Journal of Soil Sciences and Agricultural Engineering

Manufacture and Development of a Small Threshing Machine

El-Fakhrany, W. B.[*] and M. A. Aboegela

Agric. Eng. Res. Inst. (AEnRI), Giza, Egypt

Cross Mark

ABSTRACT

This study was conducted to manufacture a miniature version of the widespread threshing machine in Egypt and to evaluate its performance. The threshing machine was manufactured at Tanta Motors factory (Emagro), and its performance was evaluated at Etay El Baroud Agricultural Research Station in 2020 in two independent experiments according to the threshed crop. The crops of soybean and dry bean were threshed at different drum speeds of 350, 400, 450 and 500 rpm (9.34, 10.67, 12.01 and 13.34 m/s) and three feeding rates of 300, 400 and 500 kg/h for performance evaluation. The results indicated that the drum speed of 450 rpm (12.01 m/s) and feeding rate of 500 kg/h were the optimum for both crops, as the lowest criterion costs of 948 and 908.4 L.E/Mg were achieved for soybean and dry bean respectively. Also; the threshing efficiency of 98.03% and 97.79%, seed damage of 2.72% and 2.55%, cleaning efficiency of 97.77% and 97.61%, specific consumed energy of 37.93 and 35.41 kWh/Mg and private cost (operating and fixed costs) of 526.5 and 480 L.E/Mg were obtained with soybean and dry bean respectively.

Keywords: Small thresher, threshing efficiency, threshing damage, soybean and dry bean.

INTRODUCTION

Improving energy efficiency and energy conservation in agriculture are essential to reduce energy demand and therefore reduce costs. Srivastava (2004) stated that availability of adequate farm power is very crucial for timely farm operations for increasing production and productivity and handling the crop production to reduce losses. Also; Zarini *et al.* (2013) mentioned that correct matching of tractor-implement system would result in decreased power losses, improved efficiency of operation, reduced operating costs and optimum utilization of capital on fixed costs. In Egypt; the total number of agricultural tractors reached about 133298 in 2015 and the number of tractors with a power of less than 35 hp was about 12421 tractors which represent 9.32% of the total number. Also; the number of tractors that included power ranged in between 35 – 50 hp recorded 16600 which represent 12.45% of the total number of tractors. (Central Agency for Public Mobilization and Statistics, 2016). the minimum power required for threshing caraway crop by the Egyptian threshing machine (El-Shams) was 15.68 kW (21.3 hp); which was achieved at feeding rate of 540 kg/h, rotor speed of 500 rpm, air speed of 4.8 m/s and straw moisture content of 11.84%. (Radwan *et al.,* 2009)

Vejasit and Salokhe (2004) fabricated and tested a threshing unit with a peg-tooth drum at four levels of drum speeds, three levels of feed rates and three levels of soybean moisture contents. The results indicated that the threshing efficiency varied from 98 to 100%. The grain damage and grain loss were less than 1 and 1.5% respectively; at drum speeds of 600 to 700 rpm, feed rates of 540 to 720 kg/h and seed moisture contents of 14.34 to 22.77% (w.b.). The maximum required power was 2.29 kW at seed moisture content of 32.88% (w.b.) and drum speed of 700 rpm. The best combination of feeding rate and drum speed at 14.34% (w.b.) of seed moisture content was 600 to 700 rpm of drum speed (13.2 to 15.4 m/s) and 720 kg/h of feeding rate.

