل أقطار الكيزان كانت كالأتي:

- متوسط كفاءة التفريط ٣٥و٩٩ % - نسبة الحبوب الغير مفرطة (مفقودة) ٦٥و٠ % - نسبة الحبوب التالفة ٢٥و٥ % - الإنتاجية ٨و٩٨ كجم /ساعة . و متوسط تكاليف الكلية كانت ٤٠و١١٢ جنية / ميجا جرام .