

## **SUBDUAL OF STATIONARY THRESHER MACHINE FOR CHOPPING RESIDUES**

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### **ABSTRACT**

*The aim of the present study was to modify the stationary thresher machine to become suitable for chopping and cut farm crop residues with the desired cutting lengths from crop residues suitable for different uses. The objective of this work was to evaluate stationary thresher machine. The studied variables included: Three different feeding rates 0.5, 1 and 1.5 ton/h, three different threshing drum speeds 13.1, 15.71 and 18.33m/s, three different oval slots area were used 4, 6 and 8 cm<sup>2</sup>, three different moisture content of rice, corn and cotton were used 6.5, 10.2 and 14.3 %, three different concave clearance were used 3, 4 and 5 cm with three kinds of crop residues rice straw ,corn stalks and cotton stalks. The experiments were carried out in Bhnay village ,El-bagour center, Minofiea governorate, Egypt, during summer season of 2005. Obtained results show the stationary thresher machine can be successfully used for chopping and cut under the following condition: oval The slots area of 4cm<sup>2</sup>, drum speeds of 18.33 m/s, feeding rates of 1.5 ton/h, moisture content of 14.3 % and concave clearance of 3 cm resulting in cutting length percentage of 82.1,85.6 and 80.1% less than 3.5 cm for rice straw ,corn stalks and cotton stalks respectively. Power consumption and energy requirement were found to be (43.4,40.3 and 38.7 kW) and (28.9,27.3 and 25.8 kW.h/ ton) for rice straw ,corn stalks and cotton stalks. The maximum operation cost was 25 LE/h and 17 LE/ton for rice straw.*

### **INTRODUCTION**

**T**he amount of crop residues increased all over the world due to increasing in cereal crops production. Annual crop residues amounted to 40 million tons. Crop residues contains such elements are bonded together by energy rich bond. From an environmental pollution point of new, residues can be reclined to be changed into biogas and compost.

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Removal of agricultural residues for farmers by burn is wrong way to make pollution surroundings. The best way to remove from agricultural residues cutting and chopping for next operation of waste recycling in different industry such as making compost and improvement soil properties, animal feeding, energy source (direct burning, biogas generation) compressed wood and the field of industrial application.

Rice and corn are considered among the most important agricultural crops in Egypt. The cultivated areas in Egypt ranged between 1.9 to 2.10 million feddans yearly and about 1.6 million feddans yearly for corn and rice, respectively (**Ministry of agriculture 2000** ). Crop residues are considered the most critical problems facing the Egyptian farmer, especially after harvesting the crop. Egyptian farmers burn yearly about 2-3 ton/fed. Of rice straw and 5.87 million ton of corn stalks respectively as a means for disposing it and to save time for preparing the land of the next crop (Helmy et al., 2003). **Lashin et al. (1993)** found that chopping corn stalks with the length of 3 cm was found to be better for growing lambs. **Luis et al. (1993)** found that the cutting lengths of residues between 0.5 to 3 inches (1.27 to 7.62) are recommended for composting the residues. **El-Khateeb (2001)** reported that in Egypt there are about 15 million tons/year of the field raw materials available as vegetative residues of corn stalks and rice straw. They are currently used as fuel. Roof-top storage of cotton, corn stalks and rice straw bundles present serious fire hazards.

Beside, it offers a dwelling environment for cotton boll worms. The quantities of crop residues in Egypt are estimated about 18.7 million ton/year, 53 % of which (9.91 million ton) are directly burned. This causes great losses of energy and air pollution. The burning of cotton residues (1.24million ton/year) causes a loss of 532.000 equivalent ton of hydrocarbon fuel (1.806 million LE). Corn fields provide 4.07 and 0.61 million ton of dry stalks and cobs respectively (based on mean yield of 0.43 ton/fed), (as cited from **Awady et al., 2001**). **El-Raie et al. (1998)** investigated the characteristics of fuel values of some agricultural residues such as barley straw, fababean green coating, dry corn leaves, rice straw, corn cobs, cotton stalks, corn stalks, and wheat straw converted into energy as alternative non traditional energy source.

**Nasr (2000)** reported that the productivity of the chopper is proportional with drum speed, moisture content and feeding speed.

**Tarek et al. (2001)** developed a rice straw chopper. Their results showed that the productivity of the developed machine was 0.95 ton/h at 2000 rpm rotor speed and cut lengths of (1-9 cm) reached 95.23 % from the total amount of cut residue. **El-Berry et al. (2001)** mentioned that the quantity of crop residues in Egypt reached about 25 million-ton per year and national income is expected to increase with 1.6 billion L.E/year if residues are recycled. They evaluated Hematol chopper and compared it with Balady thresher in rice straw. **El-Iraqi and El-Khawaga (2003)** designed and evaluated a machine for cutting crop residues. The maximum percentage in cut length of less than 5 cm of 87.80 % and 92 % were obtained for rice straw and corn stalks residues respectively. Meanwhile, the energy requirement was found to be 6.36 and 6.17 kW.h/ton for rice straw and corn stalks residues respectively. The maximum operating cost was 5.10 L.E/h or 6.61 L.E/ton for cut rice straw residues. **Helmy et al. (2003)** mentioned that the quantity of different residues in Egypt equal 103.56 ton/year (agricultural, animal, sewage and rubbish residues). The agricultural residues were about 31.42 ton/year which may represent 30-50% of total agricultural production. The animal residues were about 55.37 ton/year. Meanwhile sewage residues were 3.99 ton/year and rubbish was 12.78 ton/year. **EL-Ashry(2003)**. Concluded that, the feasibility of using a local stationary thresher for chopping and grinding farm crop residues(rice straw and maize stalks) with suitable particles size for pelleting process. **Ebaid (2006)** used corn Sheller for chopping cotton and corn stalks and mentioned that: Farmers can use the corn shellers in chopping crop residues.

