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A NEWLY MANUFACTURED MACHINE FOR DESEEDING OF FLAX CROP

M.A.Abouegela[1], El-Said M Khalifa [2], G. H. El-Sayed[3] and M.A. Eltawil[4]

ABSTRACT

Flax (Linum usitatissimum L) considered the most important oil and fiber crop in the world. The flax threshing still carried out manually or trampling by tractor wheel. The aim of this investigation was to manufacture a newly machine from local materials for deseeding of flax crop. The main idea is to deseed flax capsules by rubbing and squeezing mechanisms between two movable flat belts (40 cm width each). The two belts kept in contact with each other by using pair compression and concentric helical springs fitted to cylindrical rollers with the same width of belts. The machine was operated by PTO of tractor through pulleys with different diameters and belts. The experimental work was carried out at Etay Elbaroud Agricultural Research station, Behera Governorate. Performance of the machine was tested under three driving speeds of 200, 300 and 400 rpm (1.047, 1.57 and 2.094 m/s), three speed ratios between the two movable deseeding flat belts of 1:1, 1:1.5 and 1:2, three feeding rates of 10, 15 and 20 kg/min at constant moisture content of about 12.5% for capsules and 15% for stalks. The observed results indicated that, the optimum performance of the machine for deseeding (stripping and threshing) flax capsules was achieved at driving speed of 300 rpm and feeding rate of 20 kg/min when speed ratio between belts was 1:2. The highest stripping efficiency, threshing efficiency and stalks losses were 99.05, 98.1 and 0.75%, respectively at the mentioned conditions.

***Keywords**: Flax, deseeding, efficiency, stripping, threshing, stalks losses.*

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INTRODUCTION

Flax (Linum usitatissimum L) is known in Egypt as a dual purpose flied crop and it is grown for both seeds and fiber production. In Egypt, the flax and cotton are considered the most important fiber crops. They play an important role in the national economy. The flax crop cultivated area in Egypt is limited and is about 16345 fed (Agricultural Statistics, 2005). Different methods and equipment are used in harvesting and threshing of flax crop. Any technique must function so that the percentage of capsules stripping from the stalks is maximized with minimum damage of seed and stalks. Reviewing the techniques for production of flax in Egypt indicated that harvesting, threshing, separation and getting seeds and stalks are not economical. In Egypt there are three method used for flax threshing. Conventional system (manual threshing) by beating the capsules over the stone and winnowing by manually operated stationary-cleaning machine. Partial mechanized system involving mechanical threshing using a tractor treading (trampling by tractor wheels) followed by winnowing using power operated stationary cleaning machine. Complete mechanized system involving mechanical threshing and winnowing using a combined machine. Abd El-Maksoud (1975) indicated that the primitive method of flax threshing performed by knocking the plants on hard subject is still carried out by the majority of flax producers. A very limited of large mechanical flax combines are used in the public sector farms, but these are expensive equipment, that need high technical operation and maintenance. Huynh et al. (1982) stated that the seed separation from the stalks and passage of seed through the concave grate is a function of some variables such as crop feed rate, threshing speed, concave length, cylinder diameter and concave clearance. These variables also related to the threshing losses and seed separation efficiency. Klenin et al (1985) indicated that the flax seed are removed from their pods by crushing and grinding them between three husking rolls of different diameter, rotating in opposite. Springs keep the smaller pressed against the larger roll. The pods delivered from the hopper to the gap between the rollers and during their rotation it sequel the pods, flatten them and strip their shell. Surface speeds of the two rollers are different, where the smaller and larger rollers have a speed of 2 to 2.5 and 3.0 to 3.5 m/s, respectively. Ibrahim and Abd El–Mageed (1989) evaluated three different machines for threshing the flax to select the best to produce seed and fiber. A stationary threshing machine (ML 2.8 PA), flax harvester (LKB4A) for harvesting flax in the period of early yellow or yellow ripeness stage and a Japanese rice harvester (Yanamer). They found that using the Yanamer harvester at 400 rpm, the drum speed gave a stripping efficiency of about 100%, the threshing efficiency of about 92.2%, while stalks losses reached 3.3%. Szarszunow et al (1998) concluded that ineffective threshing and threshing damage are the main causes of flax seed losses. Experiments were carried out to reduce the losses and damage of flax seeds by improving the precision of their separation during threshing. Badawy (2002) developed a feeding system for threshing of flax. The main parts of the feeding system consisted of two conveyors flat belt of 15 cm width, 125 cm length and 2 cm thickness and feeding pulleys. The ratio of feeding system to drum speed was approximately 1:8– 1:9 to give the stems enough periods for beating. The feeding operation was performed by putting the stalks on the feed system by the worker while the other worker was passing only the head parts of stalks through the conveyor belt in the deseeding chamber. The clearance between the upper and the lower flat belts was about 20– 40 mm. The head parts of stalks were fixed with feeding system, so that the rotation speed to the deseeding drum was almost constant, therefore the deseeding operation was stable. El-Ashary et al. (2003) investigated the effect of flax threshing systems partial mechanized, complete mechanized and conventional at seed moisture content 18.15, 16.85, 14.32 and 12.05% on yield component quality, threshing capacity, energy requirements and criterion cost. The results cleared that the unthreshed seed losses decreased by decreasing seed moisture content the lower values were obtained at seed moisture content of 12.05% to be 6.62, 8.35 and 1.05 % for complete, partial mechanized and conventional system respectively. The maximum criterion costs were at complete mechanized system because of increasing stalk losses and damage. They recommended the need to design a deseeder to suit flax crop accomplished by rubbing to obtain low levels of flax stalks damage.

Due to inadequate threshing machine for flax, there are a sever losses of stalks (fibers) and seeds. Therefore, the present work has been planned with the following specific objectives:

1- To locally manufacturing a new prototype deseeding machine working with the impact of rubbing and squeezing principles.
2- To evaluate the performance of a newly fabricated deseeding machine under different operating conditions.
3- To estimate the economic utility of the new deseeding machine.

MATERIALS AND METHODS

1 Experimental Site:

The experiments were carried out in the premises of Etay Elbaroud Agricultural Research Station, Behera Governorate during agriculture season 2006.

2 Manufacturing of a new prototype deseeding machine:

The new prototype deseeding machine was fabricated locally at Private Workshop in Chenow Village, Kafrelsheikh Governorate. The main idea is to deseed flax capsules by crushing mechanism (rubbing and squeezing capsules) between two flat belts moving with relatively speed.

3 Machine description:

The general specifications of the new fabricated deseeding machine is presented in Table 1 and sketched in Figs. 1 and 2.

Table1. General specifications of the new deseeding machine.

Item	Value or specification
Main dimensions	
Overall length, cm	120
Overall width, cm	105
Overall height, cm	140
Overall mass, kg	150
Feeding system	Table
Deseeding (stripping and threshing) unit type	Two movable flat belts working with rubbing (friction) and squeezing principles
Power source	Tractor (PTO)
Labor requirement, men	3