Sessiz *et al.* (2007) evaluated soybean threshing machine under different concave materials of PVC, rubber, chromium, and steel plate with three feed rates (360, 720 and 1080 kg/h) and five peripheral speeds of 7.95, 9.10 10.54, 12.16 and 14.66 m/s. The results indicated that the threshing efficiency decreased by increasing the feeding rate and increasing drum speed significantly improved the threshing efficiency. Abd El Mowla *et al.* (2014) improved the stationary threshing machine by adding a diesel engine of 49 hp and gearbox to become self-operated. The improved machine was evaluated and compared with the conventional one through threshing two crops, faba bean and wheat. The results indicated that the time required to operate the improved thresher was low (0.03 h) compared to (0.25 h) for linking the conventional thresher to the tractor. Gomaa *et al.* (2009) evaluated two different systems of harvesting soybean crop, the first system was harvesting soybean crop by combine harvester (Yanmar-CA760). The second system was harvesting by hand sickle then threshed, winnowed by Turkish threshing machine. The results indicated that the optimum operating conditions for the Turkish threshing machine was at feed rate of 0.5 kg/s, cylinder speed of 11.99 m/s and grain moisture content of 18.50%. Adekanye *et al.* (2016) designed, fabricated and evaluated a soybean threshing machine which consisted mainly of feeding mechanism, threshing unit, fan and power transmission unit. The thresher was evaluated under crop moisture contents of 10, 16 and 22% (w.b.) and drum speeds of 320, 385, 450 and 515 rpm. The performance evaluation revealed that the threshing efficiency were in the range of 98.96 - 99.88% for the range of the variable of drum speed of 320 - 515 rpm and were in the range of 99.73 - 99.29% for the range of the variable of moisture content of 10 - 22% (w.b.). Also, the cleaning efficiency decreased from 90.81 to 64.25% as the speed increased from 320 to 515 rpm. Muna *et al.* (2016) evaluated the performance of multi-crop threshing machine for threshing soybean and millet crops. The machine was evaluated under different crop moisture contents, different cylinder speeds and

different feeding rates. The results indicated that the throughput capacity is directly proportional to speed and feeding rate but inversely proportional to moisture content; threshing efficiency is directly proportional to speed but inversely proportional to feeding rate and moisture content; cleaning efficiency is directly proportional to speed but inversely proportional to feeding rate and moisture content; scattered grain loss is directly proportional to speed but inversely proportional to feed rate and moisture content; grain damage is directly proportional to speed and moisture content above 13.5 % (w. b.) but inversely proportional to feed rate.

Zaalouk (2009) studied the feasibility of using Egyptian threshing machine for dry bean under different drum speeds (11.72, 13.18 and 15.38 m/sec.), feeding rates (10, 15 and 20 kg/min) and seed moisture contents (13.56, 11.53 and 9.20 %; d.b.). The obtained results showed that, the threshing machine can be used for threshing bean at drum speed of 15.38 m/s, feeding rate of 20 kg/min and seed moisture content of 9.20 %, whereas; the seed damage, un-threshed seed, threshing efficiency, consumed power and criterion cost were 2.17 %, 1.48 %, 98.52 %, 14.70 kW and 143.20 L.E /ton respectively. Pandey and Stevens (2016) studied the performance of high capacity multi-crop thresher for threshing gram crop under three cylinder speeds of 550, 600 and 650 rpm, three feed rates of 1600, 1800 and 2000 kg/h. The results indicated that the maximum threshing efficiency and cleaning efficiency were found to be 98.98% and 97.30% respectively at cylinder speed of 600 rpm and feed rate 2000 kg/h. While the maximum total grain loss was found 3.3% at cylinder speed 550 rpm and maximum feed rate 2000 kg/h. The grain breakage was found 1.70% at cylinder speed of 650 rpm and feed rate 2000 kg/h. The output capacity was found 962 kg/h at cylinder speed of 600 rpm and feed rate 2000 kg/h. Al-Shamiry and Yahya (2020) studied performance of wheat crop threshing machine with spike tooth drum under different crop feeding rates of 10, 15 and 20 kg/min and thresher drum speeds of 1400 and 1600 rpm. The results showed that the field capacity of the machine was 600 and 1028.6 kg/h at 1400 and 1600 rpm, the highest threshing and cleaning efficiencies of 95% for both were obtained at a feeding rate of 10 kg with 1600 rpm of drum speed, the lowest threshing and cleaning efficiencies of 87 and 84 % were obtained at a feeding rate of 20 kg with 1400 rpm of drum speed and the highest grain output of 300 kg/h was obtained at 20 kg of feed rate with 1400 rpm of drum speed. The aim of this study is to manufacture a small threshing machine suitable for minor power tractors or small power engines and to evaluate its performance under threshing different crops such as soybean and dry bean with different operating parameters such as drum speed and feeding rate.
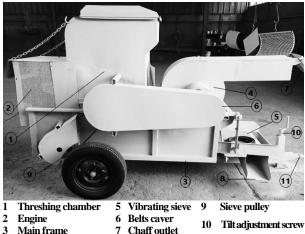
MATERIALS AND METHODS