The optimum performance was at feed rate of 750 kg/h (0.750 ton/h) and 500 kg/h (0.50 ton/h) for corn and cotton stalks residues respectively, and chopping drum speed of 33.5 m/sec (1600 rpm). Cutting length category percentage at these conditions was 63 and 45.40 % in cutting length of <3.35 for corn and cotton stalk residues respectively. It was found that the chop operation cost was 13.33 LE/ton and 20 LE/ton for cutting corn and cotton stalk residues respectively.

## MATERIALS AND METHODS

The experiments were carried out in Bhnay vilage ,El-bagour centere, Minofiea governorate, Egypt, during summer season of 2005 in order to study the effect on separation effectiveness: Feed rate, Chopping drum speed, oval slots area of concave, moisture content and concave clearance.

In the present investigation, a Stationary threshing machine was developed and tested at a private workshop in Governorate of Minofiya, Egypt. The thresher machine consists of main frame, cover, feed opening, threshing drum, concave, as shown in Fig. 1.

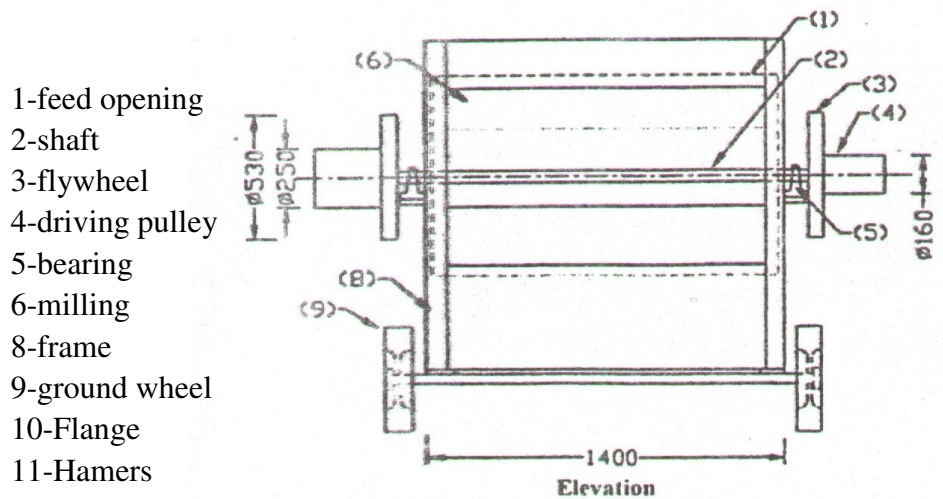


Fig. (1-a): Stationary thresher machine used in the study.

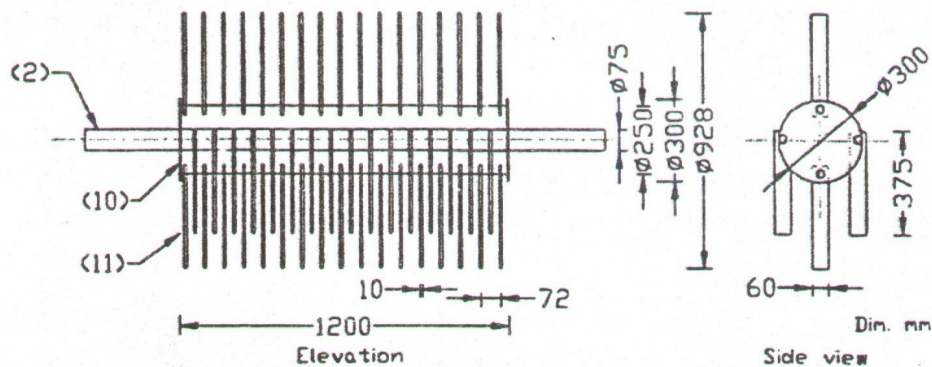


Fig.(1-b): Threshing drum of stationary thresher machine.

### **A- Stationary threshing machine specifications:**

**1-Overall dimensions:** 2.25, 1.9 and 1.8 m for length, width and height respectively.

**2-Threshing drum:** 0.95 m diam., 1.5 m len. and 4 rows, 12 flail /row.

**3-Concave:** 1.3m length, 1.25 m width and 0.025 m hole diameter.

**4-Feeding opening:** 0.75 m length and 0.45 m width.

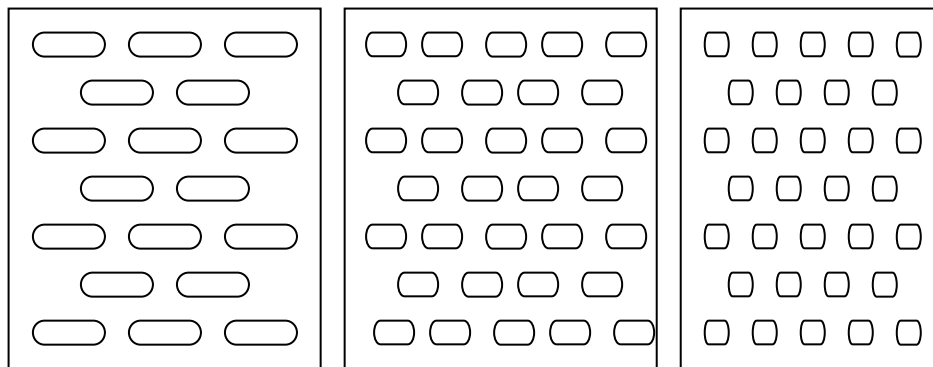
**5-Knives type:** free knives (50 knives, 0.3 m length and 0.1 m thickness).

