

MANUFACTURE OF CONCAVE SIEVES GROUP FOR SMALL THRESHER TO SUIT THRESHING LENTIL CROP

Wagdy Z. El-Haddad*

Hamada A. El-Khateeb*

Ismail F. Sayed-Ahmed*

ABSTRACT

The performance of threshing machine with different concave sieves were tested and evaluated according to the following parameters: - cylinder speeds (15.14, 18.18, 20.21 and 22.25 m/s), feeding rates (8, 10, 12 and 15 kg/min) and holes diameter of concave sieves (11, 9 and 7mm). The experimental results revealed that both seed output, cleaning efficiency, seed damage, threshing efficiency and consumed power were maximum with cylinder speed of 22.25 m/s and feeding rate of 15 kg/min (8.7 kg/min, 98.99%, 23%, 97.75% and 3.23 kW, respectively). Unthreshed seed losses and length of cut straw were minimum (0.34% and 9.5 mm) under the feed rate 8 kg/min, cylinder speed of 22.25 m/s and hole diameter for concave sieve of 7 mm. The criterion function cost for modification thresher machine was 66.978 LE/Mg at the same operation condition.

INTRODUCTION

Lentil is considered one of the main leguminous crop in Egypt, as its highly nutrition value seeds, provide the human body with its needs from vegetable proteins which is relatively lower in price comparative than animal protein. Each 100 gm of lentil seed contain 0.25 gm of vegetable protein, 1.3 gm of fat, 0.07 gm of calcium, 0.35 gm of phosphorous, 0.01 gm of iron as well as a number of other elements. Lentil is public foods consumed by the great majority of population (**El-Tatawy, 1999**).

In Egypt is cultivated in total area about 8000 fed, producing about 6880 tons, where the major planting area is in Upper Egypt. Lentil plants provide high-quality straw for animals feeding and increase soil fertility. Up till now, the manual threshing of lentil crop is still the common practice followed by the majority of the farmers in Egypt. The ultimate

* **Agric. Eng. Res. Inst. (AEnRI) – Dokki – Giza – Egypt.**

purpose of threshing operation is to recover the seeds free from residues with minimum losses and maximum efficiency.

Kadry (1987) designed a prototype of lentil walker puller to pull the lentil plants under manual and mechanical planting. Three types of puller fingers of cylindrical and conical shape with clearance of 6 mm, 22-8 mm, and 20-6 mm were tested. The efficiency of pulling plants increased with the increasing of forward speed and rotational speed, especially under mechanically planted treatments comparing to manual method, and the highest efficiency was obtained under conical shape finger of clearance of 20-6 mm. The prototype saving is about 31 L.E/feddan (262%) comparing with manual pulling method of lentil plants.

El-Haddad (2000) designed a simplified threshing and winnowing machine suitable for small holdings. Indicated that the rice grain output increased as the cylinder speed increased, the maximum amount of rice grain output was 9.891 kg/min at cylinder speed 21.25 m/s (1400 rpm), feed rate of 30 kg/min and moisture content of 14.8% (db) in grain and 12% (db) in straw.

Morad et al. (2000) developed the reciprocating mower to be suitable for harvesting lentil crop. They found that harvesting of lentil by using the developed mower maximized both field capacity and efficiency comparing with the same mower before development and manual method. Harvesting of lentil crop by using the developed mower at a kinematic parameter of 1.33 and horizontal distance between the reel axis and the cutter bar of 10 cm minimized losses.

Abo El-Naga, et al. (2005) studied feasibility of cereal threshing machine for dry lentil seed threshing and select the optimum conditions for operating it. The obtained results show that the local threshing machine can be successfully used for threshing lentil crop under the following conditions: feeding rate of 11.67 kg/min and drum speed of 11.78 m/sec at seed moisture content of 10.31%, resulting in seed damage of 0.62%, unthreshed seed of 0.15%, total seed losses of 0.77%, seed output of 302.1 kg/h, threshing efficiency of 99.79% consumed energy of 0.116 kW.h/kg and criterion cost of 85.83 L.E/ton.

Emara (2006) modified local stationary threshed for threshing the flax crop has been evaluated and tested under different operating conditions.

He reported that the maximum values of seed output and threshing efficiency in addition to the minimum values of total seed losses, stalks damage and energy requirements for all drum speeds and feed rates, compared with the machine before development.

Moussa (2006) investigate of the performance threshing machine for different legume crops (Soybean, lentil and chickpea). He illustrated that the highest values of threshing efficiency were 98.74, 97.68 and 97.46% with feed rates of 600, 800 and 900 kg/h, respectively, at drum speed 14 m/s and grain moisture content 10.12% for lentil crop. Meanwhile, the lowest threshing efficiency were 97.78, 96.25 and 95.33% at feed rates of 600, 800 and 900 kg/h, respectively, at drum speed 10 m/s and grain moisture content 13.78% for lentil crop.

Afify et al. (2007) developed a small thresher to suit threshing of Black seed. The thresher results showed that the minimum total seed losses of 2.63%, stripping efficiency of 99.31%, threshing efficiency of 98.74%, cleaning efficiency of 95.88%, required energy of 2.85 kW.h/ton and criterion cost of 199.18 L.E/ton were recorded under drum speed of 6.28 m/s, feed rate of 600 kg/h and capsules moisture content of 13.63%.

Mahmoud et al. (2007) developed feeding device of a Turkish threshing machine to increase machine efficiency and avoid many traumatic injuries during threshing process. They found that using threshing machine with the constructed feeding device decreased unthreshed grain losses by 26.99%, mechanical grain damage by 40.37% and total grain losses by 34.85%. In addition, threshing efficiency increased by 0.62% cleaning efficiency increased by 3.0%, energy requirement increased by 3.49% and finally threshing cost decreased by 14.27% at material feed rate of 1100 kg/h, drum speed of 27 m/s and grain moisture content of 19%.

The objectives of the present study are:

1. To manufacture of concave sieves group for small thresher and chose the best for threshing lentil crop.
2. To evaluate the performance of machine with different concave sieves for threshing lentil crop.
3. To investigate and test the influence of cylinder peripheral speed, feed rates and holes diameter for concave sieves on all studied variables.

MATERIAL AND METHODS

2.1. The small thresher:

This machine was built to satisfy the Egyptian farmers requirements. It was designed and constructed by (El-Haddad, 2000) for threshing and winnowing rice crop for small holdings. The present machine specifications: as shown in Table 1 and Figs. 1.