The threshing machine was manufactured at Tanta Motors factory (Emagro) in Gharbia Governorate, and its performance was evaluated at Etay El Baroud Agricultural Research Station in Beheira Governorate in 2020.

Description of the threshing machine

The manufactured threshing machine is self-operated with a 13 hp gasoline engine. Table (1) shows the technical specifications of the threshing machine and Fig. (1) is a photographic view for it. Fig. (2) shows the outline dimensions of thresher prototype and Fig. (3) shows the motion transmission from the engine to the various parts of the machine.

Table 1. Specification of the manufactured threshing machine

Item	Specification	Item	Specification
Total length, cm	278.7	Drum type	Beater
Total width, cm	147		knives
Total height, cm	184.2	Drum length, cm	75
Total weight, kg	750	Drum diameter, cm	51
Operating technique	Gasoline engine	Number of knives	32
		Drum to fan	
Engine power, hp	13	speeds ratio	2 : 3

1 **Threshing chamber** 5 **Vibrating sieve** 9 **Sieve pulley**
2 **Engine** 6 **Belts caver**
3 **Main frame** 7 **Chaff outlet** 10 **Tilt adjustment screw**
4 **Chaff suction fan** 8 **Seed outlet** 11 **Hitch point**

Fig. 1. Photographic view of the manufactured threshing machine

Fig. 2. The outline dimensions of the manufactured thresher

Fig. 3. Motion transmission

Two experiments were conducted during 2020. The first one was carried out in October for soybean crop (Giza 111 cultivar) while, the second was carried out in December for dry bean crop (Nebraska cultivar). Table (2) shows some physical properties for both crops.

Table 2. Measured physical properties of soybean and dry bean crops

Properties	Soybean, (Giza 111)	Dry bean, (Nebraska)
Stem length, cm	95.44	55.2
No. of branches /plant	2.45	6.4
No. of pods /plant	106	31.33
No. of seeds /pods	2.6	5.2
Seed length, cm	0.64	1.63
Seed width, cm	0.55	0.76
Seed thickness, cm	0.43	0.64
Sphericity, %	83.3	56.8
Mass of 1000 seeds, gm	188.6	390.5

Experimental procedures

Immediately before threshing operations, a sample was taken from each crop to estimate the moisture content of whole plant by means of an electric oven. The average moisture contents for all plant were 12% and 14.5% for soybean and dry bean respectively. The concave clearance and concave holes diameter were selected after preliminary experiments to be 4.0 and 1.5 cm respectively for soybean and 4.0 cm and 2.5 cm respectively for dry bean.

The drum speed and feeding rate were changed for soybean and dry bean crops as following:-

1- Four drum speeds of 350, 400, 450 and 500 rpm (9.34, 10.67, 12.01 and 13.34 m/s) were tested for both crops.
2- Three feeding rates of 300, 400 and 500 kg/h were tested for both crops.

Measurements

1- Threshing efficiency, (η_T)

For each treatment, the un-threshed pods were collected and their seeds separated manually and weighted, the threshing efficiency was calculated as following:-

$$\eta_T = 100 - \left(\frac{W_U}{W_T} \times 100 \right), \quad \%$$

Where; W_U is mass of un-threshed seeds (g) and W_T is mass of total seeds (g).