**6-Transmission system:** 0.17 m driving pulley, 0.25 m driven pulley and 0.6 m flywheel.

**7-Belt type:** flat belt.

**B- Modification of Stationary thresher machine:**

change the perforated concave sheet of 15 mm hole diameter from round hole to oval slots. Each slot has an area of  $4 \text{ cm}^2$  ( $2 \times 2 \text{ cm}$ ),  $6 \text{ cm}^2$  ( $2 \times 3 \text{ cm}$ ),  $8 \text{ cm}^2$  ( $2 \times 4 \text{ cm}$ ) and change concave clearance from 3mm to 3 , 4 and 5 cm.



concave of 2 x 4 cm

concave of 2 x 3 cm

concave of 2 x 2 cm

**C-Specification of used crops:**

**1-Rice straw:** Type: variety Sakha 101, 35 mm Stem diameter ,2500 mm Stem length and ( 6.5,10.2and 14.12%) moisture content, From 1 month to one year Storage time.

**2-Corn stalks:** Type: variety One-cross 10, 38.5 mm Stem diameter , 950 mm Stem length and ( 6.5,10.2and 14.12%) moisture content, From 1 month to one year Storage time.

**3-cotton stalks:** Type: Giza 70 ,175 mm Stem diameter ,1500mm Stem length and ( 6.5,10.2and 14.12%) moisture content , From 1 month to one year Storage time.

#### **D- Test procedures on the experimental Stationary threshing machine:**

The following factors were tested to show their effect on separating effectiveness:

**1-oval slots area of concave:** three different oval slots area were used 4, 6 and 8 cm<sup>2</sup>.

**2-Feed rate:** Three different feed rates were used 0.5, 1 and 1.5 ton/h.

**3-Chopping drum speed:** Three different chopping drum speeds were used

13.1, 15.71 and 18.33 m/s.

**4-moisture content:** three different moisture content of rice, corn and cotton were used 6.5, 10.2 and 14.3 %.

**5- Drum-concave clearance:** three different concave clearance were used 3, 4 and 5 cm.

#### **E-Equipment and Instruments:**

**1-Tractor:**The source of power for the field experiments was Nasr tractor ,65 hp, diesel engine and (2-WD),P.T.O speed 540,1000 r.p m and 1500 r.p.m was used to drive the machine.

**2-Handtachometer:** A handtachometer was used to measure the rotation speed in three ranges. First range: 40 – 500 rpm., second range: 400 – 5000 rpm., and third range: 4000 – 50000 rpm direct reading, with accuracy of  $\pm 1\%$ .

**3-Electronic balance:** An electronic balance (Japan make) was used for weighing samples in each category. Its scale ranged from 0 to 5 kg max., with accuracy of 0.2 g.

**4-Spring balance:** A spring balance was used for weighing the chopped materials of rice and corn. It had a range up to 75 kg max. and 0.5 kg accuracy.

**5-Stop watch:** for measuring the net time spent during cutting.

**6-Surveyor tape 30 meters:** for measuring the length of crops.

**7-Sliding caliper :** for measuring the cut length of crops

**8-Oven:** to determine the moisture content of crops under test.

#### **F-Measurements:**

The rice straw , corn stalks and cotton stalks were collected in bundles before starting the chopping process. The speed of cutting drum was measured by speedometer. The chopped materials were dropped to the

spout after cutting in threshing room through concave. Samples of chopping stalks were taken from each experiment to laboratory separated and classified into three categories using hand sieves as follows: First category >3.5 cm , second category 3.5 - 10 cm and third category <10

**1-Machine productivity:** was calculated by using the following formula by **mady,1999**.

$$P = W * 3600 / t$$

Where:

P = is productivity in t/h.      W= mass of the sample in ton.

T = time in sec.

**2-length of cutting:** was assessed by taking a sample of 1 kg from cut crop material into laboratory and separating into three categories (<3.5 cm, >3.5-10 cm and >10 cm). Each cutting length in the sample was weighed and calculated as a percentage from the total weight of the sample (Iraqi and Khawaga,2002).

**3-Threshing drum speed:** Peripheral drum speed was calculated:

$$S = (22 * n * d) / (7*60)$$

Where:

S= Peripheral drum speed, m/s      n =rotational speed, (r.p.m).

d=Threshing drum diameter, m

**4-Moisture content; dry basis (M.C<sub>db</sub> %):** The moisture content of plant stalks was measured by taking random samples from stalks and dried in air forced electric heater at 105 °C at atmospheric pressure for ten hours. The moisture content was calculated according to the following equation:

$$M_{c_{db}} = \frac{M_{wet} - M_{dry}}{M_{dry}} \times 100$$

Where:

M<sub>c<sub>db</sub></sub> = Moisture content, dry basis %.

M<sub>wet</sub> = Mass of wet samples, g. and

M<sub>dry</sub> = Mass of dry samples, g.

**5-fuel consumption determination:** consumed fuel during threshing operation was determined by measuring the volume of diesel fuel required and refueling the machine tank after finishing the operation time.