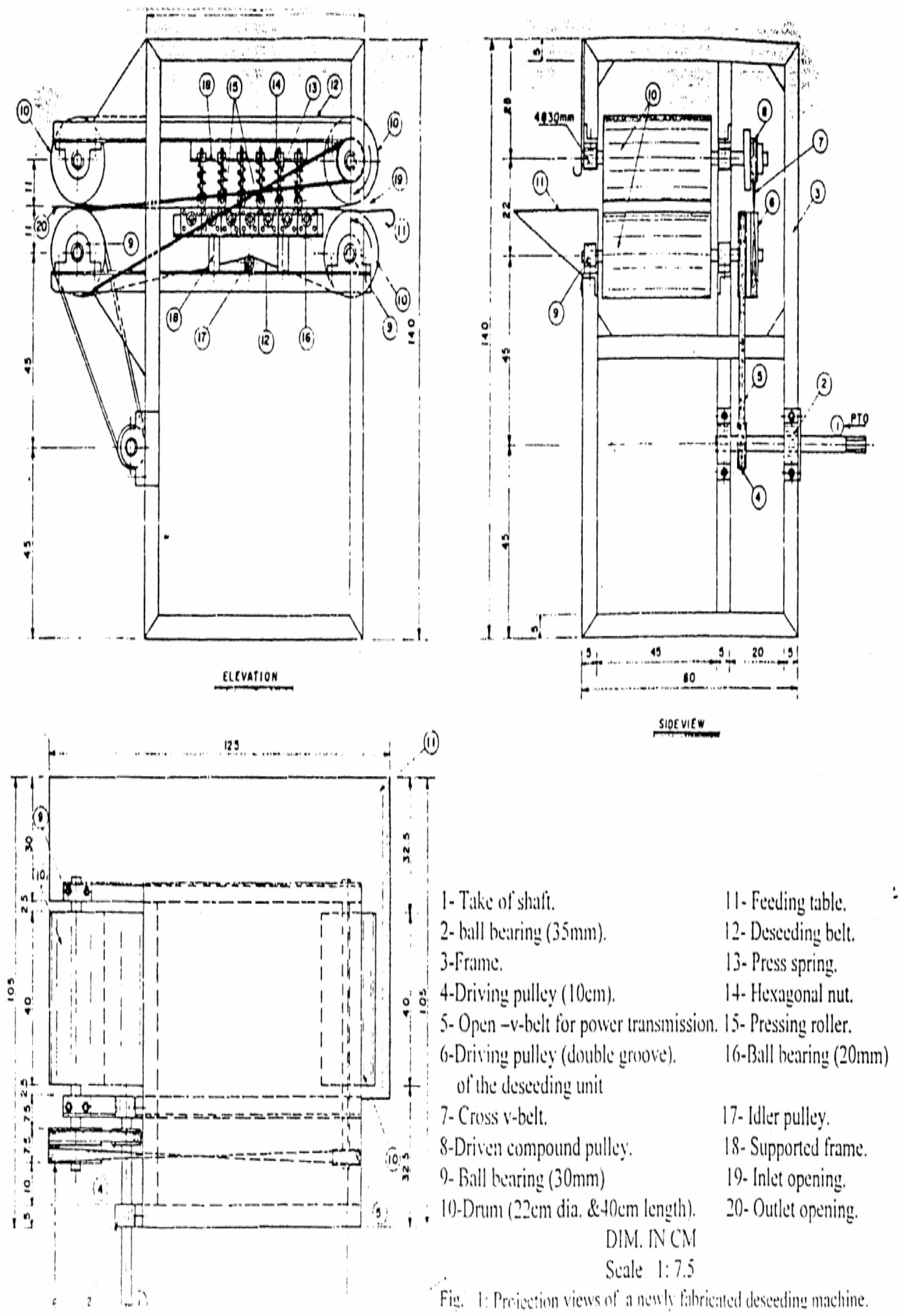


Fig. 1: Projection views of a newly fabricated deseeding machine.

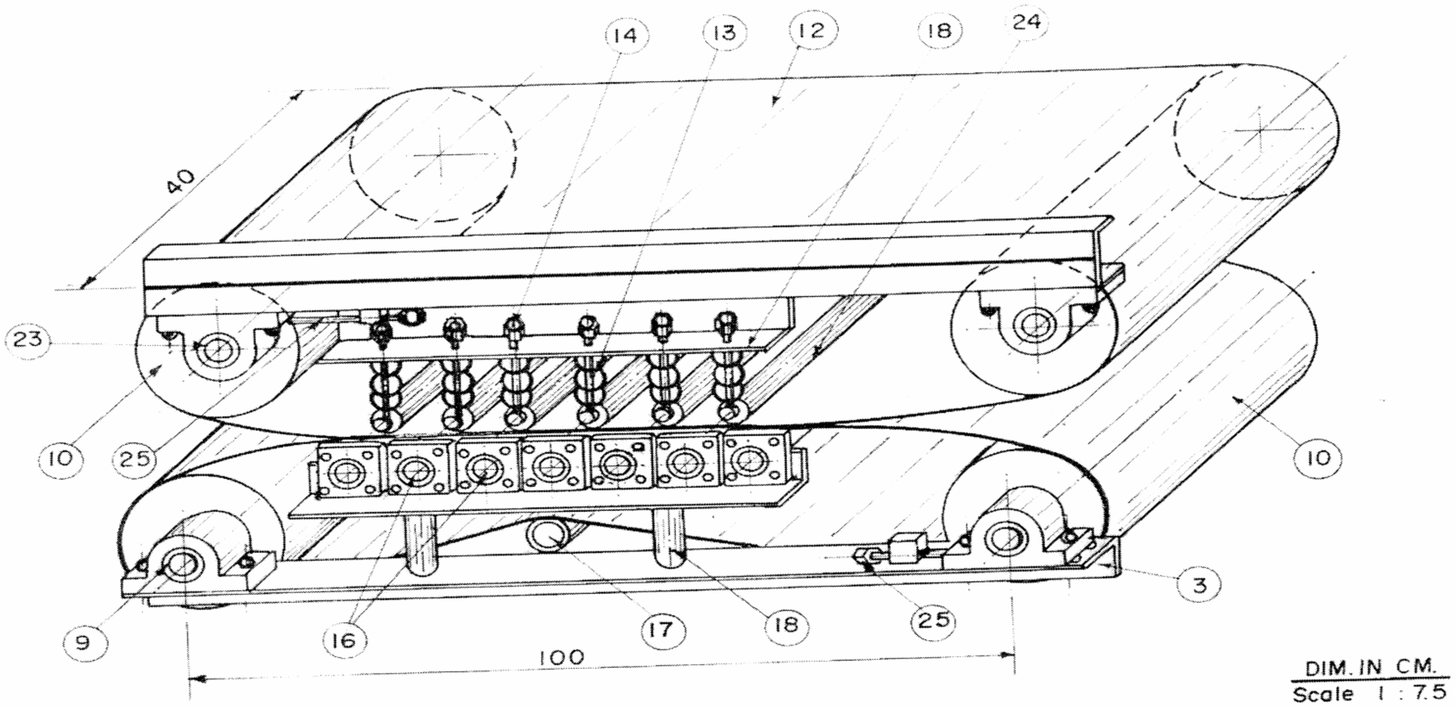


Fig. 2 New deseeding unit diagram (stripping and threshing) unit.

3- Frame. 13- Concentric spring. 18- Supported frame.
9- Ball bearing (30 mm) 14- Hexagonal nut. 23- Drum shaft.
10- Drum φ (22 cm) 16- Ball bearing φ (20 mm). 24- Roller φ 5 cm.
12- deseeding belt (40 cm width). 17- Idler pulley. 25- Tension bolt.

3.1 Power source:

The new fabricated machine was operated by Nasr tractor model DM34 and their technical specifications are presented in Table 2.

Table 2: The technical specifications of Nasr tractor.

Items	Specification
Type	Nasr DM34
Made	Egypt
Type of drive	2 W.D.
Engine	Diesel
Fuel	Diesel fuel
Number of cylinder	4
Engine power at rpm (k W)	65 hp at 2300 (48.75 kW)
Cooling system	Water

3.1.1 Power transmission system

The power is transmitted from the tractor PTO to the machine through universal coupling shaft as shown in Figs. 1 and 2. It was transmitted from the take of shaft to the shaft fixed on the machine frame by ball bearing (2) of 35 mm in diameter. The machine shaft has a driver pulley (4) of 10 cm in diameter which transmit the rotary motion to the driven pulley (20cm in diameter) of lower rubbing flat belt (10) through an open v-belt type (5). Thereafter, the power transmitted to the upper rubbing flat belt of the deseeding unit with different speed ratios through a cross– v–belt (7).

3.2 Feeding unit:

The main parts of the feeding unit are a feeding tray (11), which kept parallel to deseeding (stripping and threshing) unit in order to prevent the flax stalks damage and keep the high quality of flax fibers through the deseeding operation. The feeding operation was performed by the worker. The crop lays on feeding tray with its capsules towards the deseeding unit while anther worker was passing only head parts (capsules) of the stalks through deseeding unit (12) and the stalks moves behind the machine to the right side.

3.3 Deseeding unit

The deseeding unit consists of two rubbing flat belts (12) of 40 cm width rotating in opposite directions as shown in Fig. 1. Each of the upper and lower belts is mounting on two frictional drums (10). Each drum has 22 cm diameter, 40 cm length and supported with ball bearing (9) of 30 mm diameter. The central distances between the two drums of the upper and lower deseeding belts were 100 cm. To maintain the squeezing and rubbing forces between these deseeding belts the lower side of the upper belt (tight side) was pressed by six rotating rollers (15). Each roller of 5 cm diameter and 40 cm length was pressed by pair of concentric helical springs and the compression force can be adjusted by hexagonal nuts (14) which fixed on the supported frame (18). Meanwhile the upper side of the lower deseeding belt was supported by seven rotating rollers. Each roller hold by pair ball bearings (16) of 20 mm diameter and theses bearings were fixed on the supported frame (18). To maintain the tension force in the deseeding belt, an idler pulley (17) was used. The active distance between deseeding belts for deseeding (threshing) process is 55 cm. The flax feeding gap (input) is 10 cm while the discharge (outlet) gap is 5 cm. The motion of the two deseeding belts can be performed by 1:1, 1:1.5 and 1:2 speed ratios. These conditions can be obtained by fitting the suitable diameter of driven pulley. Flax stalks heads (Capsules) were passed between the two deseeding belts to perform the threshing of capsules.