2- Threshing damage, (D). The percentage of threshing damage was calculated from the following equation.

$$D = \frac{W_d}{W_T} \times 100, \quad \%$$

Where; W_d is mass of damaged seeds (g), and W_T is mass of total seeds (g)

3- Cleaning efficiency, (η_C). The following equation was used to calculate cleaning efficiency.

$$\eta_C = \frac{W_a}{W_b} \times 100, \quad \%$$

Where; W_a is the seed mass after cleaning (kg), W_b is the seed mass before cleaning (kg)

4- Productivity (Pr) : machine productivity was calculated as following:

$$Pr = \frac{W_T}{t} \quad \text{(kg/h)}$$

Where; t is the required time per hour to accomplish the threshing operation.

5- Power and energy requirements

The fuel consumption was measured by a calibrated cup which installed especially to take a direct reads after each treatment. The required power was calculated from equation that used by Embabie (1985):-

$$P = \frac{Fc \times \rho_f \times L.C.V \times 427 \times \eta_m \times \eta_{th}}{3600 \times 75 \times 1.36}, \quad kW$$

P	= the required power, kW;
Fc	= consumed fuel, l/h;
ρ_f	= fuel density 0.72 kg/l for gasoline;
L.C.V	= lower calorific value of fuel, 10000 kcal/kg;
427	= thermo mechanical equivalent, kg.m/kcal;
η_m	= mechanical efficiency of Otto engine, 85%;
η_{th}	= thermal efficiency of engine, 25% for Otto engine.

The specific energy consumption (kWh/Mg) was calculated by dividing the required power (kW) by the threshing machine productivity (Mg/h).

6- Private cost

The private cost of threshing operation (L.E/h) was determined using the following equation, *Hunt, (1983),* and then divided by the productivity (Mg/h).

$$C = \frac{P}{H} \left[\frac{1}{y} + \frac{i}{2} + T + R \right] + [0.9\, W.S.F] + \frac{M}{144}, \quad L.\frac{E}{h},$$

Where: −

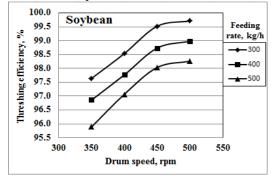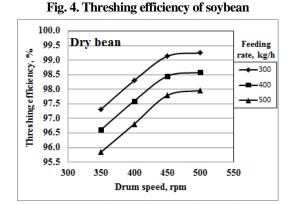|	
C	= private cost, L.E/h;
H	= yearly working hours, h/year;
i	= interest rate;
R	= repairs and maintenance ratio;
W	= engine power, hp;
F	= fuel price, L.E/l;
144	= is a reasonable estimate of monthly working hours.
P	= the estimated price of the threshing machine, L.E;
y	= life expectancy of the machine, year;
T	= taxes and overheads ratio;
0.9	= factor accounting for lubrications;
S	= specific fuel consumption, l/h.hp;
M	= monthly average wage, L.E;

7- Criterion cost

The criterion cost of each treatment includes the private cost of threshing operation (LE/Mg); plus the estimated price of the lost and damaged seeds (L.E/Mg).
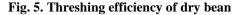
RESULTS AND DISCUSSION

Threshing efficiency

Figures (4) & (5) show the threshing efficiency for soybean and dry bean crops respectively under all drum speeds and feeding rates. As shown; the threshing efficiency was increased by increasing the drum speed at all feeding rates for the two crops.

Fig. 4. Threshing efficiency of soybean

Fig. 5. Threshing efficiency of dry bean

By increasing the drum speed from 350 to 500 rpm; the threshing efficiency increased from 97.64% to 99.71% and from 97.32 % to 99.25% with soybean and dry bean crops respectively at a feeding rate of 300 kg/h. This is due to increase the efficacy of the drum by increasing its rpm; thus reducing threshing losses.

In addition; the threshing efficiency was decreased by increasing the feeding rate at all drum speeds for the two crops,
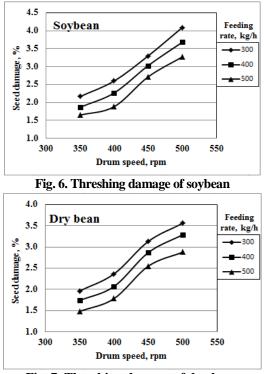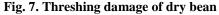
increasing the feeding rate from 300 to 500 kg/h decreased the threshing efficiency from 99.71% to 98.26% and from 99.25% to 97.96% with soybean and dry bean crops respectively at drum speed of 500 rpm. This is due to the excess plant materials in the threshing chamber; thus the plant materials protect each other from the beating by drum knives.