**G- power requirements:** The energy required for cutting operation was estimated by using the following formula (Arafa, 1991)

$$\text{Required power} = (F_c \times 1/3600) \rho_F \times \text{L.C.v.} \times 427 \eta_{Th} \times \eta_m \times 1/75 \times 1/1.36, \text{ kW}$$

Where:

$F_c$  = the fuel consumption rate, L/h

$\rho_F$  = density of the fuel, kg/ L (for solar fuel= 0.85 kg/ L)

L.C.v. = lower calorific value of fuel. Kcal/ kg (average Lcv for solar fuel is 10000 kcal/ kg)

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

$\eta_{Th}$  = thermal efficiency of engine (assumed as 40% for diesel engine) and

$\eta_m$  = mechanical efficiency of the engine (considered to be about 80% for diesel engine)

Estimation of the energy requirement for cutting operation: was carried out using the following equation:

$$\text{Energy requirements} = \frac{\text{power, requirement (kW)}}{\text{Machine, productivity (ton/h)}} \text{ (kW.h/ ton)}$$

#### **-Estimation the costs of using the machine:**

Cost of operation is calculated according to equation given by Awady (1978), which has the following form:

$$C = P/H (1/y + i/2 + t + m) + (A. k. f. u) + S/144$$

Where:

C = Total hourly cost, P = Price of machine LE (5000), H = Estimated yearly-operating hours (500), y = Estimated life-expectancy of machines in years (10), i = Interest rate (12%), t = Taxes and overhead rates (3%), m = Maintenance and repairs ratio (10%), A = Ratio of rated power and lubrication related to fuel cost (1.2), K = Power in kW or hp (65 hp), f = Specific fuel-consumption in L/kW.h or /hp.h (35%), u = Price of fuel per LE (0.6), S = Monthly salaries (600 LE), and 144 = Estimated working hours per month according to price level 2005.

\*Notice that all units have to be consistent to result in C = L.E./h.

### **RESULTS AND DISCUSSION**

#### **A-Effect of some operational factors on percentage of cut length.**

##### **1- oval slots area.**

Fig.(2):The relation between the cutting length percentage and categories of cutting length at different oval slots area for different crop residues.

The obtained results indicated that increasing oval slots area from 4 to 8 cm<sup>2</sup> for concave decreased the cutting length percentage from 68.9 to 64.5 % and 20.6 to 16.85 % of cutting length of <3.5 cm and 3.5-10 cm (first and second categories) of rice straw, from 72.5 to 65.3 % and 22.8 to 20.1% of maize stalks and from 65.4 to 61.5 % and 27.5 to 25.4% of cotton stalks respectively. While third category (<10 cm) was increased from 10.5 to 18.65 % of rice straw rice straw, from 5.7 to 14.2 % of maize stalks and from 7.1 to 13.1of cotton stalks respectively at 1.5 ton/h feed rate, 18.3m/s drum speed,14.3 % moisture content and 3 cm drum-concave clearance.

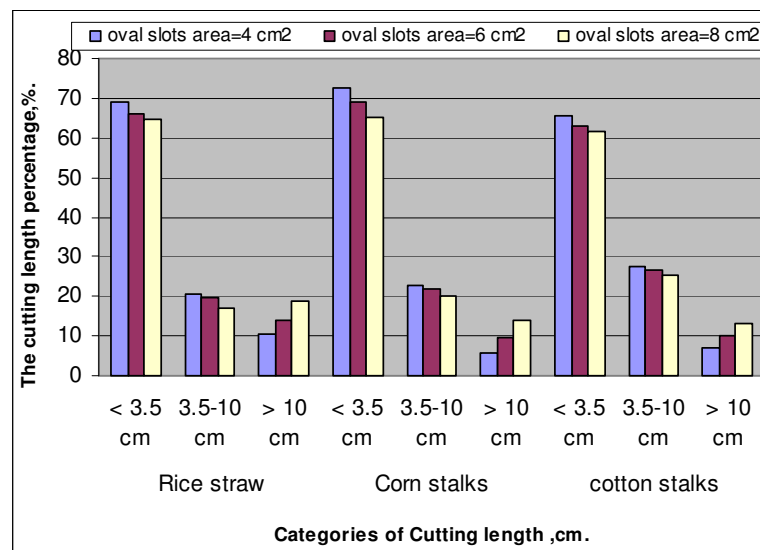


Fig.(2): the relation between the cutting length percentage % and categories of cutting length at different oval slots area for different crop residues.

For feeding animals suitable cut length as average was 3.5, 3.2 and 3 cm for rice straw, maize stalks and cotton stalks respectively. While for use in composting the cut length was (5.2-7.8),(5.5-6.4) and 4.5-6.1) cm for rice straw, maize stalks and cotton stalks respectively.

Rice straw gave the longest values of cutting length than cotton stalks or maize stalks at same operating parameters.

The reason may be due to rice straw has strong fiber contains silicon can not be cut easily and elongated before cutting. While the cotton stalks cut was the shorter than crop. residues because the cotton stalks has a solid cross-section and that wanes the chopping easier. on the other hand the difference in cut length for different crop residues was due to the difference in physical and mechanical properties of plant stalks

**2-feed rate .**

Fig.(3): the relation between the cutting length percentage % and categories of cutting length at different feeding rate for different crop residues.

