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STUDIES ON FLAX THRESHING USING A LOCAL PADDY THRESHER

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ABSTRACT

The aim of this work is to test the feasibility of using El-Shams rice thresher as a dual purpose machine to obtain seeds and stalks from flax crop. The thrshing was performed by using a range of drum speeds, feed crop rates and the lengths of conveyor chain tension at four different levels of capsule moisture contents.

Results of the experiments indicated that, for optimum perormance, the threshing drum speed, feed rate and the length of conveyer tension should be about threhing drum speed, feed rate and the length of conveyer tension should be about 31.43m/s., 20kg/min and 48 mm. respectively at 18.45% moisture content of capsules. The highest stripping efficiency, threshing efficiency and cleaning efficiency were 99.6 99.2 and 95 to 98 % respectively. At the same time, the seed damage has noeconomical importance, at the obtained value of 1.78 % . The optimum fuel consumption values were 3.70 L/h and 3.08 L/ton at 31.43 m/s drum speed and 20 Kg/min. feedrate. the average cost of flax threshing was 16.23 L.E/ton compared with 50 L.E/ton for manual threshing.

INTRODUCTION

Flax (Linum usitatasmum, L.) is known in Egypt as a dual-purpose field crop. It is grown for both seeds and fiber production. Different methods and equioment are used in harvesting and threshing the flax crop. Any technique must function so that the percentage of capsules stripping from the stalks is maximum with minimum damage of seeds and stalks. Reviewing the techniques for production of flax in Egypt indicated that harvesting, threshing, separation and getting seeds ands stalks is rather a laborious operation and not economical.

Morsi (1967) and Klenin (1985) showed that different types of combs were used to strip the pods from flax stalks. They also reported that in order to reduce damage to the stalk, the space between the gripper and point at which the teeth enter the stalks layer should be minimum and the number and speed of combing should also be minimum.

Helmy, H.A. (1988) and Abdel-Mageed (1989) found that the threshing effectiveness is related to; the cylinder speed, the cylinder concave clearance, feed rate of crops, the number of rows of concave teeth used with a spike tooth cylinder, grain and straw moisture content, and the type of crop.

Vreeke (1984) repoted a new system for separating flax seed, in which a specially designed machine removes the capsules at the time of pulling the plant out. To achieve this, the seeds should have high moisture content and need to be processsed immediately similar to combine harvested grass seeds, which are threshed at low drum speed (500 r.p.m) and dried to 9 % moisture right after harvest.

Ibrahim and Abdel-Mageed (1989) evaluated three different machines [threshing machine (ML 2.8 PA), flax harvester (LKB-4A), and a rice harvester(Yanmars TC 2400 E)], in flax threshing. They found that using the Yanmar harvester at 400 r.p.m. threshing drum speed gave a stripping efficiency about (100%), the threshing efficiency(92.2%), while stalks loesses reached 3.3%.

Ajayi (1991) indicated that the material capacity of a thresher influenced by the speed of the threshing beater drum, the feed rate and the moisture content of the material. At lower speeds of 300 and 500 r.p.m. of the beater drum, the material at 13.31% moisture gave slightly a decrease in capacity as th speed increased to 55 r.p.m. Beyond thi speed, an increase in thresher capacity was observed.

The purpose of the present research is directly towards obtaining high efficient and less expensive system for threshing flax crops in order to get both seeds and stalks in just one operation. This is thought to be done using an available local paddy rice thresher. The reason behind this is the similarity of flax and rice crops special in the position of seeds on plants, and the stalks feeding system to the theshing drum. The thrsher feeding system could be adjusted to expose only the capsules to the impact action of the drum.

MATERIALS AND METHODS

Flax plant variety Giza (7) was used. It has the following average physical properties and characteristics as given in Table (1).

Table (1) .Physical properties of flex plant Giza (7) variety.