3.4 Frame of the machine:

The frame (3) was constructed from steel angles welded together and metal sheets riveted to the steel angle to form the machine.

4 Flax crop:

Flax crop variety of Sakha 3 was used in this experimentation and its average physical properties and characteristics are presented in Table 3.

5 Performance evaluation of the new deseeding machine:

Performance of the machine was tested under the following variables:

i) Three driving speeds of 200, 300 and 400 rpm, (1.047, 1.57 and 2.094 m/s).

ii) Three speed ratios between the deseeding flat belts of 1:1, 1:1.5 and 1:2.

iii) Three feeding rates of 10, 15 and 20 kg/min.

Table 3: Physical properties and characteristics of flax crop variety of Sakha 3.

Physical	Mean value
Av . plant height, cm	114
Av . technical length, cm	98.9
Av. length of flowering zone, cm	15.1
Av. stalk diameter, mm	1.45
Av . number of capsules per plant	9
Av . number of seed per plant	70
Av . weight of 1000 seed, g	5.109
Av. seed yield per plant, g	0.355
Av. seed yield, kg/ fed.	330
Av. straw yield, ton/ fed.	3, 275

At constant moisture content of about 12.5% for capsules and 15% for stalks.

The performance was evaluated in terms of:

1- Unstripped capsules losses,
2- Unthreshed seed losses,
3- Stalks losses,
4- Stripping efficiency,
5- Threshing efficiency,
6- Energy requirement and
7- Costs evaluation of the machine.

6 Experimental procedures:

Preparing of flax for experiments: The flax crop was harvested manually by hand pulling then left for natural drying for about seven days in small piles. Later the crop gathered into large heaps in the threshing yard. Before any tests flax crop was sun- dried for a few hours to extract the moisture that the crop was picked up during the night. Before deseeding (threshing) operation, the capsules/plant and seeds/capsule ratios were calculated. The capsules and stalks moisture content levels were determined by oven drying method. After threshing the unthreshed capsules were removed manually.

$$Unstripped\ capsule\ losses = \frac{Weight\ of\ unstripped\ seed}{Total\ weight\ of\ capsules\ on\ stalks} x\, 100 \quad \text{.........} (1)$$

$$Unthreshed\ seed\ losses = \frac{Weight\ of\ unthreshed\ seed}{Weight\ of\ total\ seed} x\, 100 \quad \text{.....}(2)$$

$$Stalks\ losses = \frac{Weight\ of\ split\ portion\ of\ stalks\ during\ deseeding}{Total\ weight\ of\ stalks\ rather\ than\ capsules} x\,100 \text{ .... (3)}$$

$$Stripping\ efficiency = \frac{Weight\ of\ the\ stripped\ seed}{Total\ weight\ of\ capsules\ on\ the\ stalks} x\,100 \text{ .... (4)}$$

Threshing efficiency = 100 – unthreshed seed losses .... (5)

The power consumed by the tractor was calculated using the measured fuel during deseeding operation under different variables of the study according to Embaby (1985):

P_{req}= (F_c /3600) x F_f x L.C.V. x 427 x η_{th} x η_m x (1/75) x (1/1.36) ……(6)

Where: P_{req} = power requirement, kW,

F_c = fuel consumption, l/h

F_f = density of fuel, for solar fuel = 0.85 kg / l,

L.C.V. = lower calorific value of fuel, 10000 kcal /k g,

427 = thermo–mechanical equivalent, kg. m / kcal,

η_{th} = thermal efficiency of the engine, 35% and

η_m = the mechanical efficiency of engine, 80%.

Estimation of the consumed energy for operating the deseeding machine was carried out using the following equation:

$$\text{Energy consumption} = \frac{Power\ requirement\ (kW)}{Deseeding\ capacity\ (ton/h)},\quad kW.h/ton \text{ ..... (7)}$$

7 Cost analysis of the deseeding machine

The annual capital recovery cost of the fabricated machine and deseeding operation, can be computed as a product of the capital cost, C_o, and the capital recovery factor, CRF. If the annual operation and maintenance cost of a deseeding machine can be expressed as a fraction, *m*, of the total capital cost, and the cost of insurance and taxes, etc. expressed as a fraction, *t*, of the total capital cost, the levelized annual cost of the deseeding system can be expressed as:

$$C_{annual} = C_o\left[\frac{d\,(1+d)^n}{(1+d)^n - 1} + m + t\right] \text{ .... (8)}$$

The capital recovery factor for fuel, CRF_f, can be calculated with the following formula (ASHRAE, 1999):

$$CRF_f = \frac{(d - i_f)/(1 + i_f)}{1 - \left[1 + \frac{(d - i_f)}{(1 + i_f)}\right]^{-n}} \qquad \text{.. (9)}$$

Where:

C_o = capital cost,, L.E, n = expected useful life,

d = discount rate or attractive rate of return, 10%,

i_f = fuel inflation rate, 5.5%,

m = annual operation and maintenance cost as a fraction of the total capital cost and

t = the cost of insurance and taxes as a fraction of the total capital cost.

$$\text{Operating cost} = \frac{Machine\ capital\ cost\ (L.E/h)}{Deseeding\ capacity\ (ton/h)}, \quad L.E/ton \text{..........(10)}$$

The criterion cost can be estimated by using the following equation (Awady,1982)

Criterion cost (L.E/ton) = O.C. + Se.L.C.+ St.L.C. ……………..…(11)

Where :-

O.C. = Operating cost (L.E/ton)

Se.L.C. = Seed losses cost (L.E/ton)

St.L.C. = Straw losses cost (L.E/ton)

The experiments were arranged in factorial design with three replicates by using COSTAT software. The analysis of variance was done to investigate the significance of the studied variables as well as the best fit multiple linear regression equations were developed for each variable.

RESULTS AND DISCUSSION

1 Effect of different variables on unstripped capsules

Figure 3 shows the effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on unstripped capsules losses. It was found that the unstripped capsule losses decreased by increasing the driving pulley speed up to 300 r.p.m and thereafter increased by increasing driving speed up to 400 r.p.m for different feeding rates and different speed ratios of deseeding belts. This may by attributed to that increasing driving pulley speed more than 300 r.p.m, increased the gap