The obtained results indicated that increasing feed rate from 0.5 ton/h to 1.5 ton/h, decreased the percentage of cut length of <3.5 cm (first category) from 78.5 to 70.2 % of rice straw, from 80.2 to 75.2 % of corn stalks and from 70.4 to 66.7 %of cotton stalks respectively. While the second and third categories (3.5 -10 cm and <10 cm) was increased from 16.2 to 20.7 % and 5.3 to 9.1%of rice straw, from 15.3 to 18.3 and 4.5 to 6.5% of corn stalks and from 19.0 to 21.1 % and 10.6 to 12.2 % of cotton stalks respectively at 4 cm<sup>2</sup> oval slots concave, 18.3m/s drum speed,14.3 % moisture content and 3 cm drum-concave clearance.

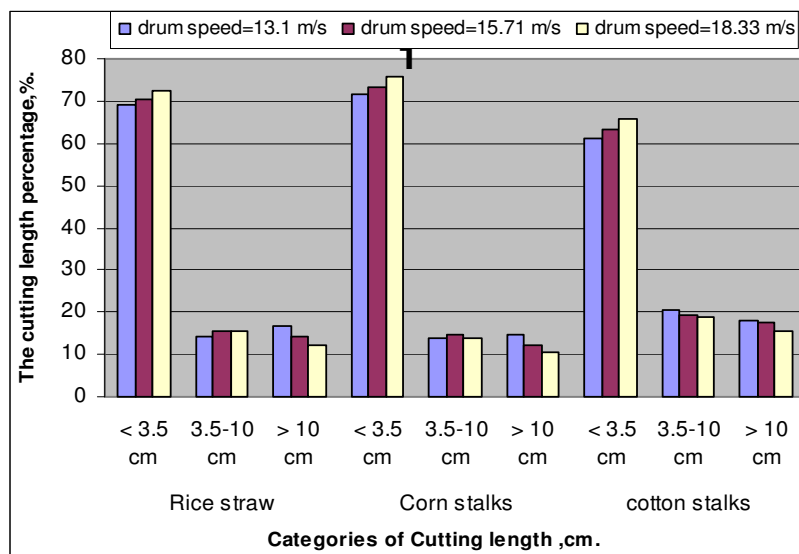


Fig.(3): the relation between the cutting length percentage % and categories of cutting length at different feeding rate for different crop residues.

### **3-chopping drum speed.**

Fig.(4): the relation between the cutting length percentage % and categories of cutting length at different drum speed for different crop residues. The obtained results indicated that increasing drum speed from 13.1 to 18.33 m/s, increased the percentage of cut length of <3.5 cm (first category) from 69.1 to 72.26 % of rice straw, from 71.5 to 75.61 % of corn stalks and from 61.3 to 65.81 % of cotton stalks respectively. While the second category (3.5 -10) cm was increased from 14.2 to 15.64 % of rice straw, from 13.9 to 14.89 % of corn stalks and reduced from 20.9 to 18.9 % of cotton stalks respectively.

Thus the third category (>10 cm) was decreased from 16.7 to 12.1 % of rice straw, from 14.6 to 10.5 % of corn stalks and from 18.2 to 15.3 % of cotton stalks at 4 cm<sup>2</sup> oval slots concave, 1.5 ton/h feed rate, 14.3 % moisture content and 3 cm drum-concave clearance.

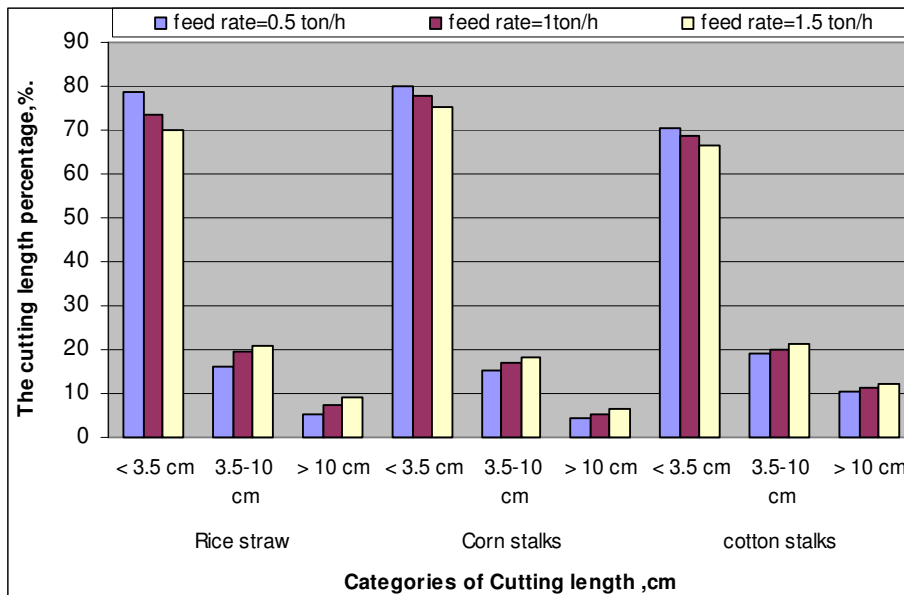


Fig.(4): the relation between the cutting length percentage % and categories of cutting length at different drum speed for different crop residues.

### **4- moisture content.**

Fig.(5): the relation between the cutting length percentage % and categories of cutting length at different moisture content for different crop residues.

The obtained results indicated that increasing moisture content from 6.5 to 14.3%, decreased the percentage of cut length of <3.5 cm (first category) from 82.1 to 68.2 % of rice straw, from 85.6 to 70.3 % of corn stalks and from 80.1 to 70.1 % of cotton stalks respectively. While the second and third categories (3.5 -10 cm and <10 cm) was increased from 14.4 to 22.9 % and 3.5 to 8.9% of rice straw, from 10.1 to 22.5% and 4.3 to 7.2% of corn stalks and from 14.7 to 21.4 % and 5.2 to 8.5 % of cotton stalks respectively at 4 cm<sup>2</sup> oval slots concave, 1.5 ton/h feed rate, 18.3m/s drum speed and 3 cm drum-concave clearance.