Property	Value (average)
Stem diameter (mm)	1.64
Technical length (cm)	68.5
1000 seed weights (g)	8.0
No. of capsules per plant	4.85
No. of seeds per plant	30.71
Capsule dimeter (mm)	6.50

The thresher has 209 cm width, 230 cm length and 165 cm height, and manufactured by Tanta Motors Co. The Thresher has two functions: threshing and cleaning. The Threshing drum (119 cm length and 75 cm diameter) is an axial flow type. The Threshing drum cover (125 cm length and 83 cm width) has adjustable angles spiral louvers which can be set to vary the the movement of the crop material along spiral louvers which can be set to vary the movement of the crop material along the axis of the threshing cylinder. The clearance between the the threshing cylinder and the conave is constant at 20 mm. The thresher has a feeding conveyer that conveys the capsules to the threshing chamber parallel to the shaft while the plant stalks remain out side the threshing chamber. The machine is operated from the PTO of a 45 KW. Fiat 55-66 DT tractor.

The experiment were carried out at sakha Experiment Station (Kafr-Sheikh Governorate).

Procedures:

Four random samples of threshed flax were taken from each of the following runs. Five different peripherals drum speeds i.e. 19.64, 25.54, 31.43, 37.32 and 43.21m/s were used with:

* Five feed rates of flax 10,15,20,25 and 30 kg/min.

* Four lengths of conveyor chain tension 38, 43, 48 and 53 mm., and

* Four capsules moisture contents 13.74, 18.45,26.26 and 32.73% (dB) at the optimum maturity of flaxs crop were considered.

Fuel consumption was determined during the threshing operation measuring the volume of fuel consumed by the tractor throughout the test using a graduated glass cylinder.

Power consumption was calculateds using fuel consumption rate each test run in the following standard equation:

$$B.HP = Fc \times 1/3600 \times 1 \times P_f \times L.C.V. \times 427 \times \pi_{th} \times \pi_m \times 1/75$$

Where:

Fc = Fuel consumptio, lit/h

pf = Density of fuel kg/lit (for solar fuels 0.85 kg/lit.).

L.C.V = Lower calorific value of fuel (Kcal/kg = 104 Kcal/kg for most petrol fuels).

427 = Mechanical eequivalent of het., kg.m/Kcal.

η_{th} = Thermal efficiency of the engine (considered being 40% for diesel engines).

η_{m} = Mechanical efficiency of the engine (considered being 80% for diesel engines).

RESULTS AND DISCUSSION

The effect of drum speed on the stripping efficiency and stalks losses (chopping talks during passing throught the threshing chamber) of El-Shams thresher are shown in Fig. (1).

Increasing drum speed from 19.64 to 31.43 m/s caused an increase in stripping efficiency from 92.8 to 99.6% and stalks losses from 0.52 to 1.42%, rspectively. At the same time, increasing drum speed 31.43 to 43.21m/s the stripping efficiency remained constant at 99.6%, on the other hand stalks losses incresed from 1.42 to 4.75 with on visual seed damage and losses observed in all trials.

Increasing moisture content from 13.74% to 32.74% decreased stripping efficiency by 20.7% whill increasing stalks losses by 73.3% which may be due to the elastic conditions of capsules stalks at high moisture content.

Fig. (2) shows the effect of drum speed and the moisture content of seeds on the threshing effciency. Increasing drum speed from 19.64 to 37.32 m/s at moisture content 18.45% increased threshing efficiency by 8.8%. This may be attributed to the high impact force applied to the flax plants, which tended to improve stripping and threshing operation.

On the other hand, incrasing moisture content from 13.74% to 32.73% at drum speed 31.43 m/s, decreased threshing efficiency by 14.9%. This may by due to the strong attachment of capsules or high moisture-content than at low moisture content.

The results aiso showed that increasing feed rate from 10 to 20 kg/min increased stripping efficiency by 1.8% and decreased stalk losses by 73.6%. While incrasing feed rate from 20 to 30kg/min increased striping efficiency by 18.53 and stalk damage by 85.38%. At the same time the percentage of seed damage reached 1.75%. Fig (3), shows the effect of feed rate and moisture content on threshing