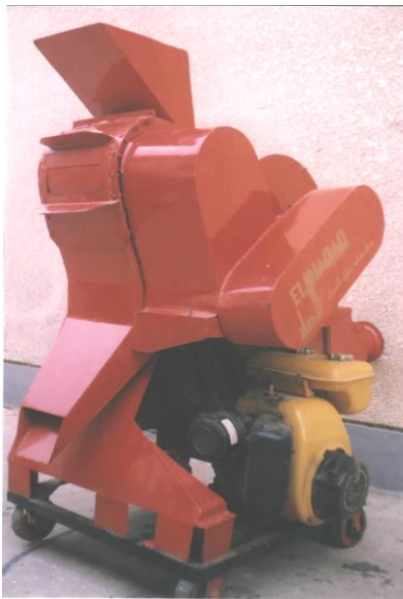
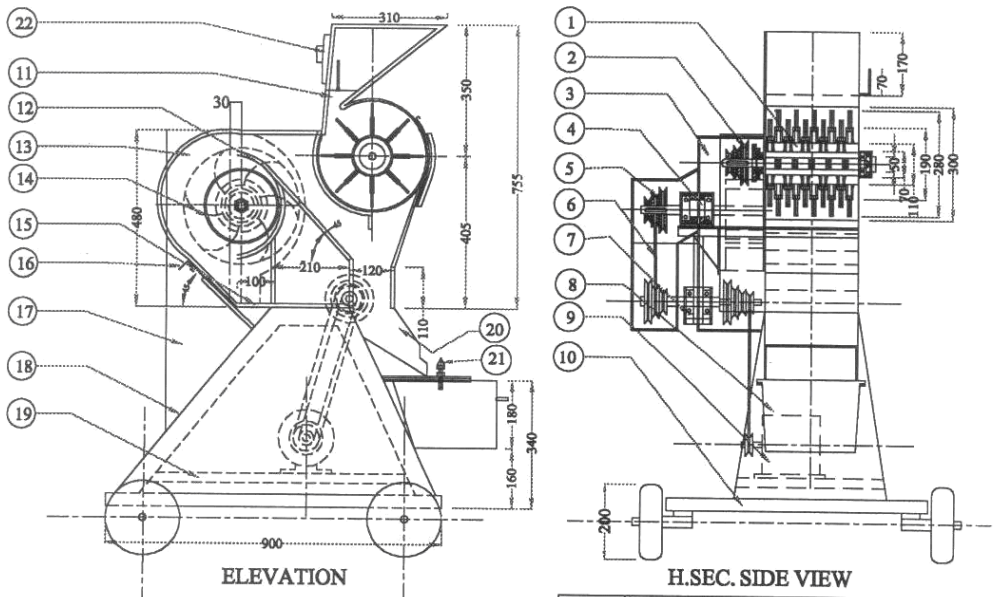
A study was conducted to manufacture of concave sieves group for small thresher and chose very best types for threshing lentil crop.

2.1.2 Concave sieves specifications:

Type: perforated sheet metal 3 mm thick-perforations as shown in Fig. 2:

- a) The first concave sieve: (hole concave) 11 mm dia. round holes
(193.87 to 367.5 cm² (1 : 0.896) perforation to soled area) .
The number of concave holes, 55 per 100 cm²
- b) The second concave sieve: (hole concave) 9 mm dia. round holes
(178.128 to 367.5 cm² (1 : 1.063) perforation to soled area) .
The number of concave holes, 76 per 100 cm²
- c) The thread concave sieve: (hole concave) 7 mm dia. round holes
(157.017 to 367.5 cm² (1 : 1.341) perforation to soled area).
The number of concave holes, 111 per 100 cm²
- d) Sieves dimensions are 15 cm wide, 24.5 cm long and 3 mm thick.
- The clearance between cylinder and concave sieve is constant, 10 and 4mm at inlet and outlet respectively (there is no possibility to change).

Experiments were performed on lentil crop at Research Farm of Gemmeza Agricultural Research Station, Gharbia Governorate, Egypt. The performance of the threshing were tested and evaluated according to the following criteria: (Machine capacity, kg/min – unthreshed seed losses, % cleaning efficiency, %, total seed damage, % - threshing efficiency, % the independent variables were four cylinder speeds: 15.14, 18.18, 20.21 and 22.25 m/s; four feeding rates: 8, 10, 12 and 15 kg/min and three hole diameter for sieves: 11, 9 and 7 mm. Some of physical properties of lentil crop Giza 9 are shown in Table 2.



(22)	Switch motor 220/380 V	—	1
(21)	Blot	Steel	1
(20)	Output opening	—	1
(19)	Motor base	Steel	1
(18)	Frame (Tripod)	Steel	1
(17)	Fence	Steel	1
(16)	Slider governor	Steel	1
(15)	Out put	—	1
(14)	blowing unit	Steel	1
(13)	Screw bolt	Steel	36
(12)	Slider	Steel	1
(11)	Arm	IRON	1
(10)	Machine base	Steel	1
(9)	Electrical motor	—	1
(8)	Grain box	IRON	1
(7)	Bearing idler pulley shaft	Steel	1
(6)	V - Belt	RUP.	3
(5)	Alluminium cone (fan pully)	ALL.	1
(4)	Bearing fan shaft	Stell	1
(3)	Pulley cover	ALL.	1
(2)	Alluminium cone (pully)	ALL.	1
(1)	Threshing drum.	Steel	1
REF. NO.	PART NAME	MAT.	NO. OFF
SCALE 1 : 15	DESCRIPTION.	DRG. NO.	
	THRESHING AND WINNOWER MACHINE.	DIMS.IN CMS	

Fig.1 : Threshing and winnowing machine model El-Haddad WZ -1 for small holding, (Original machine). Designed and constructed by (El-Haddad, 2000) and patent applied for 280 – 84

-The machine has obtained a prize competition for the best innovations and inventions of industrial (Dr -Wagdy El-Haddad) from Arab Organization for Industrialization (factory of kader El Harbi).