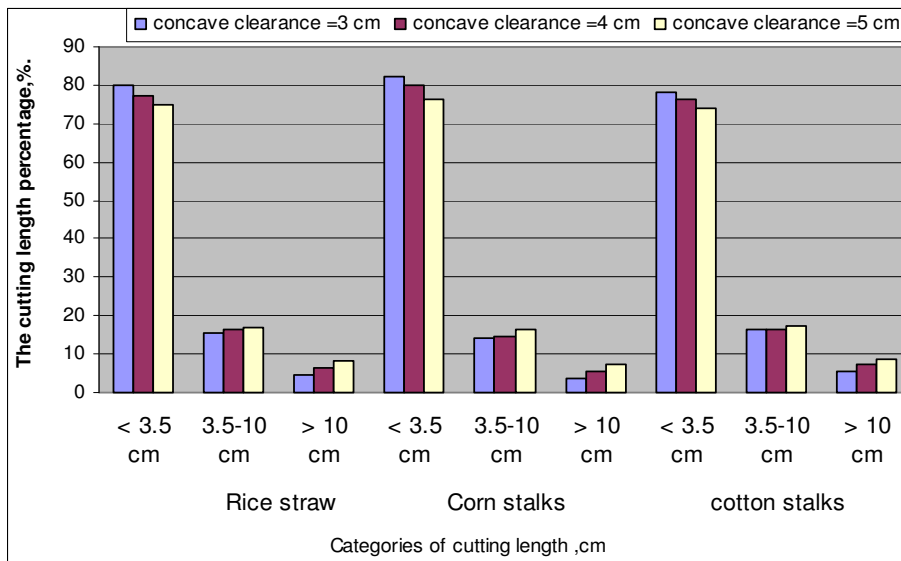


Fig.(5): the relation between the cutting length percentage % and categories of cutting length at different moisture content for different crop residues.

**5-Drum- concave clearance.**

Fig.(6): the relation between the cutting length percentage % and categories of cutting length at different concave clearance for different crop residues.

The obtained results indicated that increasing concave clearance from 3 to 5 cm, decreased the percentage of cut length of <3.5 cm (first category) from 80.1 to 75.1 % of rice straw, from 82.3 to 76.4 % of corn stalks and from 78.3 to 74.1 % of cotton stalks respectively. While the second and third categories (3.5 -10 cm and <10 cm) was increased from 15.4 to 16.7 % and 4.5 to 8.2 % of rice straw, from 14.2 to 16.5 and 3.5 to 7.1% of corn stalks and from 16.3 to 17.4 % and 5.4 to 8.5 % of cotton stalks respectively.

stalks respectively at 4 cm<sup>2</sup> oval slots concave, 1.5 ton/h feed rate, 18.3m/s drum speed and 14.3 % moisture content.

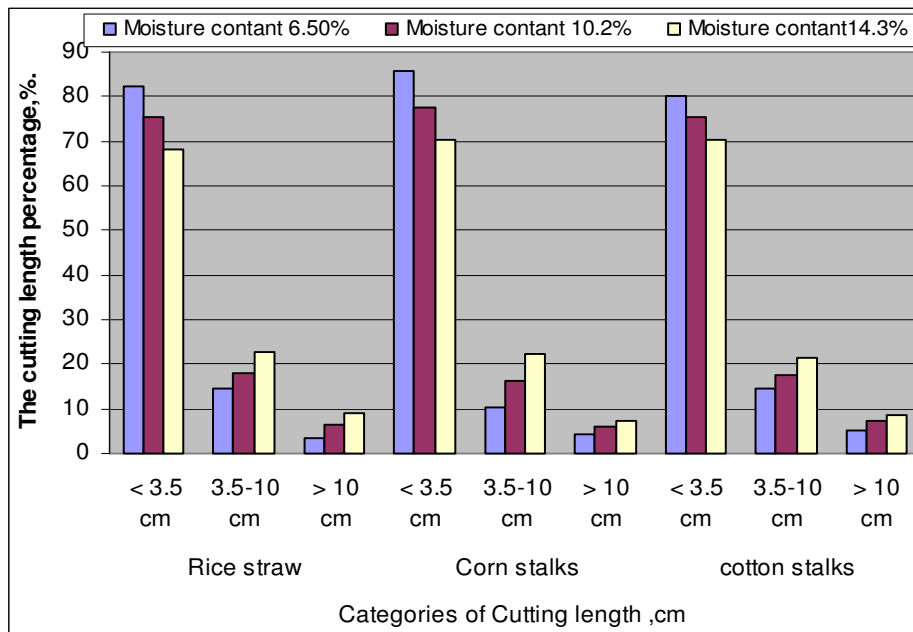


Fig.(6): the relation between the cutting length percentage and categories of cutting length at different concave clearance for different crop residues.

### **B-power consumption and energy requirement.**

Fig.(7and 8) the relation between power consumption and energy requirement and different factors.

The results show that the power consumption and energy requirement for cutting different residues was increased with increasing drum speed, feed rate and moisture content for different crops residues but the power consumption and energy requirement were decreased by increasing oval slots area and concave clearance.