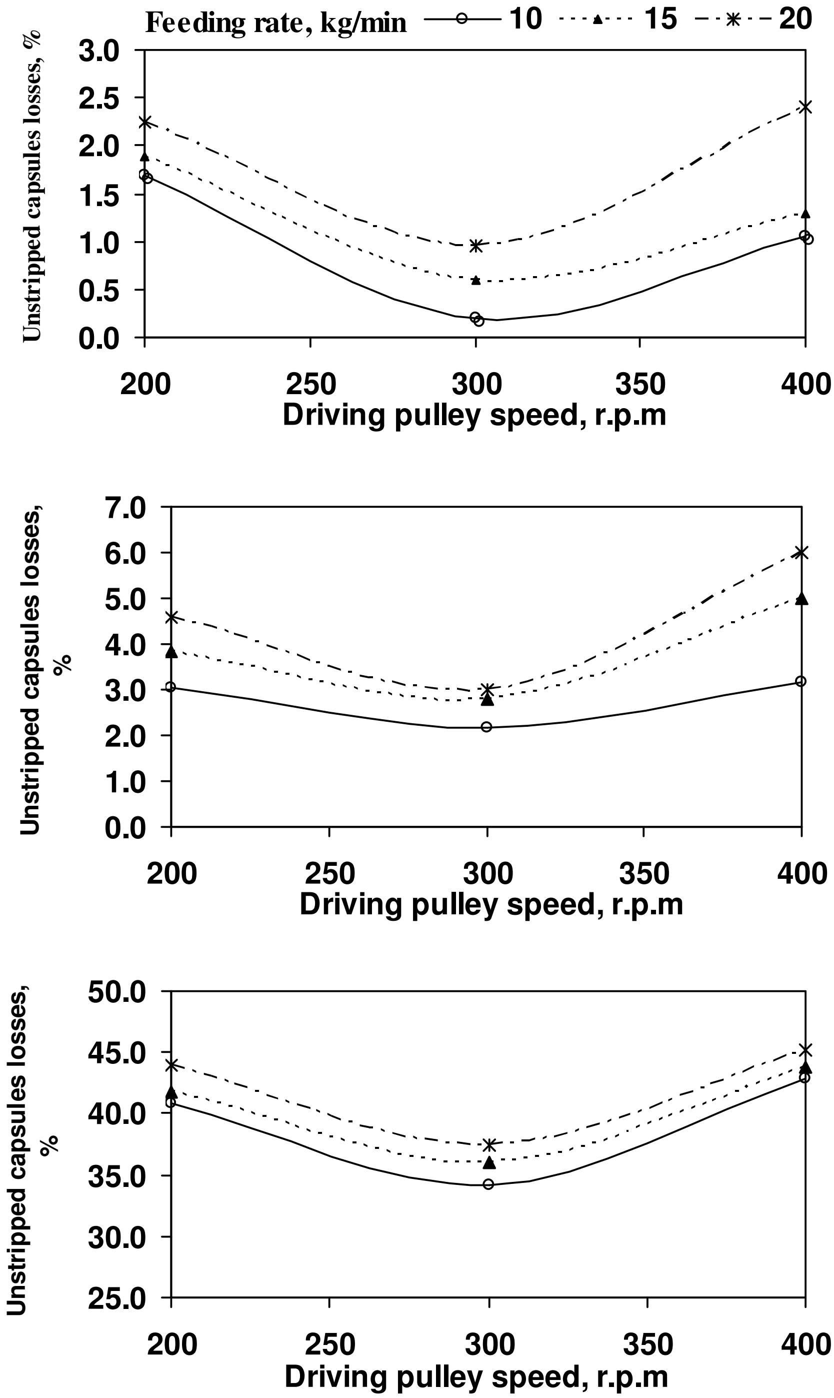


Fig. 3: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on unstripped capsules losses.

between deseeding belts due to decrease of springs pressure. The observed results of unstripped capsules losses is in agreement with Khatab (1998) and Badawy (2002) for driving pulley speed ranged from 200 to 300 r.p.m, while disagreed at the higher speed ranged from 300 to 400 r.p.m. The effect of feeding rate on the unstripped capsules losses is shown in Fig. 3. Observed results indicated that, the unstripped capsules loss increased by increasing feeding rate for different driving pulley speeds and different speed ratios of deseeding belts. Increasing the unstripped capsules loss with the increase of feeding rates may be attributed to increase the thickness (bulking) of flax crop hence minimizing the chance of deseeding belts to crush the capsules from the stalks. This result is in agreement with Badawy (2002). Observed results indicated that, the unstripped capsules loss decreased with increase of speed ratio between deseeding belts from 1:1 to 1:2 at different driving pulley speeds and different feeding rates. The recorded results revealed that at 300 r.p.m driving speed, increasing speed ratios between deseeding belts from 1:1 to 1:2, the unstripped capsules loss decreased from 35.99 to 0.6 % for feeding rate 15 kg/min. The maximum and minimum values of unstripped capsules loss were recorded with 1:1 and 1:2 speed ratios between deseeding belts for all feeding rates and driving pulley speeds. This may be attributed to more friction and crushing for capsules at higher speed ratio and vice versa at lower speed ratio of deseeding belts. These results are in agreement with Allen (1998). The maximum values of unstripped capsules losses of 42.89, 43.79 and 45.2 % were recorded at 1:1 speed ratio of deseeding belts and 400 r.p.m driving pulley speed for 10, 15 and 20 kg/min feeding rate, respectively. While minimum values of 0.19, 0.60 and 0.95 % were recorded at 1:2 speed ratio of deseeding belts, 300 r.p.m driving pulley speed and 10, 15 and 20 kg/min, respectively. In general, the driving pulley speed has the most important effect on the unstripped capsule losses.

2 Effect of different variables on unthreshed seed losses:

Figure 4 shows the effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on unstripped capsules losses. The maximum values of unthreshed seed losses of 37.2, 36.7 and 32.79 % were recorded at 1 speed ratio of deseeding belts and 400 r.p.m driving pulley speed for 20, 15 and 10 kg/min feeding rate, respectively.

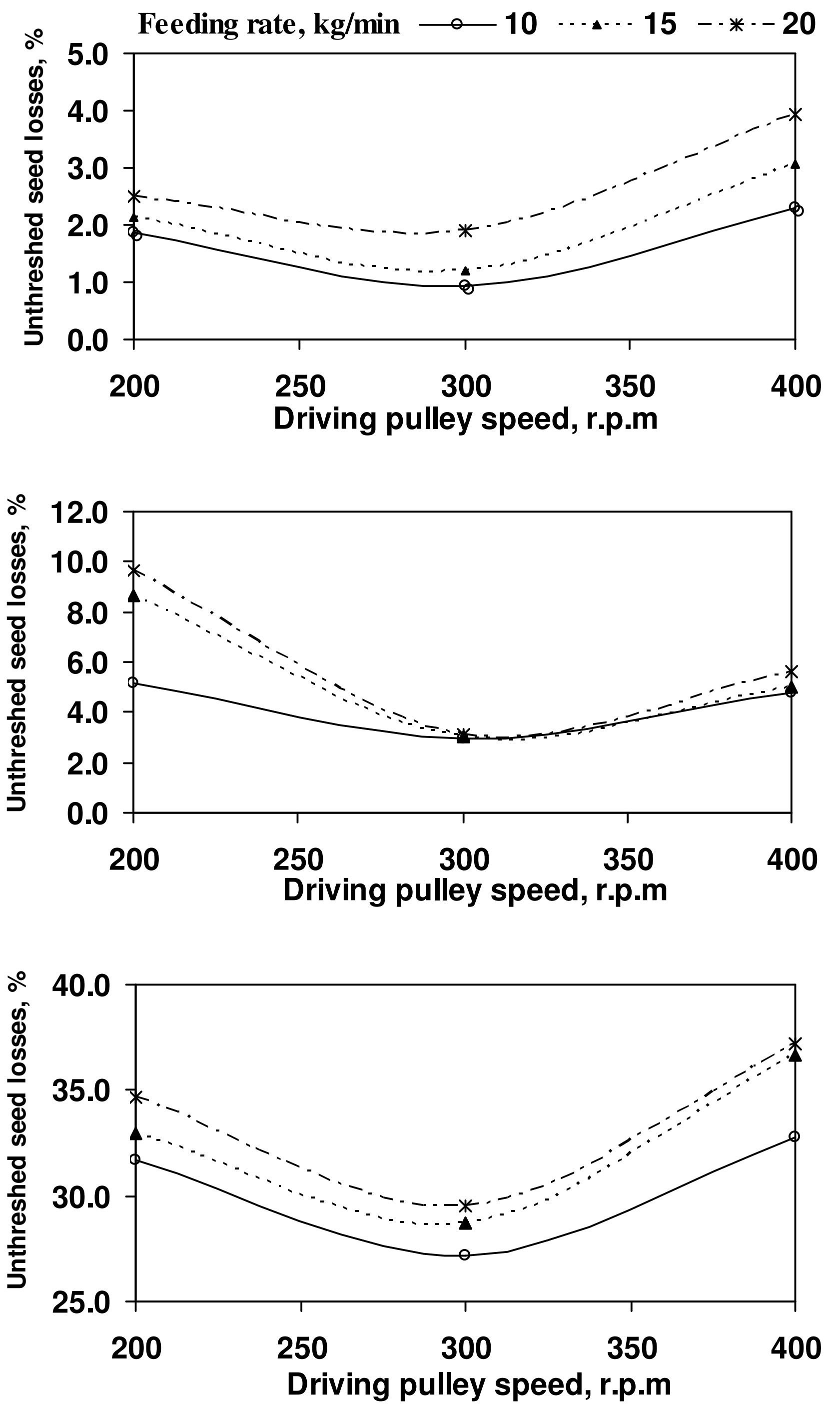


Fig. 4: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on unthreshed seed losses.