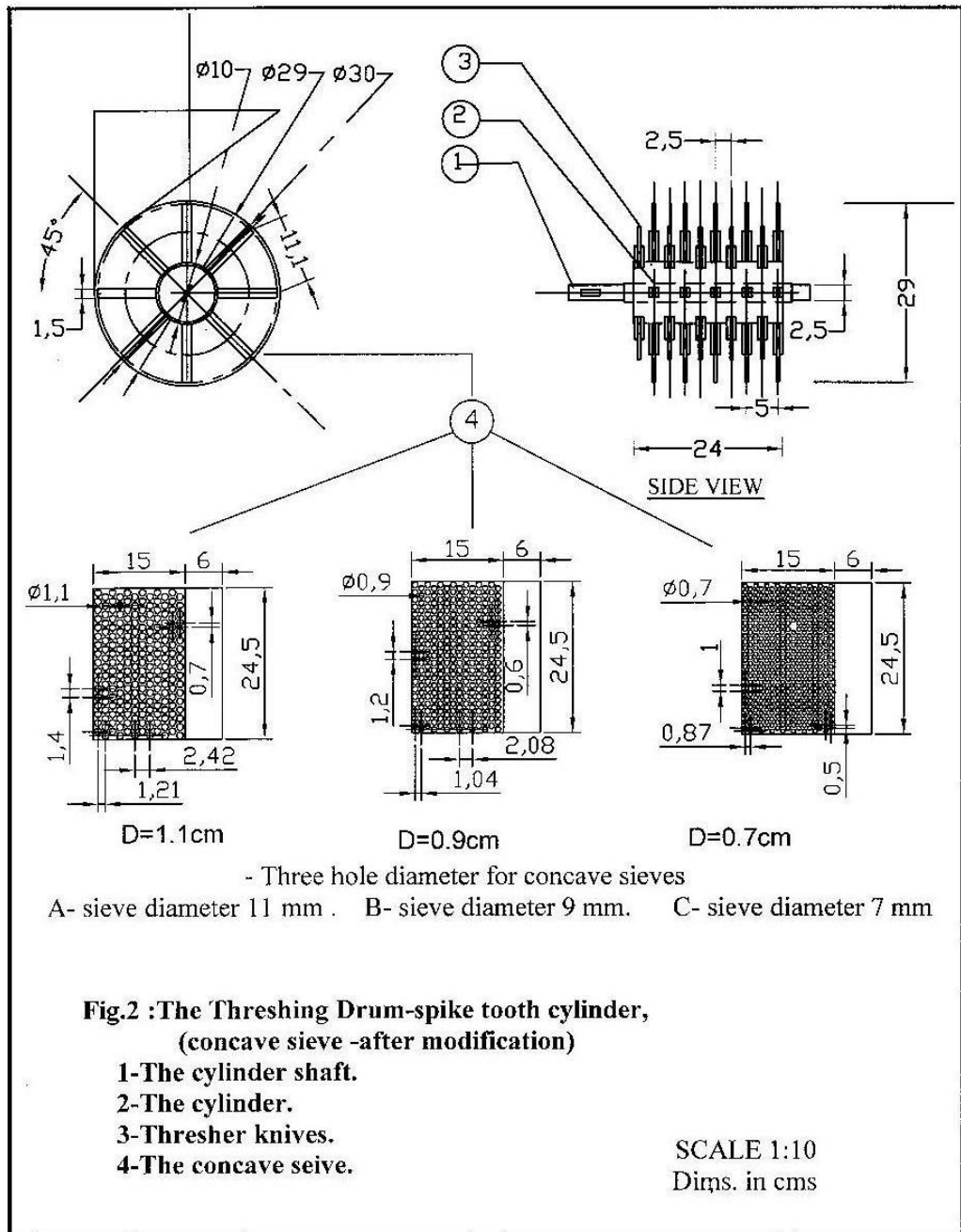


Fig.2: The concave sieves group was manufactured for small thresher to suit threshing lentil crop.

Table 1: The present machine specifications

Items	Specifications
Length, Width and Height, cm	124, 71 and 145
Mass, kg	154
Source of power	Solar engine, 5 hp (3.75 kW)
Type of cylinder	Spike tooth
(Cylinder), Length × Diameter, cm	24 × 29
Cylinder knives, cm	Total of (40) peg tooth, (9.5) long, (1.5) wide and (0.5) thickness
Input opening for crop, cm	30 × 25
Output opening for straw, cm	25 × 12
Output opening for grain, cm	19 × 12
Blower dimensions, cm	(30) diameter and (10) wide

Table 2: Physical properties of lentil crop

Items	Average
Stem length, cm	36
Stem diameter, mm	3.5
Number of branches/plant	10
Number of pods/plant	40
Mass of 1000 seeds, gm	25
Diameter of seed, mm	3.76
Thickness of seed, mm	2.24

*Taking samples of ten lentil crop (Giza 9)

-Measuring equipments:

Speedometer – grain moisture content meter – balance – stop watch – hot wire anemometer for measuring air velocity, m/s.

Measurements:-

During test performance of the threshing machine the following parameters were measured and taken into consideration.

The samples were taken periodically from the machine outlet and placed in polyethylene bags. The time of run of the experiment was measured by means of a stop watch. A tachometer was used to measure the cylinder drum speed of the threshing machine. The percentage of threshed seeds and unthreshed pods was evaluated as a ratio of the total weight threshed and unthreshed seeds. Also, the physical properties of lentil crop were

very important to select the adjustable concave sieves group for small thresher and chose their best for threshing lentil crop.

The laboratory test was carried out on a sample of threshed grain to determine the total seed damage (visible and invisible damage). The visible grain damage percentage was determined by separating the broken grain from a mass of 50 grams sample taken randomly from the threshed grain, whilst the invisible grain damage percentage was calculated by the germination test. Three replicates of 50 seeds were germinated at Petri dishes on a paper filter covered with water and incubated at 308°K (25°C) for 8 days. After threshing operation for each test, the amount of lentil seeds was recorded. An average of three replicates of this procedure was taken. The threshing output (threshing capacity), kg/min; the total losses (%) power consumption (kW), useful power (kW), and specific energy requirements (kW.h/M) were estimated for each test.

a) Machine Productivity (threshing capacity):

Time of threshing process was measured by stop watch to determine the capacity of machine, kg/min. Machine productivity was calculated as the following:-

$$\text{Machine productivity} = \frac{P_w}{t}, \text{ kg/h} \text{ -----(1)}$$

Where:

P_w = Mass of total seeds output, kg and

t = Time consumed in threshing operation, h.

(Total seeds output, kg.= threshed seeds + total seed damage + unthreshed seeds)

b) Cleaning efficiency:

The following relationship was used to determine the cleaning efficiency:

$$E_{cl} = \frac{M_{ts} - M_a}{M_{ts}} \times 100, \% \text{ -----(2)}$$

Where:

E_{cl} = Cleaning efficiency, %.