The power consumption and energy requirement were increased from 22.5 to 40.1 kW and from 15.3 to 26.7 kW.h/ton of cutting rice straw, from 20.3 to 38.2 kW and from 13.5 to 25.46 kW.h/ton of cutting cotton stalks and from 18.6 to 35.6 kW and from 12.4 to 23.7 kW.h/ton of cutting corn stalks whenever the drum speed increased from 13.1 to 18.32 m/s.

Thus The power consumption and energy requirement were increased from 28.1 to 43.4 kW and from 18.7 to 28.9 kW.h/ ton of cutting rice

straw, from 27.5 to 40.9 kW and from 18.3 to 27.3 kW.h/ton of cutting cotton stalks and from 25.2 to 38.7 kW and from 16.8 to 25.8 kW.h/ton of cutting corn stalks whenever the feed rate was increased from 0.5 to 1.5 ton.

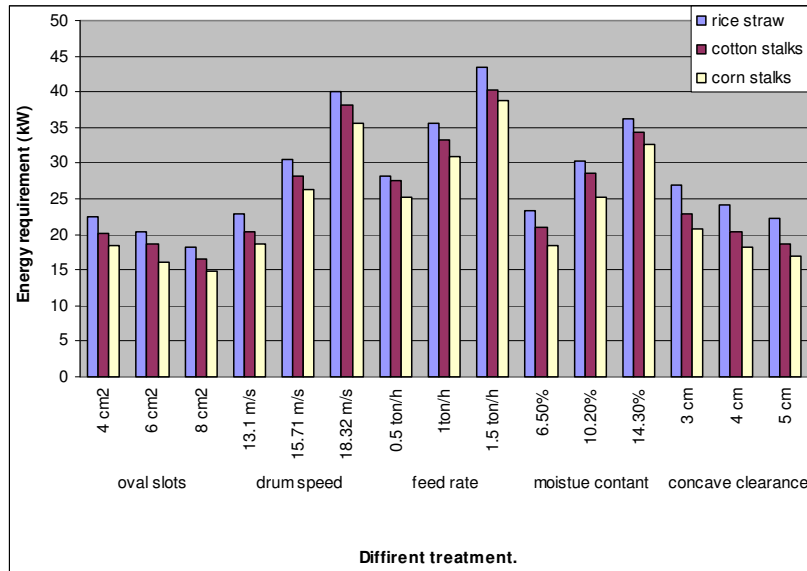


Fig.(7):the relation between power consumption and different factors.

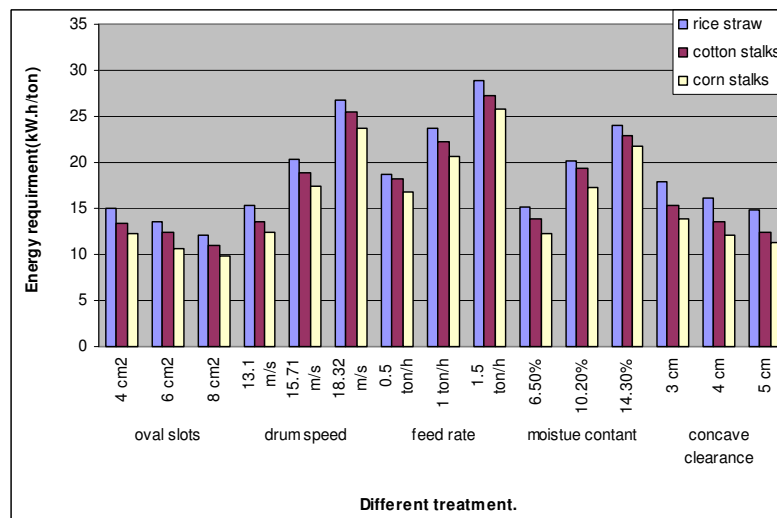


Fig.(8): the relation between energy requirement and different factors.

So, The power consumption and energy requirement were increased from 23.2 to 36.2 kW and from 15.2 to 24.1 kW.h/ton of cutting rice  
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straw, from 20.9 to 34.3 kW and from 13.9 to 22.9 kW.h/ton of cutting cotton stalks and from 18.5 to 32.6 kW and from 12.3 to 21.7 kW.h/ton of cutting corn stalks, whenever the moisture content was increased from 6.5 to 14.3% .

Also, The power consumption and energy requirement were decreased from 22.5 to 18.2 kW and from 15 to 12.1 kW.h/ton of cutting rice straw, from 20.1 to 16.5 kW and from 13.4 to 11 kW.h/ton of cutting cotton stalks and from 18.5 to 14.8 kW and from 12.3 to 9.9 kW.h/ton of cutting corn stalks, whenever the oval slots area was increased from 4 to 8 cm<sup>2</sup> .

The power consumption and energy requirement were decreased from 26.9 to 22.2 kW and from 17.9 to 14.8 kW.h/ton of cutting rice straw, from 22.9 to 18.6 kW and from 15.3 to 12.4 kW.h/ton of cutting cotton stalks and from 20.8 to 16.9 kW and from 13.9 to 11.3 kW.h/ton of cutting corn stalks, whenever the concave clearance was increased from 3 to 5 cm .

The evaluation of power consumption and energy requirement were at 1.5 ton/h feed rate of rice straw , cotton stalks and corn stalks. It could be remarked that the power consumption and energy requirement for cutting rice straw were higher than that for cutting cotton stalks and corn stalks. This may be due to the difference in physical and mechanical properties of different residues.