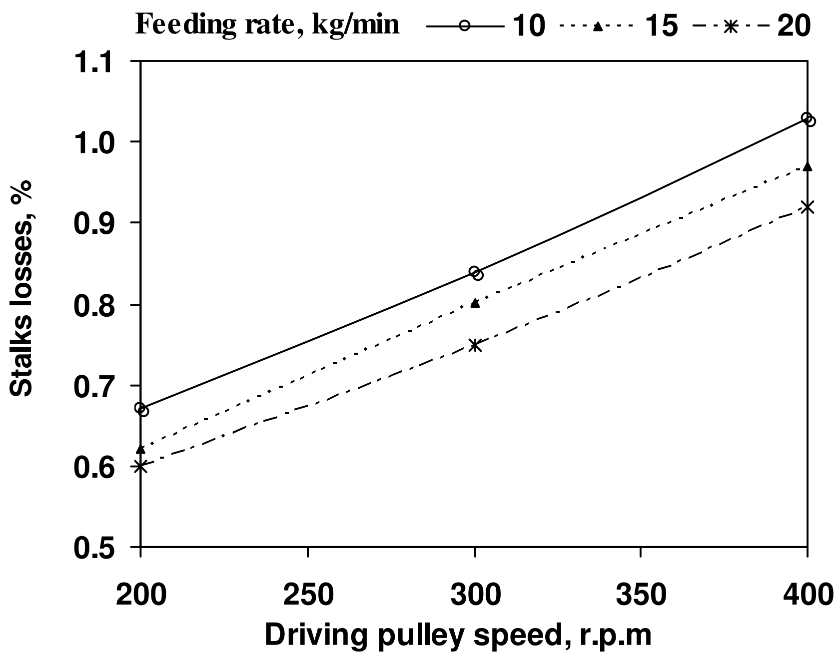
While minimum values of 0.946, 1.19 and 1.9 % were recorded at 1:2 speed ratio of deseeding belts, 300 r.p.m driving pulley speed and 10, 15 and 20 kg/min feeding rate, respectively. In general, the feeding rate has the most important effect on the unthreshed seed losses.

3 Effect of different variables on stalks losses:

Figure 5 shows that, the effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on stalks losses. It was found that, stalks losses increased by increasing driving pulley speeds from 200 to 400 r.p.m at all feeding rates and speed ratios between deseeding belts. This may be attributed to high and more crushing force applied to the stalks by increasing the driving pulley speed. Stalks losses decreased by increasing feeding rate from 10 to 20 kg/min for all driving pulley speeds and at 1:1 and 1:2 speed ratios between deseeding belts. Stalks losses increased from zero to 0.75 by increasing speed ratios between deseeding belts from 1:1 to 1:2 at feeding rate of 20 kg/min and driving pulley speed of 300 r.p.m. This may be attributed to more friction and crushing for stalks at higher speed ratio and vice versa at lower speed ratio of deseeding belts. The highest value of stalks losses was 1.03 % at 400 r.p.m driving pulley speed, 10 kg/min feeding rate of and 1:2 speed ratio of deseeding belts. While there were no stalks losses (zero %) at 1:1 speed ratio of deseeding belts for all levels of driving pulley speed, feeding rates. The speed ratio of deseeding belts has the most important effect on stalks losses. The speed ratio between deseeding belts has the most important effect on the stalks losses.

4 Effect of different variables on stripping and threshing efficiencies:

Figures 6 and 7 show the effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on the stripping and threshing efficiencies, respectively. It was noticed that, the stripping efficiency decreased with the increase of feeding rate from 10 – 20 kg/min. The minimum values of stripping efficiency of 57.11, 56.2 and 54.8 % were recorded at 1:1 speed ratio of deseeding belts and 400 r.p.m driving pulley speed for 10, 15 and 20 kg/min feeding rate, respectively. While maximum values of 99.81, 99.4 and 99.05 % were obtained at 1:2 speed ratio of deseeding belts, 300 r.p.m driving pulley speed and 10, 15 and 20 kg/min feeding rate, respectively.



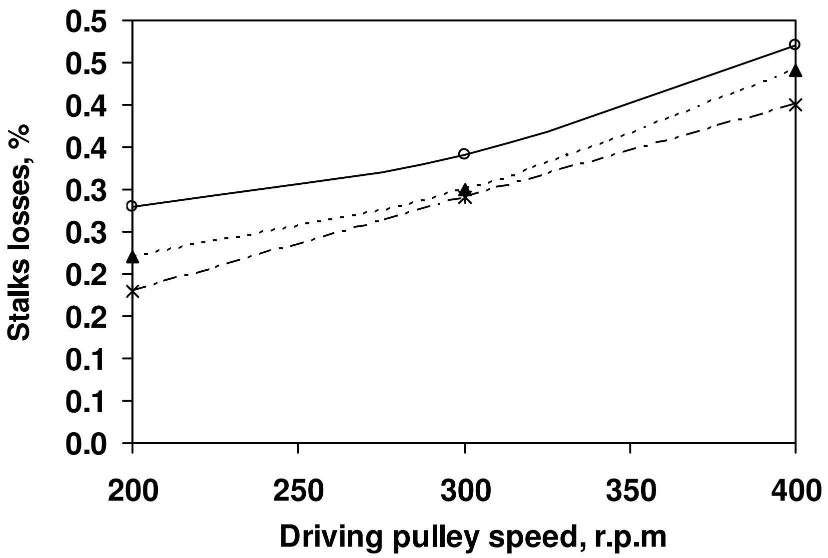


Fig. 5: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on stalks losses.

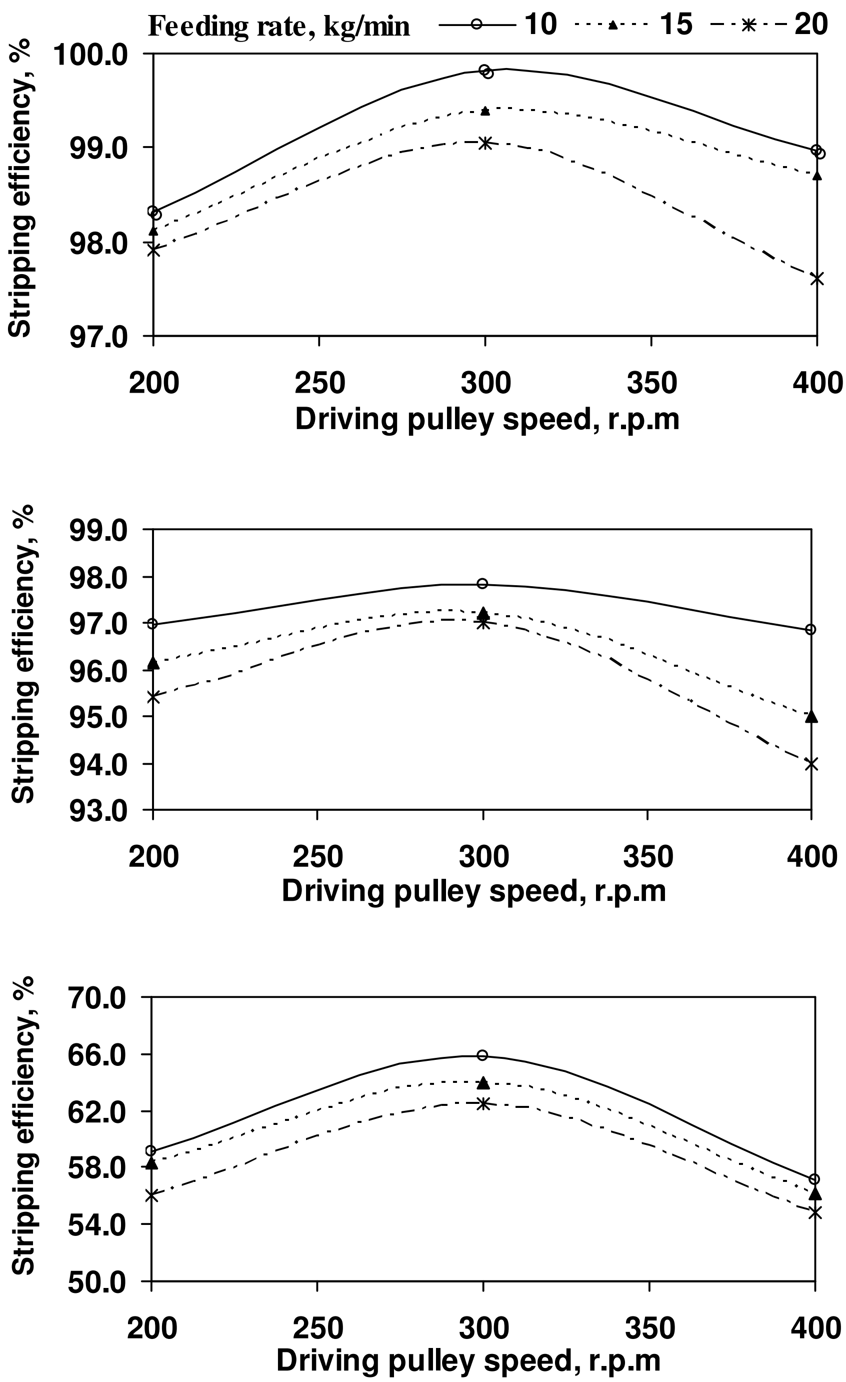


Fig. 6: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on stripped efficiency.