M_a = Mass of impurities, kg.

M_{ts} = Mass of total seeds, kg.

c) Unthreshed seeds:

Unthreshed seeds were calculated according to the following formula:

$$\text{Unthreshing seeds} = (W_{us}/W_{ts}) \times 100 \text{ ----- (3)}$$

Where:

W_{us} = Mass of unthreshing seeds, g and

W_{ts} = Mass of total seeds, g.

d) Seeds damage percentage were calculated as follows:-

$$\text{Seed damage} = M_{ds}/M_{ts} \times 100 \text{ ----- (4)}$$

Where:

M_{ds} = Mass of seed damage, g and

M_{ts} = Mass of total seeds, g.

e) Threshing efficiency:

The threshing efficiency (E_t) was estimated according to the following formula (**Mishra and Desta 1990**)

$$\text{Threshing efficiency, \%} = 100 - (W_2/W_1) \times 100 \text{ ---- (5)}$$

Where:

W_1 = Total mass of seed in the sample, g and

W_2 = Mass of unthreshing seed in the sample, g

f) Consumed power:

Consumed power was calculated by accurately measuring the decrease in fuel level in fuel cylinder immediately after carrying out each treatment. The following formula was used to determine consumed power (**Hunt, 1983**):

$$EP = \left[Fc \times \frac{1}{60 \times 60} \right] \rho_f \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36}, \text{ kW ---(6)}$$

Where:

$F.C$ = Fuel consumption, (l/h).

P_f = Density of fuel, (kg/l), (for solar fuel = 0.85).

$L.C.V$ = Calorific value of solar fuel, (10000 kcal/kg).

427 = Thermo-mechanical equivalent, (kg.m/kcal).

η_{th} = Thermal efficiency of the engine, (35% for diesel engine).

η_m = Mechanical efficiency of the engine, (80% for Diesel engine).

So, the Specific energy can be calculated as following:

$$\text{Specific energy requirements} = \frac{\text{Consumed power, (kW)}}{\text{Machine capacity, Mg / h}}, \text{kW.h/Mg} \text{ --(7)}$$

The costs:

g) Machine depreciation (Dep.):

Declining balance method employed in calculating depreciation (**Barger et al, 1978**). The relationships are as follows:

$$D = V_n - V_{n+1} \text{ -----(8)}$$

$$V_n = C (1 - R/L)^n, V_{n+1} = C (1 - R/L)^{n+1} \text{ -----(9)}$$

Where:

- D = amount of depreciation charged for year n + 1
- C = original cost.
- R = the ratio of depreciation rate for used machines. It will be between 1 and 2 normally.
- L = service life.
- n = number representing age of machine in years at beginning of year.
- V = remaining value at any time (R.V.)

h) Interest on investment, housing, taxes and insurance, (IHTI):

It was estimated 13.8 % of the remaining value (**Barger et al., 1978**).

i) Repairs and maintenance (R & M):

Repair costs are very high in developing countries and contribute significantly to the total cost. It was estimated 50% of the initial value, spread over the life of the machine, has been taken (**Kaul and Egbo, 1985**).

j) Criterion function cost:

This function can be calculated as the sum of the unit cost (U_c) plus the losses cost (L_c) using the following equation (**Helmy, 1988**).

$$C_f = U_c + L_c, \text{ L.E/Mg} \text{ ----- (10)}$$

$$L_c = 10^{-2} C_{pw} (U_G + 0.67^* T_{GD}), \text{ L.E/Mg}$$

Where:

$$C_{pw} = \text{Current price of one ton of lentil seeds, (8000 L.E/Mg).}$$

U_G = Unthreshed seeds, %.

T_{GD} = Total seed damage, %.

* Current price of one ton of broken lentil seeds = $0.67 C_{pw}$.

RESULTS AND DISCUSSION

1- Effect of cylinder speed, feed rate and hole diameter of concave sieves on threshing capacity, (total seeds output) kg/min.

Data and results of seed output as affected by different variables are shown in Fig. 3.

At feed rate 8 kg/min by increasing cylinder speed from 15.14 to 22.25 m/s it was found that total seed output increased from 4.5 to 4.7 kg/min (by increasing ratio of 0.04) at hole diameter of concave sieves 11 mm. This result may be due to increasing cylinder speed tends to increasing damage of grain into small pieces and through out with straw of threshed materials. At feed rate of 8 kg/min, increasing hole diameter of concave sieves from 7 to 11 mm, the total seed output increased from 4.0 to 4.5 kg/min (by increasing ratio of 0.11) and from 4.4 to 4.7 kg/min (by increasing ratio of 0.06) at cylinder speed of 15.14 and 22.25 m/s, respectively.

2- Effect of cylinder speed, feed rate and hole diameter of concave sieves on unthreshed seed, (%).

a) Data and results of unthreshed seed are affected by different variables are shown in Fig. 4.

At feed rate 8 kg/min, increasing cylinder speed from 15.14 to 22.25 m/s, it was found that unthreshed seed decreased from 3.70 to 3.21% at hole diameter of concave sieve 11 mm. At cylinder speed of 20.21 m/s when the feed rate increased from 8 to 15 kg/min, the unthreshed seed increased from 3.45 to 3.83% at hole diameter of concave sieve 11 mm. At feed rate 8 kg/min and cylinder speed of 15.14 m/s, when the hole diameter for concave sieves increased from 7 to 11 mm, the unthreshed seed increased from 0.85 to 3.70