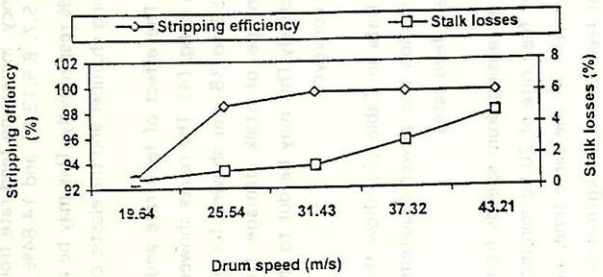

Fig. 1: Effect of drum speed on the stripping efficiency and stalks losses

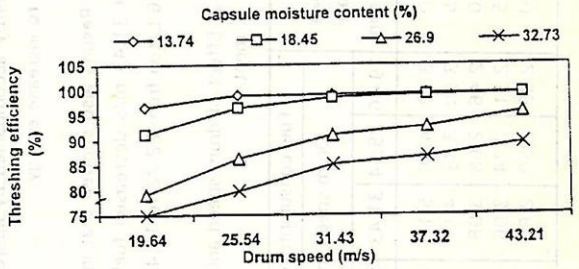

Fig. 2: Effect of drum speed and moisture content on threshing efficiency

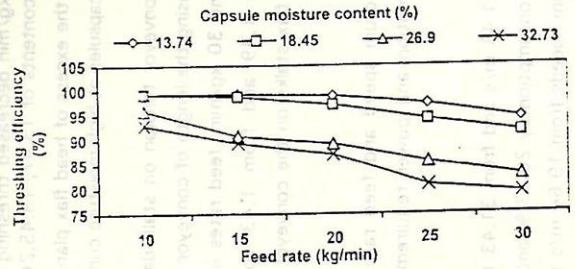

Fig. 3: Effect of moisture content and feed rate on threshing efficiency

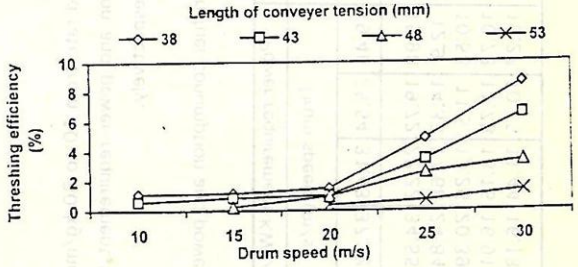

Fig. 4: Effect of feed rate and length of conveyer tension on stalks damage

efficiency. Increasing feed rate from 10 to 30 kg/min decreased threshing efficiency by 5.7, 8.5,13.85 and 14.84% at moisture contents of 13.47, 18.45,26.9 and 32.73% respectively. This may be attributed to the excess of head flax plants in the threshing chamber and the elastic conditions of capsules at high moisture content.

The effect of feed rate and length of conveyor tension on stalk damage is shown in fig. (4). The reults showed that decreasing the length of conveyor teension from 53 to 38 mm showed for both of 20 and 30 kg/min. feed rates increased percentage of stalk damage from 0.37 to 1.49 and from 1.43 to 8.62% respectively.This may be dut to the excess of flax stalks on the conveyor and the metal conveyor.

Data in Table (2) show the effect of drum speed and feed rate on fuel consumption and power requirements. consumption and power requirements for different feed rates.

Increasing drum speeds from 19.64 to 31.43 m/s and from 31.43 to 43.21 m/s at feed rate of 20 kg/min increased fuel consumption by 20.13 % and 37.9 % respectively. At the same time, increasings drum speeds from 19.64 m/s to 43.21 m/s at feed rate of 20 kg/min increased threshing power requirements from 10.58 to 21.33 KW/ton. This may be due to the increases in drum speed which is frequently accompanied by appreciable increase in fuel consumption, which in turn trnds to increase energy.

Results also showed that increasing feed rate from 10 to 30 kg/min at drum speed 31.43 m/s decreased fuel comsumption and power requirement from 5.17 to2.66 L/ton from 22.22 to 11.44 KWh/ton respectively.