The highest values of threshing efficiency for soybean and dry bean were 99.71% and 99.25% respectively, which obtained at drum speed of 500 rpm and feeding rate of 300 kg/h, while the lowest values were 95.89 % and 95.85% respectively, and were obtained at drum speed of 350 rpm and feeding rate of 500 kg/h.

Threshing damage

As mentioned in figures (6) & (7) the seed damage for soybean and dry bean were increased by increasing the drum speed and decreased by increasing the feeding rate.

Increasing the drum speed from 350 to 500 rpm increased the threshing damage by 88.77%, 96.79% and 98.18% with soybean crop at feeding rates of 300, 400 and 500 kg/h respectively; and increased it by 81.02, 89.08 and 94.16% with dry bean; at the same feeding rates respectively. This is because the seeds take more hits at the higher speeds of the drum.

Fig. 6. Threshing damage of soybean

Fig. 7. Threshing damage of dry bean

The results indicated also that; increasing the feeding rate from 300 to 500 kg/h decreased the threshing damage of soybean crop by 23.85% and 20.05% at 350 and 500 rpm of drum speed respectively, and decreased the threshing damage of dry bean by 24.58% and 19.10% at the same rotational speeds respectively. This is because lower feeding rates mean exposing the seeds to more knife hits.

The highest seed damage values for soybean and dry bean were 4.09 % and 3.56% respectively, and were obtained at drum speed of 500 rpm and feeding rate of 300 kg/h, and the lowest values were 1.65 % and 1.48% respectively, which obtained at drum speed of 350 rpm and feeding rate of 500 kg/h.

Cleaning efficiency

The cleaning efficiency of the threshing machine for soybean and dry bean was shown in Fig. (8) and Fig. (9).

Increasing the rotating speed of the threshing drum means increasing the rotating speed of the chaff suction fan. The cleaning efficiency increased by increasing the drum speed under the two crops and all feeding rates as a result to increase the rotating speed of the suction fan.

Increasing the drum speed from 350 to 500 rpm led to increase the cleaning efficiency from 95.80% to 98.72% with soybean crop at feeding rate of 400 kg/h; and led to increase it from 95.60% to 98.61% with dry bean at the same feeding rate. On the contrary; increasing the feeding rate decreased the cleaning efficiency with the two crops at all drum speeds as a result to increase the load on the chaff suction fan; increasing the feeding rate from 300 to 500 kg/h decreased the cleaning efficiency from 99.11% to 98.14% with soybean at 500 rpm of drum speed, and decreased it from 98.93% to 98.05% with dry bean at the same drum speed.

The highest values of cleaning efficiency for soybean and dry bean were 99.11% and 98.93% respectively, and were obtained at drum speed of 500 rpm and feeding rate of 300 kg/h, while the lowest values were 95.27 % and 95.10%; respectively, which obtained at drum speed of 350 rpm and feeding rate of 500 kg/h.
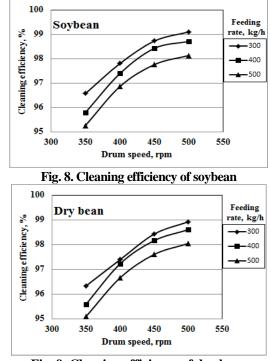

Fig. 8. Cleaning efficiency of soybean

Fig. 9. Cleaning efficiency of dry bean

Power requirement

The required power increased by increasing the drum speed for the two crops at all feeding rates as shown in Fig. (10) and Fig. (11). In case of soybean crop; the required power increased from 4.40, 5.04 and 5.67 kW to 5.95, 6.67 and 7.42 kW by increasing the drum speed from 350 to 500 rpm at feeding rates of 300, 400 and 500 kg/h respectively, and increased from 4.68, 5.42 and 5.95 kW to 6.20, 6.92 and 7.69 kW in case of dry bean by increasing the drum speed from 350 to 500 rpm at the mentioned feeding rates respectively. This is because the drum speed was increased by increasing the rate of fuel consumption.