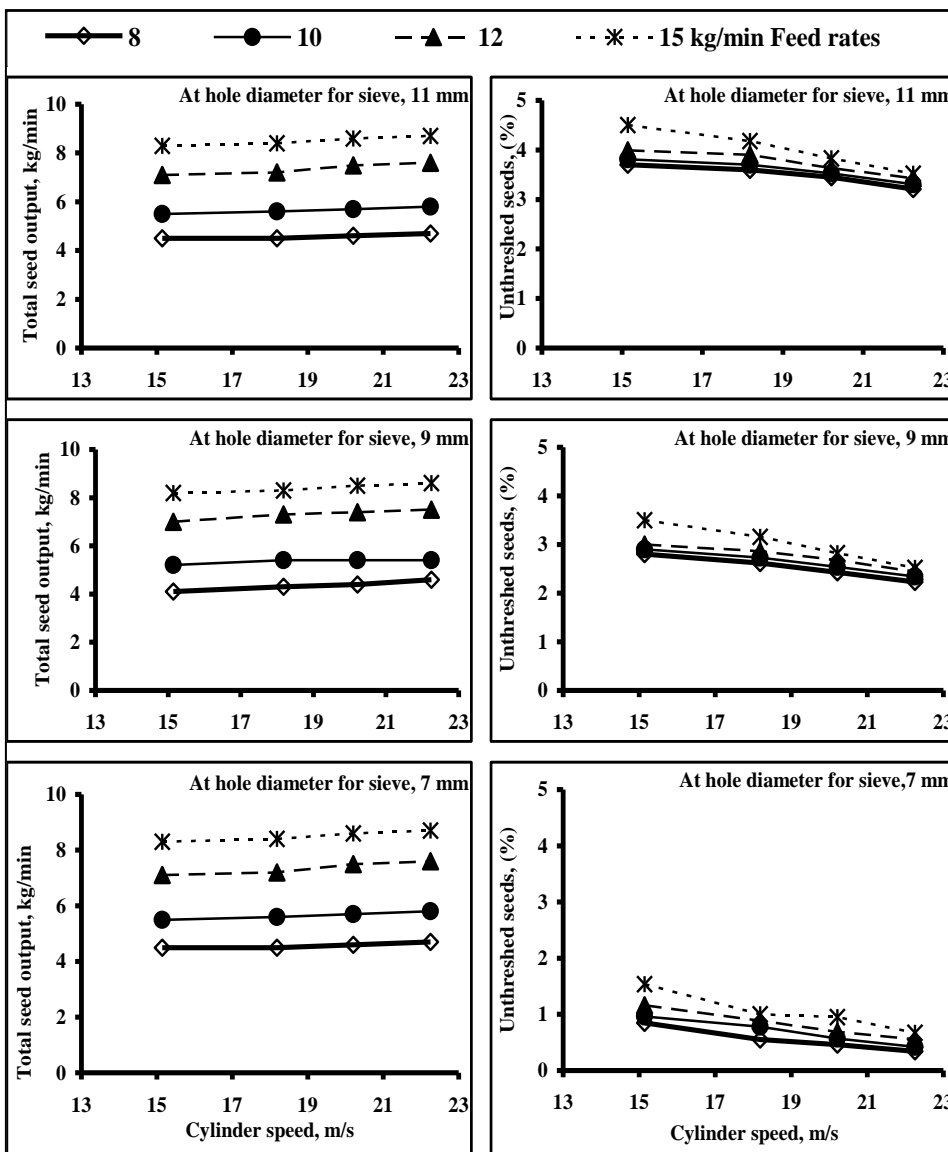


Fig. (3): Effect of cylinder speed, feed rate and hole diameter for concave sieve on total seeds output, (kg/min).

Fig. (4): Effect of cylinder speed, feed rate and hole diameter for concave sieve on unthreshed seed, (%).

3- Effect of cylinder speed, feed rate and hole diameter of concave sieves on total seed damage, (%).

During threshing operation, seed damage occurs mainly due to the impact of knives with seed which is related to the cylinder speed. This damage classified as follows (visible and invisible seed damage). Total seed damage are may reduce the quality and value of the product, so visible seed damage reduce the quality and not reduce the feeding quality of seeds, but invisible seed damage reduce germination ratio (reduce the quality and value of product if seeds are wanted for planting use).

Data and results of total seed damage as affected by different variables are shown in Fig. 5. At feed rate of 8 kg/min and hole diameter of sieve 11 mm, when the cylinder speed increased from 15.14 to 22.25 m/s, the total seed damage increased from 12 to 23%. At cylinder speed of 15.14 m/s, when the feed rate increased from 8 to 15 kg/min, the total speed damage decreased from 12 to 4% at hole diameter of sieve 11mm. At cylinder speed of 15.14 m/s and feed rate of 8 kg/min,

4- Effect of cylinder speed, feed rate and hole diameter of concave sieves on cleaning efficiency, (%).

Increasing feeding rate decreased cleaning efficiency. Also, increasing cylinder speed increased cleaning efficiency. The high cylinder speed increased the velocity of cleaning air results in higher capability of air to carry the foreign material from seeds consequently increased cleaning efficiency. Data and results of cleaning efficiency for modified thresher machine as affected by different variables are shown in Fig. 6 At feed rate 8 kg/min and hole diameter for sieve 11 mm, when the cylinder speed increased from 15.14 to 22.25 m/s, the cleaning efficiency increased from 83.20 to 87.50 % At cylinder speed 15.14 m/s and hole diameter for sieve 11 mm, when the feed rate increased from 8 to 15 kg/min the cleaning efficiency decreased from 83.20 to 75.60%. The maximum cleaning efficiency was 98.99% at hole diameter for sieve 7 mm at feed rate 8 kg/min and cylinder speed of 22.25 m/s.