Table 2. Effect of drum speed and feed rate on fuel conumption and power requirement.

feed Rate	Fuel consumption l/ton					Power requirement KWh/ton				
	Drum speed (m/s)					Drum speed (m/s)				
kg/min	19.46	25.54	31.43	37.32	43.21	19.46	25.54	31.43	37.32	43.21
10	3.72	4.58	5.17	8.03	9.42	15.98	19.72	22.22	34.55	40.50
15	3.00	3.33	4.11	5.2	6.38	12.9	14.33	17.68	24.84	27.42
20	2.46	2.68	3.08	4.74	4.96	10.58	11.5	13.26	20.39	21.33
25	2.51	2.74	3.06	3.93	4.60	10.78	11.78	13.16	16.91	19.78
30	2.39	2.50	2.66	3.75	4.06	10.27	10.75	11.44	16.13	17.44

The cost analysis has been conducted to find out the profitability gained from using El-Shams paddy rice thresher for additional working hours for flax crop. The cost calculations were based on the list price of 38000 L.E. for the tractor and 7000 L.E. for the paddy rice threshing machine.

Results showed that increasing feed rate from 10 to 30 kg/min decreased threshing cost from 35.73 to 11.9 L.E./ton. The total cost ws 16.23 L.E. /ton at the optimum drum speeds and feed rate of 31.43 m/s and 20 kg/min. repectively. The daily wage for one labourer to manually thresh flax crop was about 1.5 L.E./ha. On the other hand, the cost was about 50 L.E./ton when threshing flax crop manually .

CONCLUSIONS

This reearch aimed to improve the threshing machine performance as dual crop obtaining seeds and fiber of flax crop. The obtained data showed that:

1- The optimum performnce of the threshing drum, feed rate and lenght of conveyor tension were 31.43 m/s 20 kg/min., and 48 mm, repectively at 18.45% moisture content of flax capsules.

2-The highest stripping efficiency, threshing efficiency and cleaning efficiency were 99.6, 99.2 and 98% respectively.

3-The seed damages value of 1.7% have no economical importance.

4- The minimum fuel consumption and power requirement values were 3.08 L/ton and 1.326 KWh/ton at 31.43 m/s-drum speed and 20 min fed rate.

5- Using this machine for threshing flax beside paddy rice, reduces its operating cost, and increases machine working hours per year.

It is recommended to change the metal conveyor type to a rubber conveyor, to produce lesss damage.

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دراسات على الكتان باستخدام الة محلية لدرس الارز (سراتة الارز)

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فى هذا الدراسة تم استخدام اله دراس الارز " الشمس المصنة محليا لدراس محصول الكتان الذى يتم دراسه يدويا. اجريت التجربة باستخدام سرعات مختلفة من درفيل الدراس ومعدلات تغذية مختلفة مع احداث شد للعمل على استطالة سير التغذية عند نسب مختلفة من الرطوبة فى كبسولة الكتان على اساس الوزن الجاف .

وقد زوضحت النتائج ان ظروف التشغيل المثلى لالة هى : سرعة درفيل الدراس ٣١,٤٣ متر / ثانية ومعدل تغذية ٢٠ كجم / دقيقة واستطالة الشد حتى ٤٨ مم عند نسبة الرطوبة ١٨,٤٥ ٪ حيث اعطت أعلى قيم لكفاءة الفصل والدراس والتنظيف كما يلى ٩٩,٦ ،٩٩,٢، ٩٨ ٪ على التوالى وكانت نسبة الكسر فى الحبوب ١,٧٥ ٪ وكانت اقل نسبة فقد للسقان تسحب داخل غرفة الدراس هى ٠,٥٢ ٪ واعلى نسبة تلف للسيقان بواسطة سير النقل مع زيادة لمعدل التغذية ٨,٦٢٪ مما يوصى فى نهاية هذه الدراسة بتغير سير التغذية المعدنى عند دراس الكتان الى سير كاوتش خشن ليساعد على التحكم فى حركة التاثير عليها سيقان الكتان دون التأثر كما يوصى بتقليل قطر فتحات غربال التنظيف الي فتحات ذات قطر أصغر من قطر الكبسولات لمنع خروج الشوائب والكبسولات غير المدروسة مع الحبوب .

كما كان استهلاك الوقود ٣,٠٨ لتر/طن كتان والطاقة المستهلكة ١٣,٢٦ كيلو وات طن / ساعة عند انسب ظروف التشغيل للالة. وكانت تكلفة دراس الكتان هى ١٦,٢٣ جنية / طن مقارنة باليدوى ٥٠ جنية /طن بالة دراس الارز الشمس .