#### **C-Operation cost :**

The operation cost ( LE/h and LE/tan) of the stationary researcher machine was calculated during cutting rice straw , corn stalks and cotton stalks under maximum feeding rate, drum speed, moisture content, concave clearance and oval slots area. The maximum obtained operation costs were found to be 25 LE/h and 17 LE/tan for cutting rice straw residues.

### **CONCLUSION**

The main results in this study can be summarized as follows:-

1-farmers can use the stationary threshing machine in the chopping from crop residues. it was succeeded with rice straw, cotton stalks and corn stalks for cutting the proper length, which can be used composting as the particular cutting size about 0.5-3 inches (1.27-7.62) cm, Luis et al.1993 and for feeding animal suitable (cut length <3 cm according to Lashin et al 1993).

- 2-The increasing of oval slots area decreasing the percentage of cut length of less than 3.5 cm. While increasing the cut length of 3.5-10 cm and more than 10 cm of all crop residues under study.
- 3-The increasing of feeding rate decreasing the percentage of cut length of less than 3.5 cm. While increasing the cut length of 3.5-10 cm and more than 10 cm of all crop residues under study.
- 4-The increasing of drum speed increasing the percentage of cut length of less than 3.5 cm and 3.5-10 cm. while reducing the cut length of >10 cm of all crop residues under study.
- 5-The increasing of moisture content decreasing the percentage of cut length of less than 3.5 cm. While increasing the cut length of 3.5-10 cm and more than 10 cm Of all crop residues under study.
- 6-The increasing of concave clearance decreasing the percentage of cut length of less than 3.5 cm. While increasing the cut length of 3.5-10 cm and more than 10 cm of all crop residues under study.
- 7-Increasing the concave oval slots area decreased power consumption and energy required.
- 8-Increasing the drum speed increased power consumption and energy required.
- 9-Increasing the feed rate increased power consumption and energy required.
- 10-Increasing the moisture content increased power consumption and energy required.
- 11-Increasing drum-concave clearance decreased power consumption and energy required.
- 12-The option condition for operating were conducted at 4 cm<sup>2</sup> oval slots concave, 1.5 ton/h feed rate, 18.3m/s drum speed and 14.3 % moisture content and 3 cm drum-concave clearance,43.4 kW power consumption, 28.9 kW.h/ton, 25 LE/h and 17 LE/ton.

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### الملخص العربى

## تطوير ماكينة الدراس البلدى لفرم المخلفات الزراعية

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التخلص من المخلفات الزراعية لدى المزارعين بالحرق طريقة خاطئة تعمل على تلوث البيئة وفضل طريقة للتخلص من المخلفات الزراعية فرمها وتقطيعها لاعادة تدويرها والاستفادة منها فى الصناعات المختلفة مثل السماد العضوى لتحسين التربة وتغذية الحيوان ونتاج الغاز الطبيعى والطاقة المباشرة والخشب المضغوط وغيرها من المجالات .

ويهدف هذا البحث الى تطوير ماكينة الدراس القديمة لدى المزارعين ( التى اصبحت ليس لها فائدة بعد انتشار الات الدراس والتذرية الجديدة ) لفرم وتقطيع مخلفات المحاصيل الحقلية عن طريق زيادة انتاجها والحصول منها على اطوال مختلفة تناسب المجالات العديدة التى تستخدم فيها وتقليل تكاليف تشغيلها وبذلك يمكن تقليل تكاليف استيراد وتصنيع الات الفرمة . حيث تم اجراء تعديلات على صدر الماكينة وتغير الخلوصل بين الدرفيل والصدر لكى تلائم عملية الفرمة والتقطيع . وقد اجريت هذه التجارب فى قرية بهناى مركز الباجور- المنوفية خلال الموسم الصيفى لعام 2005 على ثلاث انواع مختلفة من المخلفات الزراعية وهى قش الارز وسيقان الاذرة وحطب القطن.

وللوصول الى هدف الدراسة قد تم تقييم اداء الاله المعدلة بتشغيلها بمتغيرات دراسية هى ثلاث معدلات تغذية 0.5 ، 1.0 ، 1.5 طن/ساعة وثلاث سرعات لدرفيل الفرمة هى 13.1 ، 15.7 ، 18.3 م/ث وثلاث مستويات لمساحة ثقب الصدر 4 ، 6 ، 8 سم<sup>2</sup> وثلاث مستويات للخلوصل بين الدرفيل والصدر 3 ، 4 ، 5 سم.

وقد اوضحت النتائج امكانية استخدام اله الدراس القديمة فى فرم وتقطيع المخلفات الحقلية بكفاءة عالية تحت ظروف تشغيل استخدمت فيها مساحة ثقب الصدر 4 سم<sup>2</sup> وسرعة درفيل الصدر 18.3 م/ث ومعدل تغذية 1.5 طن/ساعة ومحتوى رطوبى للمخلفات 14.3 % والخلوصل بين الدرفيل والصدر 3 سم اعطت نسبة طول قطع لاقبل من 3.5 سم ( 82.1 ، 85.6 ، 80.1 % ) والقدرة المستهلكة ( 43.4 ، 40.3 ، 38.7 كيلو وات/ساعة ) والطاقة المستهلكة ( 28.9 ، 27.3 ، 25.8 كيلو وات. ساعة/طن ) لكل من قش الارز وسيقان الاذرة وحطب القطن على الترتيب .

وأعلى تكاليف تشغيل كانت لمحصول الارز 25 جنيه/ساعة و 17 جنيه/طن .

باحث بمعهد بحوث الهندسة الزراعية