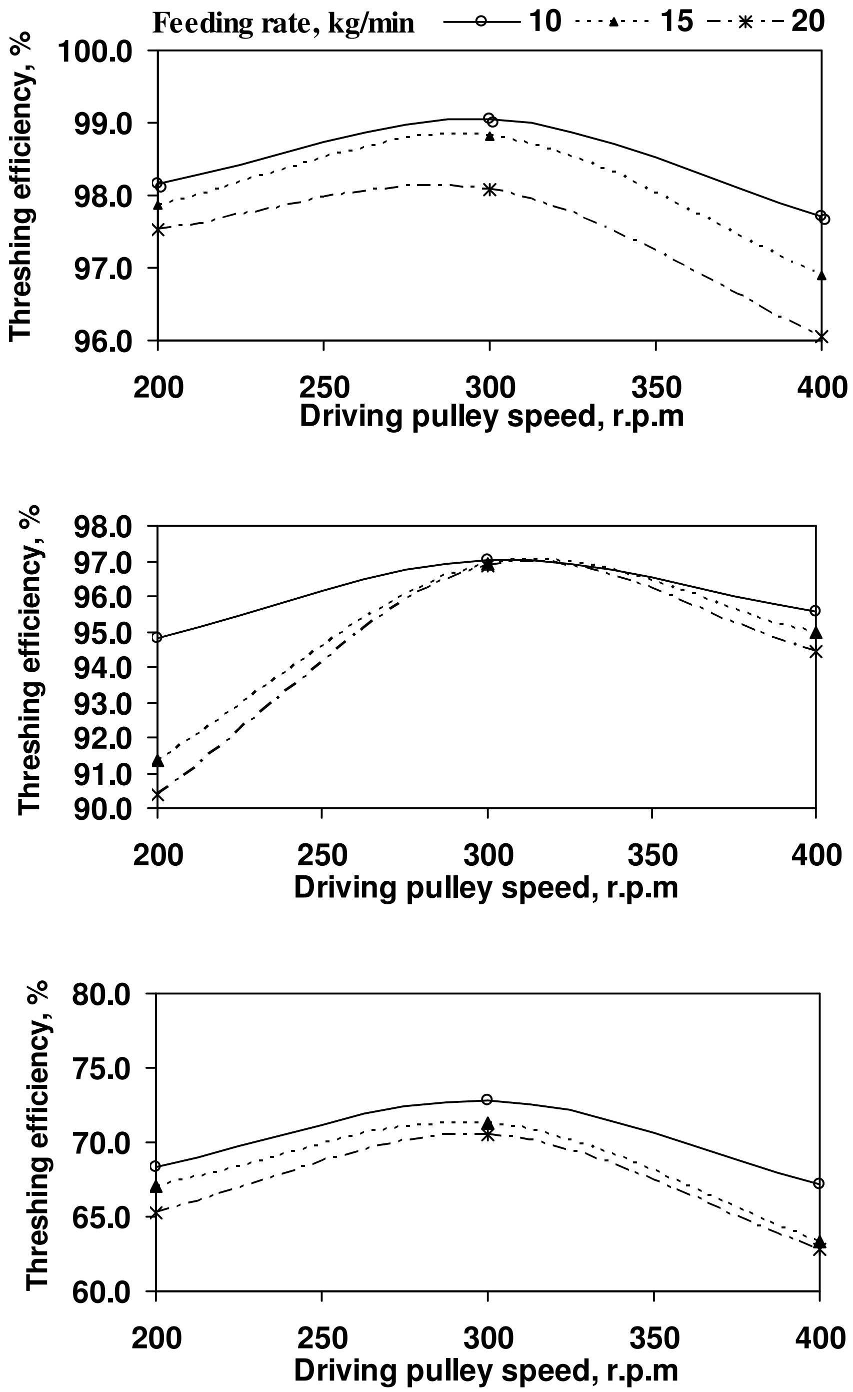


Fig. 7: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on threshing efficiency.

Results showed that, the threshing efficiency increased by increasing driving pulley speed from 200 to 300 r.p.m, and thereafter decreased with the increase of driving pulley speed from 300 to 400 r.p.m at all levels of feeding rates and speed ratios of deseeding belts. Increasing feeding rate from 10 to 20 kg/min caused a decrease of threshing efficiency with the percentage of 3.24 and 0.98 % at driving pulley speed of 300 r.p.m and speed ratio between deseeding belts 1:1 and 1:2, respectively. The threshing efficiency increased by increasing speed ratios between deseeding belts from 1:1 to 1:2 with the percentage of 39.12 % at feeding rate of 20 kg/min and driving pulley speed of 300 r.p.m. The highest value of threshing efficiency was 99.053 % at 300 r.p.m driving pulley speed, feeding rate of 10 kg/min and 1:2 speed ratio of deseeding belts. While the minimum value of 62.8 % was achieved at 400 r.p.m driving pulley speed, feeding rate of 20 kg/min and 1:1 speed ratio of deseeding belts. This may be attributed to more friction and crushing for capsules at higher speed ratio and vice versa at lower speed ratio of deseeding belts. The feeding rate has the most important effect on threshing efficiency.

5 Effect of different variables on energy consumption:

The effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on the energy consumption is shown in Fig.8. It was found that increasing driving pulley speed from 200 to 400 r.p.m caused an increase of energy consumption from 3.48 to 5.14 and from 4.55 to 6.31 kW.h/ton at 15 kg/min feeding rate and speed ratios of 1:1 and 1:2 between deseeding belts, respectively. The same tend was noticed at the other feeding rates. Energy consumption decreased by increasing feeding rate at the different driving pulley speeds. It decreased from 7.79 to 4.11 and from 6.15 to 3.26 kW.h/ton by increasing feeding rate from 10 to 20 kg/min, at driving pulley speed of 300 r.p.m, and speed ratio between deseeding belts of 1:2 and 1:1 respectively. The same trend was noticed at the other driving pulley speed. Energy consumption increased from 4.27 to 5.33 kW.h/ton by increasing speed ratio between deseeding belts from 1:1 to 1:2 respectively, at driving pulley speed of 300 r.p.m and feeding rate of 15 kg/min. In general the speed ratio between deseeding belts has the most important effect on the Energy consumption.