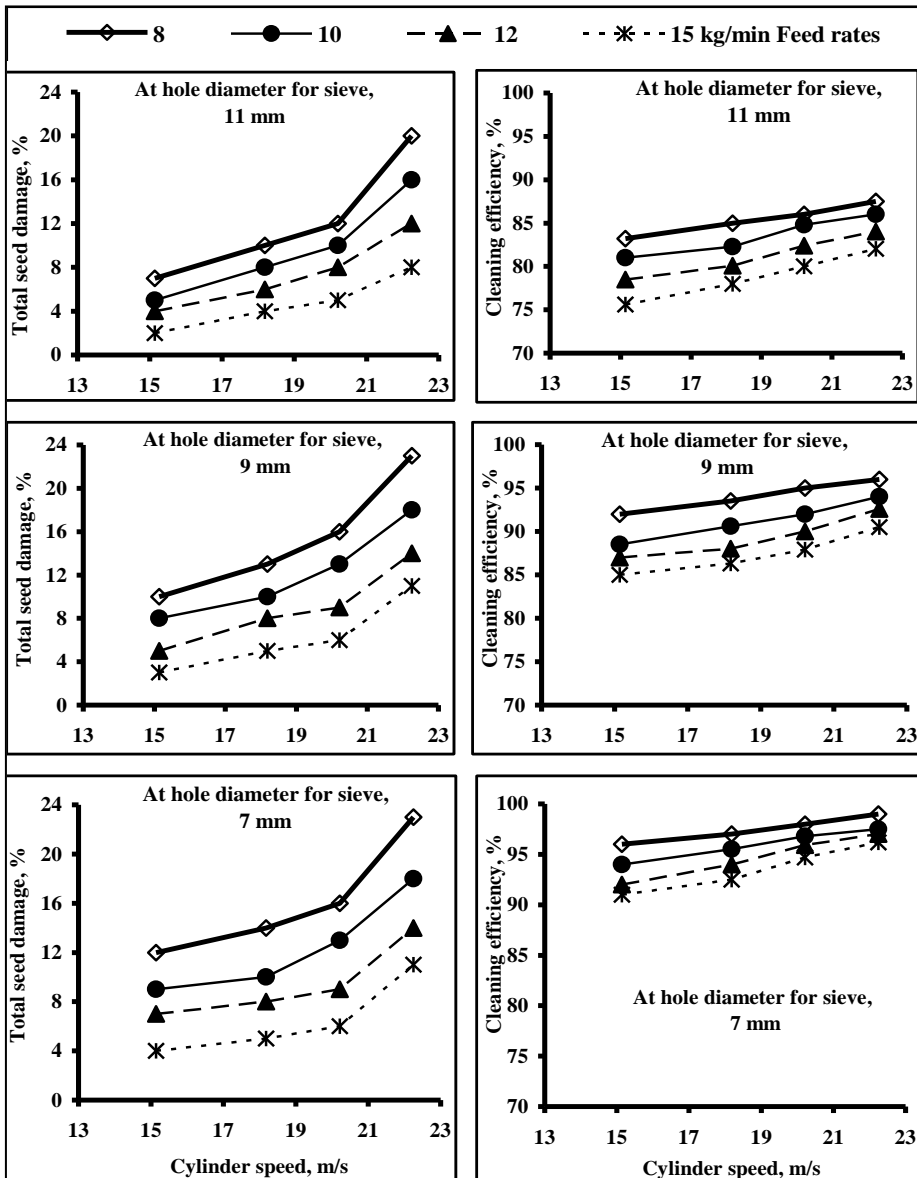


Fig. (5): Effect of cylinder speed, feed rate and hole diameter of concave sieve on total seed damage, (%).

Fig. (6): Effect of cylinder speed, feed rate and hole diameter of concave sieve on cleaning efficiency, (%).

5- Effect of cylinder speed, feed rate and hole diameter for concave sieves on threshing efficiency, (%).

Data and results of threshing efficiency for modified thresher machine, as affected by different variables are shown in Fig. 7. At feed rate 8 kg/min and hole diameter of concave sieve 11 mm, when the cylinder speed increased from 15.14 to 22.25 m/s, the threshing efficiency increased from 95.25 to 95.80%. At cylinder speed 15.14 m/s and hole diameter of sieve 11mm, when the feed rate increased from 8 to 15 kg/min, the threshing efficiency decreased from 95.25 to 94.50%.

At cylinder speed of 15.14 m/s and feed rate of 8 kg/min, when the hole diameter of concave sieves increased from 7 to 11 mm, the threshing efficiency decreased from 97.29 to 95.25%.

6- Effect of cylinder speed, feed rate and straw moisture content on average length of cut straw (Tibbin).

Length of cut straw is considered an important factor because cut straw (tibbin) is an expensive material. The production of cut straw from one feddan is about 1500 kg (6 hemel). The price of one hemel is about 90 L.E. So, the machine which gave tibbin whose length rang from 1.5 to 2 cm this rang is suitable for feeding of animals.

Fig. 8 indicated at feed rate of 8 kg/min and straw moisture content of 14%, when cylinder speed increased from 15.14 to 22.25 m/s, the length of cut straw decreased from 18.33 to 12.33 mm. At cylinder speed of 15.14 m/s and straw moisture content 10%, when the feed rate increased from 8 to 15 kg/min, the length of cut straw increased from 11 to 19.67 mm. At cylinder speed of 15.14 m/s and feed rate of 8 kg/min, when the straw moisture content decreased from 14 to 10%, the length of cut straw decreased from 18.33 to 11 mm.