Also; the mentioned figures showing that, increasing the feeding rate from 300 to 500 kg/h increased the required power too; as a result to increase the fuel consumption rate by increasing the feeding rate. The required power for threshing

soybean crop increased from 4.40, 4.93, 5.54 and 5.95 kW to 5.67, 6.34, 6.75 and 7.42 kW by increasing the feeding rate from 300 to 500 kg/h at 350, 400, 450 and 500 rpm of drum speeds respectively; and increased from 4.68, 5.29, 5.81 and 6.20 kW to 5.95, 6.64, 6.95 and 7.69 kW in case of dry bean under the same conditions.

The highest power values required for threshing soybean and dry bean were 7.42 and 7.69 kW respectively, and were obtained at drum speed of 500 rpm and feeding rate of 500 kg/h, while the lowest values were 4.40 and 4.68 kW and were obtained at drum speed of 350 rpm and feeding rate of 300 kg/h.

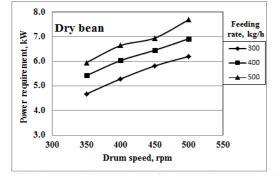**Fig. 10. The required power for threshing operation of soybean**

Fig. 11. The required power for threshing operation of dry bean

Specific energy Consumption

Figures (12) & (13) show the specific consumed energy (kWh/Mg) for the two crops under the different drum speeds and feeding rates. As shown; increasing drum speed increased the consumed energy for the two crops at all feeding rates as a result to increase the required power.
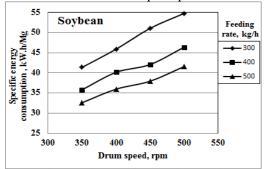

Fig. 12. The consumed energy during threshing operation of soybean

The specific consumed energy increased from 41.36, 35.79 and 32.58 kWh/Mg to 54.76, 46.38 and 41.56 kWh/Mg by increasing the drum speed from 350 to 500 rpm during threshing soybean at feeding rates of 300, 400 and 500 kg/h respectively, also it increased from 39.92, 34.98 and 30.94 kWh/Mg to 51.89, 43.73 and 39.15 kWh/Mg during threshing dry bean at the same feeding rates respectively.
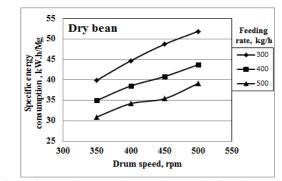

Fig. 13. The consumed energy during threshing operation of dry bean

The obtained results indicated also that the specific consumed energy decreased by increasing the feeding rate as a result to increase the productivity of the threshing machine with increase the feeding rate. With soybean; the consumed energy decreased from 41.36, 45.88, 51.04 and 54.76 kWh/Mg to 32.58, 35.95, 37.93 and 41.56 kWh/Mg under drum speeds of 350, 400, 450 and 500 rpm respectively, while; it decreased from 39.92, 44.67, 48.70 and 51.89 kWh/Mg to 30.94, 34.20, 35.41 and 39.15 kWh/Mg with dry bean under the same drum speeds respectively.

The highest energy consumption for soybean and dry bean threshing operations was 54.76 and 51.89 kWh/Mg respectively, and was obtained at drum speed of 500 rpm and feeding rate of 300 kg/h, while the lowest consumption was 32.58 and 30.94 kWh/Mg; respectively and was obtained at drum speed of 350 rpm and feeding rate of 500 kg/h.

Private costs

The private costs include the fixed and operating costs of the threshing machine; as shown in Table (3); the private costs of threshing soybean ranged between 524.7 - 846.5 L.E/Mg; and ranged between 478.3 - 774.4 L.E/Mg with threshing dry bean. The results indicated a considerable decrease in the private costs (L.E/Mg) with an increase in the feeding rate as a result of increasing the productivity (Mg/h). The private costs of threshing soybean and dry bean decreased from 846.5 and 774.4 L.E/Mg to 533.5 and 487.5 L.E/Mg respectively by increasing the feeding rate from 300 to 500 kg/h at drum speed of 500 rpm. Also; the mentioned Table shows a relatively small increase in the private costs as the drum speed increased under all feeding rates of the two crops; this is due to increase the operating cost.