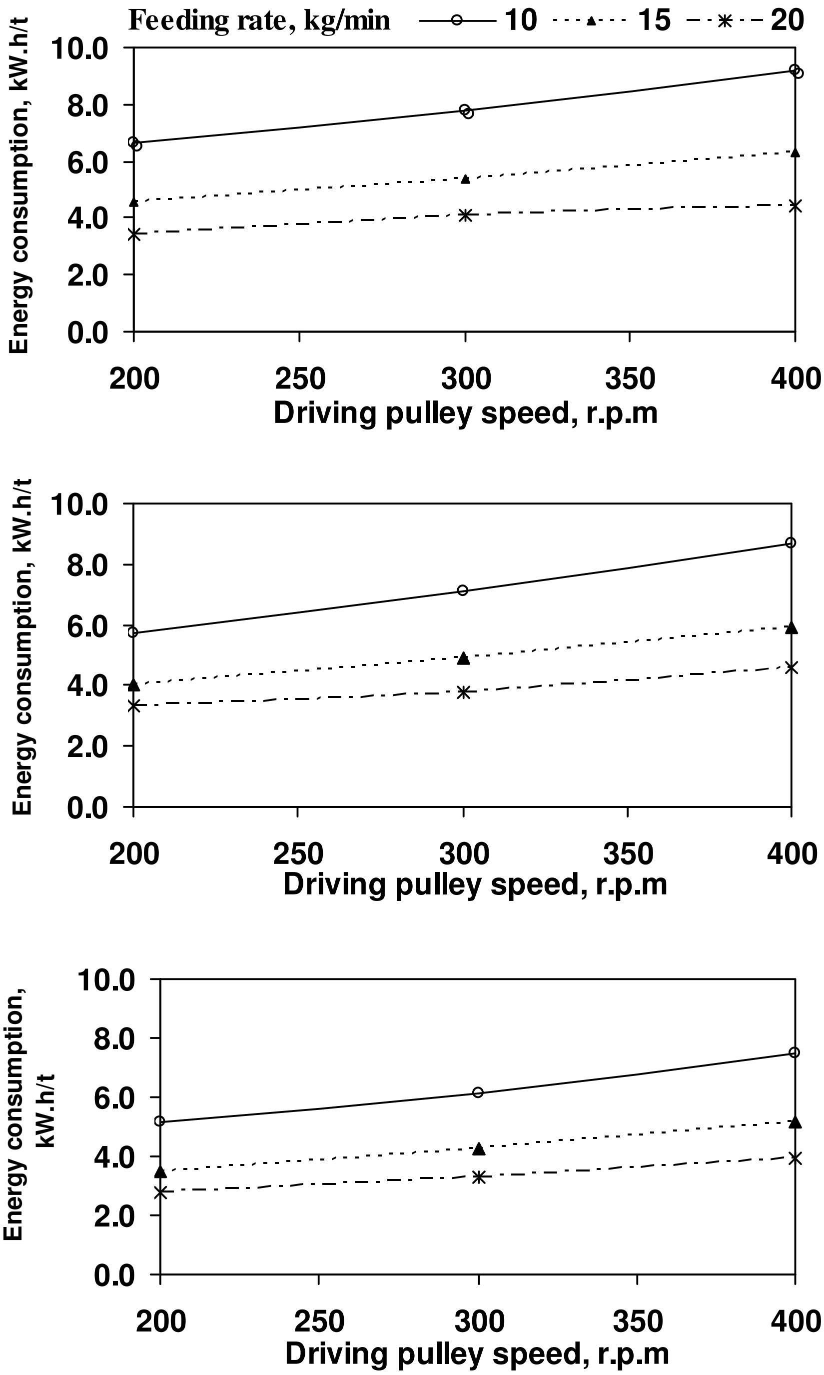


Fig. 8: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on energy consumption.

6 Effect of different variables on energy consumption:

The effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on the energy consumption is shown in Fig.8. It was found that the energy consumption increased from 3.48 to 5.14 and from 4.55 to 6.31 kW.h/ton by increasing driving pulley speed from 200 to 400 r.p.m at 15 kg/min feeding rate and speed ratios of 1:1 and 1:2 between deseeding belts, respectively. The same trend was noticed at the other feeding rates. Energy consumption decreased by increasing feeding rate at the different driving pulley speeds. It was decreased from 6.15 to 3.26 and from 7.79 to 4.11 kW.h/ton by increasing feeding rate from 10 to 20 kg/min, at driving pulley speed of 300 r.p.m, and speed ratio of 1:1 and 1:2 between deseeding belts, respectively. The same trend was noticed at the other driving pulley speed. Energy consumption increased from 4.27 to 5.33 kW.h/ton by increasing speed ratio between deseeding belts from 1:1 to 1:2 respectively, at driving pulley speed of 300 r.p.m and feeding rate of 15 kg/min. In general the speed ratio between deseeding belts has the most important effect on the Energy consumption. The speed ratio between deseeding belts has the most important effect on the Energy consumption.

7 Effect of different variables on costs evaluation of the machine:

Figure 9 shows the effect of driving pulley speeds, speed ratios of deseeding belts and feeding rates on criterion cost. Results showed that, The minimum values of criterion cost of 38.74, 29.68 and 23.86 L.E/ton were recorded at 1:2 speed ratio of deseeding belts and 300 r.p.m driving pulley speed for 10, 15 and 20 kg/min feeding rate, respectively. While maximum values of 105.69, 100.5 and 97.54 L.E/ton were obtained at 1:1 speed ratio, 400 r.p.m driving pulley speed and 10, 15 and 20 kg/min, respectively.

A multiple regression analysis was made taking unstripped capsules losses, unthreshed seed losses, stalks losses, stripping efficiency, threshing efficiency, energy requirement and criterion costs as dependent variable and driving pulley speeds, speed ratios of deseeding belts and feeding rates as independent variables.

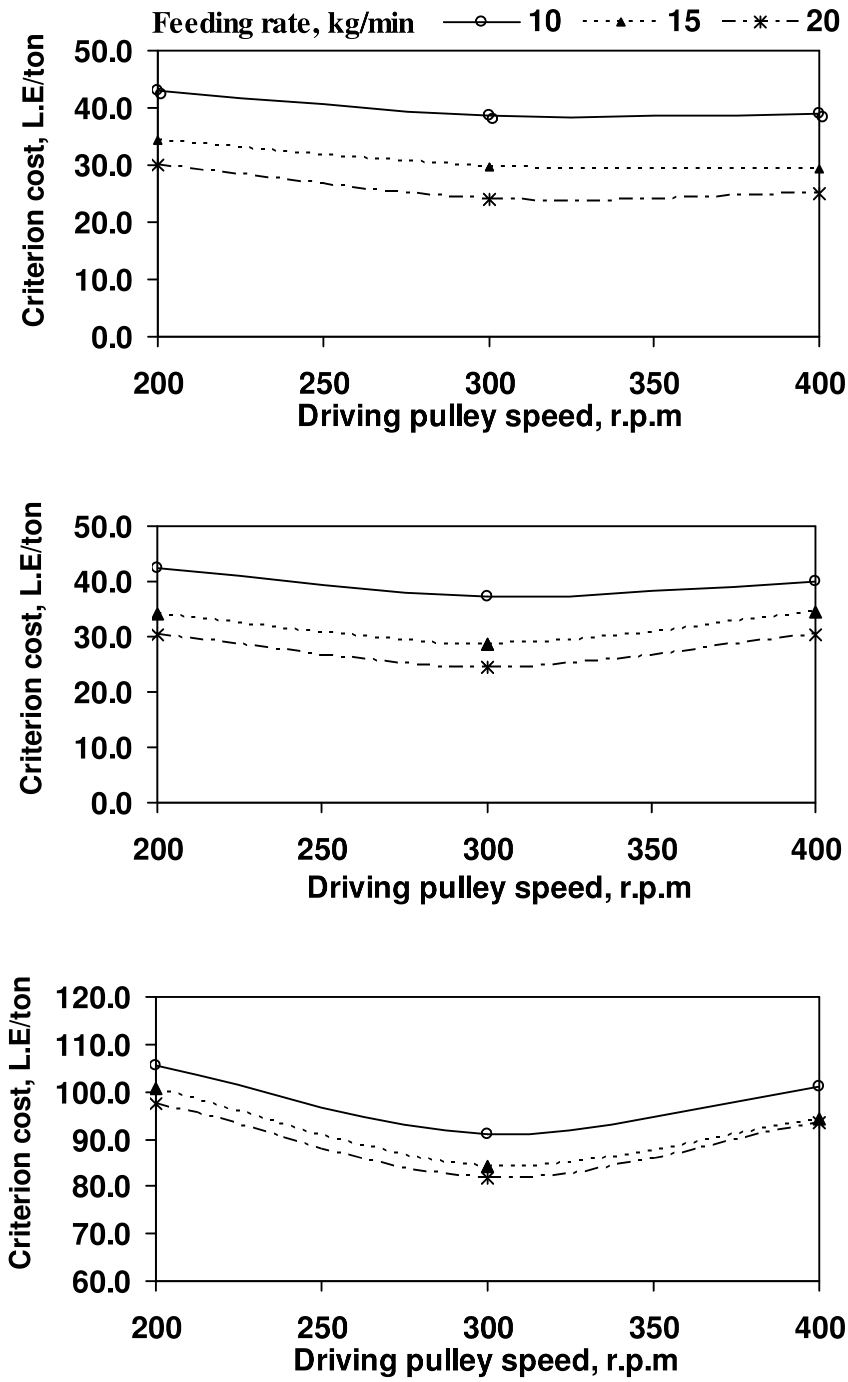


Fig.9: Effect of driving pulley speed, speed ratio of deseeding belts and feeding rate on criterion cost. belts and feeding rate on criterion cost.

The regression equations obtained were in the following form:

$C_{unstripp}$, $S_{unthresh}$, $Stalks_{Losses}$, η_{Stripp}, η_{thresh}, E_{cons}, $C_{Required} = A_0 + A_1 S_R + A_2 F_{Rate} + A_3 D_S$.. (12)

Where:

$C_{unstripp}$ = unstripped capsules loss, %,

$S_{unthresh}$ = unthreshed seed losses,%,

$Stalks_{Losses}$ = stalks losses, %,

η_{Stripp} = stripping efficiency, %,

η_{thresh}= threshing efficiency, %,

Econs = energy consumption, l/ton,

S_R = speed ratios between deseeding belts ($1 \le S_R \le 2$),

F_{Rate} = feeding rate, kg/min ($10 \le F_{Rate} \le 20$),

D_S = driving pulley speed, r.p.m. ($200 \le D_S \le 400$) and

A_0, A_1, A_2, A_3 = regression coefficients.