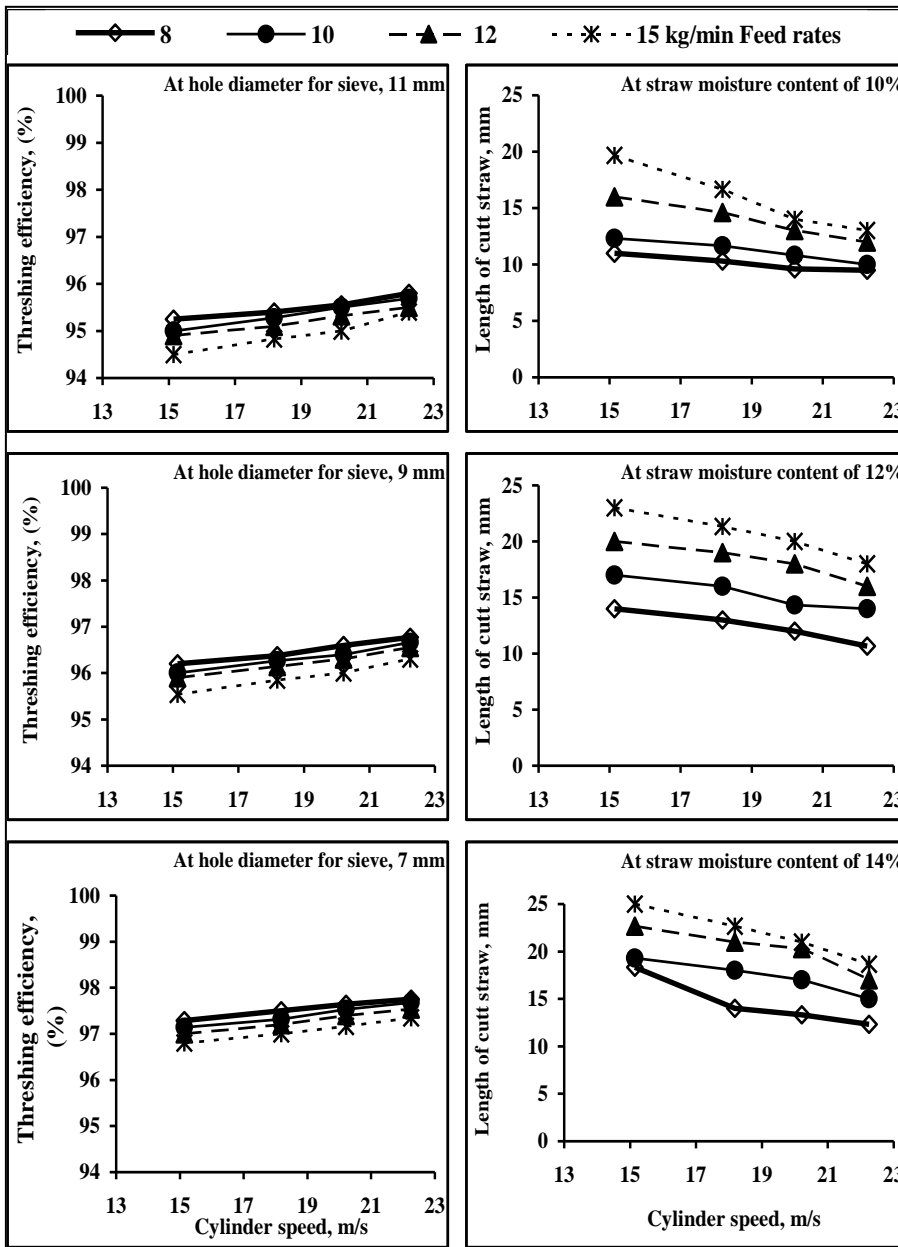


Fig. (7): Effect of cylinder speed, feed rate and hole diameter of concave sieve on threshing efficiency, (%).

Fig. (8): Effect of cylinder speed, feed rate and straw moisture content on average length of cut straw (Tibbin), mm.

7- Effect of cylinder speed, feed rate and hole diameter of concave sieves on consumed power, (kW).

Data and result of consumed power as affected by different variables are shown in Fig. 9. Threshing machine at feed rate 8 kg/min, increasing cylinder speed from 15.14 to 22.25 m/s, it was found that power consumed increased from 2.15 to 3.01 kW at hole diameter of concave sieve 11 mm. Similar results were indicated by El-Haddad, 2004.

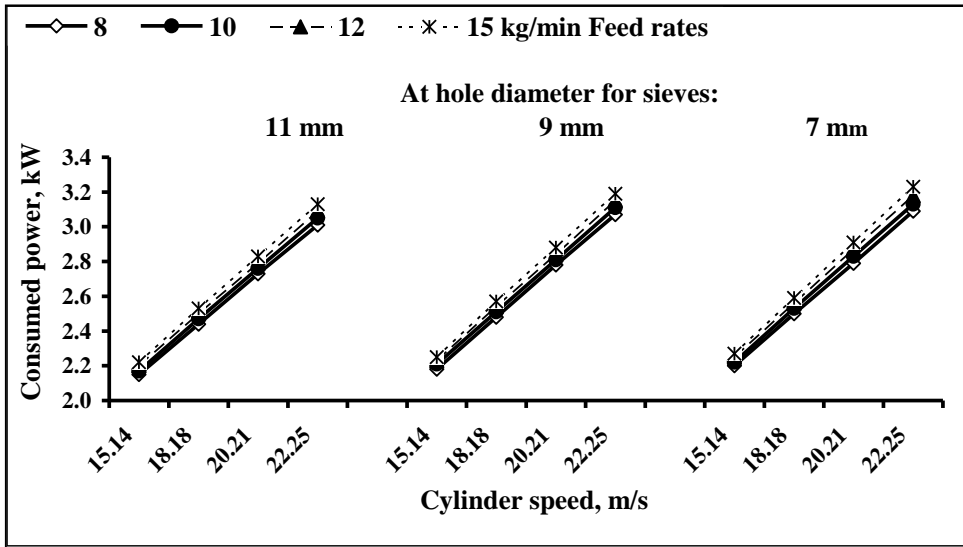


Fig. (9): Effect of cylinder speed, feed rate and hole diameter for sieve on consumed power, (kW).

Threshing machine at 20.21 m/s, when the feed rate increased from 8 to 15 kg/min, the power consumed increased from 2.73 to 2.83 kW at hole diameter for sieve of 11 mm. Threshing machine at feed rate of 8 kg/min and cylinder speed of 15.14 m/s, when the hole diameter for sieves decreased from 11 to 7 mm, the power consumed increased from 2.15 to 2.20 kW. Similar results were indicated by Mahmoud et al. (2007).

8- Cost analysis:

The items of cost analysis are presented in Table 3. The fabricated cost of a modified thresher machine was about 5000 L.E. the cost of operating hours was determined considering ten years service life of the machine. It could work about 500 hours every year. The cost of operating the thresher for one hour is 14.329 L.E/h. and the criterion function cost was 66.978 L.E/Mg.

Table 3: Criterion function cost for a modified thresher at feed rate 15 kg/min, cylinder speed 22.25 m/s, hole diameter for concave sieve of 7.0 mm. and constant moisture content 14 % of lentil seeds

Modified thresher	Cost items, LE/h						Total cost, LE/h
	Dep.	IHTI	R & M	Labor	Fuel	Oil	
Threshing machine+ engine	7.225	0.99	0.50	5	0.514	0.10	14.329

Modified thresher	Total cost, (L.E/h)	Productivity, (Mg/h)	Unit cost, (L.E/Mg)	Losses cost, (L.E/Mg)	Criterion function cost, (L.E/Mg)
Threshing machine+ engine	14.329	0.522	27.45	39.528	66.978

CONCLUSION

The results of the present study led to the following conclusion:

1. The seed output increased as the cylinder speed increased, the maximum amount of grain output was 8.7 kg/min at cylinder speed 22.25 m/s, feed rate of 15 kg/min and hole diameter for sieve of 11 mm.
2. The maximum cleaning efficiency was 98.99% at hole diameter for sieve 7.0 mm at feed rate 8 kg/min and cylinder speed of 22.25 m/s.
3. The minimum unthreshed grain losses were 0.34% at cylinder speed of 22.25 m/s, feed rate of 8 kg/min and hole diameter for sieve of 7 mm.
4. The threshing efficiency increased with increase of cylinder speed and decrease of feed rate. The maximum threshing efficiency was 97.75% at cylinder speed 22.25 m/s, feed rate 8 kg/min and hole diameter for sieve of 7 mm.
5. The minimum length of cut straw was 9.5 mm at cylinder speed of 22.25 m/s, feed rate of 8 kg/min and straw moisture content of 10%.
6. The maximum consumed power was 3.23 kW at cylinder speed of 22.25 m/s, feed rate of 15 kg/min and hole diameter for sieve of 7.0 mm.
7. The total threshing cost for a machine operated by solar engine 5 hp (3.75 kW) costed 14.329 L.E/h, while the criterion function cost was 66.978 L.E/Mg.