Table 3. The private costs (L.E/Mg) of the threshing operation

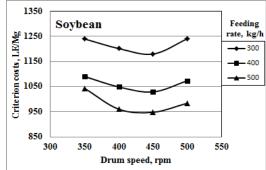|		Soybean				Dry bean			
		Drum speeds, rpm				Drum speeds, rpm			
		350	400	450	500	350	400	450	500
Feeding rates, kg/h	300	832.5	835.7	839.7	846.5	761.3	765.0	768.2	774.4
	400	639.3	643.7	642.4	650.6	585.7	588.3	589.0	594.8
	500	524.7	526.6	526.5	533.5	478.3	481.4	480.0	487.5

Criterion costs

To determine the criterion costs; the estimated price of the lost and damaged seeds was added to the private costs of each treatment. Figures (14) and (15) show the criterion costs of the threshing operation of soybean and dry bean respectively under all drum speeds and feeding rates.
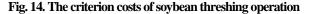
At all feeding rates of the two crops, the lowest values of the criterion costs obtained at 450 rpm of the drum speed; due to the totality estimated price of the lost and damaged seeds. Also; the criterion costs decreased by increasing the feeding rates; due to increase the productivity of the threshing machine.

The lowest values of the criterion costs were 948 L.E/Mg and 908.4 L.E/Mg with soybean and dry bean

respectively; which obtained at 450 rpm and 500 kg/h of drum speed and feeding rate respectively, while; the highest values were 1240.7 L.E/Mg and 1162.3 L.E/Mg respectively; and were obtained at 500 rpm and 300 kg/h of drum speed and feeding rate respectively.
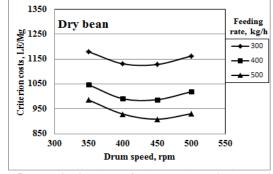

Fig. 14. The criterion costs of soybean threshing operation

Fig. 15. The criterion costs of dry bean threshing operation

CONCLUSION

The obtained results clarified that, the drum speed of 450 rpm (12.01 m/s) and the feeding rate of 500 kg/h were the optimum for threshing soybean and dry bean crops by the manufactured threshing machine, as the lowest criterion costs of 948 L.E/Mg and 908.4 L.E/Mg were attained for soybean and dry bean respectively. In addition, the threshing efficiency of 98.03% and 97.79%, cleaning efficiency of 97.77% and 97.61%, seed damage of 2.72% and 2.55% and specific energy consumption of 37.93 and 35.41 kWh/Mg; were identified for soybean and dry bean crops respectively.

REFERENCES

Abd El Mowla, M.A.; M.H. Dahab; F.A. El Mahie and F.E. Abdallah (2014). Improvement and performance evaluation of stationary combine thresher. International Journal of Engineering & Scientific Research. 2(11): 40-51.

Adekanye, T.A.; A.B. Osakpamwan and I.E. Osaivbie (2016). Evaluation of a soybean threshing machine for small scale farmers. Agricultural Engineering International: CIGR Journal, 18(2): 426-434.

Al-Shamiry, F.M.S. and N.M.A. Yahya (2020). The performance evaluating of thresher machine attached to the tractor. IJRDO - Journal of Agriculture and Research. ISSN: 2455-7668. 6(3): 7-16

Central Agency for Public Mobilization and Statistics (2016). Annual bulletin of mechanical farm machinery; 2015. Nov. 2016, Ref. No - 72-22129 - 2015.

Embabie, A.T. (1985). A comparison of different mechanization systems for cereal crop production. Unpub. M.Sc. Thesis. Agr. Eng. Dept.; Fac. of Agr., Cairo Univ., Egypt.