The values of regression coefficients and R^2 are given in Tables 4.

Table 4:Multiple regression coefficients for the output parameters of new deseeding machine.

Variables	Regression coefficients				R^2
	A_0	A_1	A_2	A_3	
$C_{unstripp}$	70.28	- 39.306	0.184	0.004	0.78
η_{Stripp}	29.099	39.326	- 0.161	- 0.003	0.79
$S_{unthresh}$	55.181	- 30.180	0.204	0.001	0.81
η_{thresh}	44.843	30.180	- 0.208	- 0.001	0.81
$Stalks_{Losses}$	-1.02	0.80	- 0.005	- 0.001	0.96
E_{cons}	5.832	1.138	- 0.337	- 0.009	0.94
$C_{Required}$	157.933	- 61.85	-1.130	0.018	0.75

8 Suggestions for future work:

Due to functional limitations with small scale deseeding machine, the following suggestions are made for large scale threshing machine:

1- To regulate the machine capacity and performance, it is recommended to use a mechanical feeding system; hence number of lobar can be reduced.

2- For complete threshing process (deseeding and separation) it is recommended to add a winnowing unit to the machine, hence seed losses and energy consumed can be minimized.

CONCLUSION

- From the above results the following conclusions are derived:
- The driving pulley speed (200 - 400) was a major controlling factor that affected the unstripped capsules losses and costs of the machine.
- The feeding rate (10- 20 kg/min) had a major effect on the threshing capacity and unthreshed seed losses at all levels of speed ratio between deseeding belts and driving pulley speed.
- The speed ratios of deseeding belts (1:1– 1:2) were affected the stalks losses, stripping efficiency, threshing efficiency and energy consumption. Increasing the speed ratio of deseeding belts caused an increase of both stalks losses, stripping efficiency, threshing efficiency and energy consumption at all levels of driving pulley speed.
- The minimum and maximum values of threshing efficiency of 62.8 and 99.053 % were recorded at 400 and 300 r.p.m driving pulley speed, 10 and 20 kg/min feeding rate for 1:1 and 1:2 speed ratio of deseeding belts, respectively.
- The highest value of stalks losses of 1.03 % was recorded at 400 r.p.m driving speed, 10 kg/min feeding rate of and 1:2 speed ratio of deseeding belts. While the minimum value of zero % was achieved at all levels of driving speed, feeding rates and 1:1 speed ratio of deseeding belts.
- The highest value of energy consumption was 9.196 kW.h/ton at 400 r.p.m driving pulley speed, 10 kg/min feeding rate of and 1:2 speed ratio of deseeding belts. While the minimum value of 2.76 kW.h/ton was achieved at 200 r.p.m driving pulley speed, feeding rate of 20 kg/min and 1:1 speed ratio of deseeding belts.
- The minimum values of criterion cost of 38.74, 29.68 and 23.86 L.E/ton were recorded at 1:2 speed ratio of deseeding belts and 300 r.p.m driving pulley speed for 10, 15 and 20 kg/min feeding rate, respectively.
- Several multiple regression equations were obtained and can be used to predict the performance of the newly manufactured machine.
- By taking the criterion costs and losses into considerations the following conditions can be adopted to operate the new fabricated machine 300 r.p.m driving speed, 20 kg/min feeding rate and 1:2 speed ratios between

deseeding belts at constant moisture constant of about 12.5% for capsules and 15% for stalks.

- Performance of the new fabricated machine was found adequate to justify the investment and attractive to the farmers under the Egyptian conditions because it gives high capacity, high deseeding efficiency, low energy consumption and low production costs with considerable losses of stalks and seeds.

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الملخص العربـي

آله جديدة مصنعة لهدير محصول الكتان

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د / محمد عبد العزيز الطويل[4]

يعتبر محصول الكتان من أهم المحاصيل الألياف والزيوت في العالم حيث أنه يزرع في مصر لغرض الحصول على الألياف والبذور وتم إجراء هذه الدراسة في محطة البحوث الزراعية بإيتاي البارود محافظة البحيرة على محصول الكتان صنف سخا 3 في الموسم 2006 باستخدام الآلة الجديدة المصنعة في إحدي الورش الخاصة بشنو– محافظة كفر الشيخ لهدير محصول الكتان مقارنة بالطرق الاخري في عملية الدراس

الهدف من الدراسة :

1- تصنيع نموذج محلي لأله جديدة لهدير(دراس) محصول الكتان تعمل علي أساس الضغط و الاحتكاك.

2- تقيم أداء هذه الآلة الجديدة تحت ظروف التشغيل المختلفة.

3-التقييم الاقتصادي لاستخدام هذه الآلة في عملية هدير محصول الكتان .

وقد تم دراسة بعض العوامل المؤثرة علي عملية هد ير محصول الكتان مثل:

1- ثلاث سرعات للطا ره القائدة 200، 300، 400 لفه/دقيقه (1.047، 1.57، 2.094 م/ث)

2- ثلاث نسب للسرعة بين سيري الدراس 1:1 ، 1: 1.5 ،2:1.

3- ثلاث معدلات تغذيه 10 ،15، 20 كيلوجرام/دقيقه

وقد تم تقييم الآلة المصنعة محليا من خلال المتغيرات الأتيه:

1- فواقد الكبسولات الغير منزوعة	2- فواقد البذور الغير مدروسة
3- فواقد السيقان	4 - كفاءة النزع
5- كفاءة الدراس	7- تكلفة التشغيل
6- الطاقة المستهلكة	

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وتم التوصل إلي النتائج الآتية :-

- تعتبر سرعة الطارة القائدة من (200 – 400) أهم عامل متحكم والذي يؤثر علي فواقد الكبسولات الغير منزوعة والتكاليف للآلة.
- يعتبر معدل التغذية من (10 – 20) من أهم العوامل المؤثرة علي سعه الدراس و فواقد البذور الغير مدروسة عند كل مستويات نسبة السرعة بين سيري الدراس و سرعة الطارة القائدة.
- نسبة السرعة بين سيري الدراس من (1:1- 2:1) تؤثر علي فواقد السيقان و كفاءة النزع و كفاءة الدراس والطاقة المستهلكة. بزيادة نسبة السرعة بين سيري الدراس تسبب زيادة في كل من فواقد السيقان و كفاءة النزع و كفاءة الدراس و الطاقة المستهلكة عند كل المستويات لسرعة الطارة القائدة.
- أقل وأكبر قيم لكفاءة الدراس كانت 62.8 و 99.053 ٪ والتي سجلت عند 400 و 300 لفة/د لسرعة الطارة القائدة ومعدل تغذية 10 و20 كج/د و نسبة سرعة بين سيري الدراس 1:1 و2:1 علي التوالي.
- أقصي قيم لفواقد السيقان كانت 1.03 ٪ والتي سجلت عند سرعة الطارة القائدة400 لفة/د و معدل تغذية 10كج/د نسبة سرعة بين سيري الدراس1 :2. بينما اقل قيم كانت صفر٪ والتي نحصل عليها عند كل مستويات السرعة للطارة القائدة و معدلات التغذية و نسبة سرعة بين سيري الدراس 1:1.
- أقل قيم للتكاليف المعيارية كانت 38.76، 29.68 و 23.86جنية/طن والتي سجلت عند نسبة السرعة بين سيري الدراس1: 2 وسرعة الطارة القائدة300 لفة/د وذلك عند معدل تغذية 10، 15 و 20 كج/د علي التوالي.
- معادلات الارتداد المتعدد المختلفة نحصل عليها ونستخدمها لمعرفة الأداء الأمثل للآلة المصنعة الجديدة.
- بأخذ التكاليف المعيارية و الفواقد في الاعتبار يوصي بتشغيل الآلة المصنعة الجديدة عند هذه الظروف:-

  سرعة الطارة القائدة 300 لفة/د و معدل تغذية 20 كج/د و نسبة سرعة بين سيري الدراس1 :2 و ذلك عند ثبات المحتوي الرطوبي 12.5 ٪ للكبسولات و 15 ٪ للسيقان.
- الأداء للآلة المصنعة الجديدة وجد أنة مناسب للاستثمار وجذاب للفلاح تحت الظروف المصرية لان الآلة تعطي سعة عالية و كفاءة دراس عالية وطاقة مستهلكة بسيطة و تكاليف منخفضة مع الأخذ في الاعتبار فواقد السيقان والبذور.