Threshing machine was satisfactory where it gave the highest productivity of 8.7 kg/min, the lowest value of unthreshed seed losses of 0.34%, cleaning efficiency of 98.99% the threshing efficiency of 97.75%, the highest consumed power of 3.23 kW, the minimum specific energy of 6.188 kW.h /Mg and cutting lengths of 9.5 mm at drum speed of 22.25 m/s and hole diameter for sieve of 7.0 mm. However, the machine threshing cost reached 14.329 L.E/h and the criterion function cost was 66.978 L.E/Mg.

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الملخص العربي

تصنيع مجموعة غرابيل صدر لماكينة دراس صغيرة لإمكانية دراس محصول العدس

د/ وجدى زغلول الحداد* د/ حمادة على الخطيب*

د/ إسماعيل فؤاد سيد أحمد*

يعتبر محصول العدس من المحاصيل البقولية الغذائية الرئيسية فى مصر، وذلك لكون بذوره ذات قيمة غذائية عالية، إذ تمد الجسم بحاجته من البروتين النباتى الذى يمتاز بإنخفاض ثمنه مقارنة بأسعار البروتين الحيوانى، حيث يحتوى كل 100 جم عدس على 0,25 جم بروتين نباتى 1,3 جم دهن 0,07 جم كالسيوم 0,35 جم فوسفور 0,01 جم حديد هذا بالإضافة إلى بعض العناصر الأخرى ويعتبر العدس من الأغذية الشعبية إذ يستهلكه الغالبية العظمى من السكان (نشوى التطاوى 1999).

أجريت التجارب بمحطة البحوث الزراعية بالجميزة - محافظة الغربية. وفى هذا البحث تم دراسة بعض العوامل التى تؤثر على أداء ماكينة الدراس المحلية (الحداد 2000) مع غرابيل

* معهد بحوث الهندسة الزراعية - مركز البحوث الزراعية - دقى - جيزة - مصر.

الصدر المختلفة التي تم تصنيعها بفتحات دائرية ذو اقطار ١١ ، ٩ ، ٧ مم لتحديد أنسب غربال صدر لتشغيل هذه الآلة مع محصول العدس صنف جيزة ٩ يحقق أعلى كفاءة دراس مع أعلى كفاءة تنظيف للمزارع المصرى الصغير وهذه العوامل هي:

١. السرعة الخطية للدرفيل (١٤,١٥ - ١٨,١٨ - ٢٠,٢١ - ٢٢,٢٥ م/ث).

٢. معدلات التلقيم (٨ - ١٠ - ١٢ - ١٥ كجم/دقيقة).

٣. قطر فتحات الغربال (١١ - ٩ - ٧مم).

أهم ما خلصت إليه النتائج:

١- وجد أن سعة الماكينة تزداد طردياً بزيادة سرعة الدرفيل وهذا يعنى أن أعلى انتاجية للحبوب كانت ٨,٧ كجم/دقيقة عند سرعة درفيل ٢٢,٢٥ م/ث ومعدل تغذية ١٥ كجم/دقيقة وقطر فتحة الغربال ١١مم.

٢-أعلى كفاءة تنظيف كانت ٩٨,٩٩% عند قطر فتحة الغربال ٧مم ومعدل تغذية ٨ كم/دقيقة وسرعة درفيل الدراس ٢٢,٢٥ م/ث.

٣- وجد أن أقل نسبة فاقد للحبوب غير المدروسة كانت ٠,٣٤% عند سرعة درفيل ٢٢,٢٥ م/ث ومعدل تلقيم ٨ كجم/دقيقة وقطر فتحة الغربال ٧مم.

٤- توجد علاقة طردية بين كفاءة الدراس وسرعة الدرفيل حيث بزيادة السرعة تزداد كفاءة الدراس. بينما توجد علاقة عكسية بين كفاءة الدراس ومعدل التلقيم حيث بزيادة معدل التلقيم تقل كفاءة الدراس وكانت أعلى قيمة لكفاءة الدراس ٩٧,٧٥% عند سرعة درفيل ٢٢,٢٥ م/ث ومعدل تغذية ٨ كجم/دقيقة وقطر فتحة الغربال ٧مم.

٥- القدرة المستهلكة والمستفادة فى عملية الدراس للبذور كانت تزداد بزيادة سرعة الدرفيل ومعدل التغذية وكانت أقصى قيمة للقدرة المستهلكة والمستفادة ٣,٢٣ كيلووات عند سرعة درفيل ٢٢,٢٥ م/ث ومعدل تغذية ١٥ كجم/دقيقة وقطر فتحة الغربال ٧مم.

٦- أظهرت النتائج أن أقل قيمة لأطوال القش المقطوع كانت ٩,٥ مم وذلك عند سرعة اسطوانة الدراس ٢٢,٢٥ م/ث ومعدل تغذية ٨ كجم/دقيقة ومحتوى رطوبى للقش ١٠%.

٧- أظهرت النتائج أن تكاليف الدراس الكلية باستخدام الماكينة والمركب عليها محرك بنزين قدرته ٥ حصان (٣,٧٥ كيلو وات) تتكلف ١٤,٣٢٩ جنية/ساعة بينما كانت الدالة المعيارية لها تكون ٦٦,٩٧٨ جنية/ميجا جرام.

آلة الدراس المعدلة كانت مرضية حيث أعطت أعلى انتاجية ٨,٧ كجم/دقيقة عند أعلى قدرة مستهلكة ٣,٢٣ كيلو وات وهى قدرة صغيرة جداً لما حصلنا عليه من إنتاج وذلك عند سرعة درفيل ٢٢,٢٥ م/ث وقطر فتحة الغربال ٧مم وأقل نسبة حبوب غير مدروسة ٠,٣٤% وأعلى كفاءة للدراس ٩٧,٧٥% وأعلى كفاءة تنظيف ٩٨,٨٨% وأقل قطع من أطوال القش ٩,٥ مم وأيضا كانت تكاليف الدراس الكلية لآلة الدراس ١٤,٣٢٩ جنية/ساعة بينما كانت الدالة المعيارية لها كانت ٦٦,٩٧٨ جنية/ميجا جرام والطاقة النوعية المستهلكة ٦,١٨٨ كيلو وات/ساعة/ميجا جرام.