Hunt, D. (1983). Farm power and machinery management. 8th Edition, Iowa state Univ., Ames, U.S.A.

Gomaa, S.M.; R.R. Abu-Shieshaa; F.I. Hindy and M.A. Hassan (2009). A study on harvesting mechanization of soybean crop. J. Agric. Sci. Mansoura Univ., 34 (3): 2381 – 2395.

Muna, N.H.; U.S. Muhammed; A.M. El-Okene and M. Isiaka (2016). Perfomance evaluation of a modified I.A.R. multicrop thresher. International Journal of Scientific & Engineering Research. ISSN 2229-5518. 7(11):1107-1116

Pandey, A. and R.M. Stevens (2016). Performance evaluation of high capacity multi crop thresher on 'gram' crop. International Journal of Agricultural Engineering, 9(1): 94-101.

Radwan, G.G; R.G. Salim and A.S. Al-Ashry (2009). Development and test attachments to the tangential flow thresher to suit caraway crop threshing. Misr J. Ag. Eng., 26(3): 1068 - 1080

Sessiz, A.; Y. Pinar and T. Koyuncu (2007). Soybean threshing efficiency and power consumption for different concave materials, Agricultural Mechanization In Asia, Africa, And Latin America Vol.38 No.3..

Srivastava, N.S.L. (2004). Farm power source, their availability and future requirement to sustain agricultural production. IARI, New Delhi. India, p: 36-44.

Vejasit, A. and V. M. Salokhe (2004). Studies on machine-crop parameters of an axial flow thresher for threshing soybean. Agriculture Engineering International: the GIGR Journal of Scientific Research and Development. Manuscript PM 04 004.

Zaalouk, A.K. (2009). Evaluation of local machine performance for threshing bean. Misr J. Agric. Eng., 26(4): 1696 – 1709

Zarini, R.L., A. Akram, R. Alimardani and R. Tabatabaekoloor (2013). Development of decision support system of matching tractor implement system used on Iranian farms. Americ. J. Eng. Res., 2(7): 86-98.

تصنيع وتطوير آلة دراس صغيرة

وليد البنداري السعيد الفخراني* و محمد عبدالجواد أحمد أبو عجيلة

معهد بحوث الهندسة الزراعية – الدقي - الجيزة

في هذه الدراسة تم تصنيع آلة دراس صغيرة وضبطها بما يناسب دراس محصولي فول الصويا والفاصوليا. وتم تصنيع الآلة بمصنع طنطا موتورز (إيماجرو) بمحافظة الغربية؛ بينما تم إختبارها وتقييم أدائها في محطة البحوث الزراعية بإيتاي البارود بمحافظة البحيرة، وتم تجهيز الآلة لتعمل ذاتياً عن طريق محرك احتراق داخلي (13 حصان). لتقييم أداء آلة الدراس المصنعة تم إجراء تجربتين منفصلتين في عام 2020 لدراس محصولي فول الصويا صنف (جيزة 111) والفاصوليا صنف (نبراسكا) عند أربع سرعات لدرفيل الدراس 350 و400 و450 و500 لفة/دقيقة (9,34، 10,67، 12,01، 13,34 م/ث) وكذلك ثلاث مستويات لمعدل التغذية 300 و400 و500 كجم/ساعة. وأظهرت النتائج المتحصل عليها أن سرعة درفيل الدراس 450 لفة/دقيقة (12,01 م/ث) ومعدل التغذية 500 كجم/س هي الظروف المثلى التي تناسب دراس كلا المحصولين باستخدام آلة الدراس المصنعة حيث كانت أقل قيم للتكاليف الكلية مضافاً إليها قيمة البذور المفقودة والتالفة هي 948 و908,4 جنيه/طن لكل من فول الصويا والفاصوليا على الترتيب. في حين كانت كفاءة الدراس 98,03% و 97,79% ونسبة البذور التالفة 2,72% و 2,55% وكفاءة التنظيف 97,77% و 97,61% والطاقة النوعية المستهلكة 37,93 و 35,41 كيلو وات ساعة/طن لكلا المحصولين على الترتيب.