

DEVELOPMENT OF A RICE STRAW BALES CHOPPER

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ABSTRACT

The present research work was carried out in Rice Mechanization Center at Meet El Deeba, Kafr El-Sheikh Governorate to develop and evaluate the performance of a rice-straw bales chopper.

The field experiments were conducted to determine the suitable operation parameters to reach the straw lengths suitable for the manufacture of animal feed and compost.

The results indicated that , the optimum operation parameters were cutting-knives speed of 1260 rpm (26.4 m/s), platform tilt-angle of 20 degree, 24 cutting knives and claws (or cutting-knives) spacing of 6 cm, which gave the average cutting-length of rice straw about 5.19 cm, cutting-length percentage of rice straw < 8 cm around 74.54 %, machine productivity of 892 kg/h, power requirement about 5.05 kW and specific energy of 5.67 kW.h/t., the operation and production costs according to prices of year 2015 were 13.63 L.E./h and 15.27 L.E./ton, respectively .

INTRODUCTION

Rice straw is one of the most residues problems in Egypt. Egyptian farmers burn About 4 million tons of rice straw yearly for disposing it and gave the chance to prepare the field to planting next crop. The burning of rice straw in the farms causes of dangerous phenomenon of soil and air pollution (El-Berry et al.,2001). There are great efforts towards recycling rice straw in a useful uses will help keeping safety on environment in addition to increase the national income of country. Therefore the rice-straw chopping process is very necessary as a pretreatment to reuse the rice straw in different uses such as animal fodder and compost. The chopping process can be done by using variable type of chopping machines, but the productivity of these choppers is still little, not covering the farmer's needs in addition to the high operation and production cost of the rice-straw chopping process (Arif, 1999).On the other hand, recycling of rice-straw residues and utilization from it in variable fields required transport the rice straw in form bales from field to production place. Where chopping process take place to increase use of rice-straw residues efficiently either as animal fodder or compost. Therefore, the rice-straw bales chopper developed to overcome the previous problems. Luis et al. (1993) mentioned that, in compost practice the appropriate cutting length of rice straw, which can be used in composting should be within the range of about 1.27–7.62 cm. El-Iraqi and El-Khawaga (2003) designed and evaluated a machine for cutting crop residues. They found that the maximum percentage cutting-length of rice straw less than 5 cm about 87.80 % was investigated at using feeding rate 0.771 ton/h and cutting speed 10.09 m/s.

Meanwhile, they found the energy requirement was 6.36 kW.h/ton. The maximum operating and production cost were 5.10 L.E/h and 6.61 L.E/ton for cut rice straw residues. Abo-Habaga and Khader (2005) developed of a combined cutting-unit with harvesting combine machine. They showed the effect of cutting speed on the length of cutting straw. About 27% from straw length < 5 cm recorded at cutting speed 12.65 m/s, while rice-straw length between 5-15 cm was about 54% and rice-straw length > 15 cm was about 19%.The main straw cutting-length was 8.18 cm. Meanwhile, cutting speed 11.43 and 9.15 m/s recorded straw cutting-length about "24, 51 and 25%" and "22, 49 and 29%", with main straw cutting-length about 10.98 and 11.78 cm respectively. Chou et al. (2009) used a chopping system to cut rice straws into smaller sizes (10-5, 5-2 and <2 mm). They indicated that by increasing the rotation speed, the average feed rate increased. The average feed rate increased from 2.3 to 2.5 kg/min by increasing the rotation speed from 620 to 980 rpm for cutting-length straw of 10 mm. El-Hanfy and Shalby (2009) modified and evaluated the Japanese combine chopping-unit. They found that the lowest average of cutting length was obtained at forward speed 0.75 m/sec and cutting speed 550 rpm, meanwhile the highest value was obtained at forward speed 0.35 m/sec and cutting speed 450 rpm. Arfa (2007) subdued the stationary thresher machine for chopping residues and indicated that by increasing feed rate from 0.5 ton/h to 1.5 ton/h, the percentage cutting-length of rice straw for first category (<3.5 cm) decreased from 78.5 to 70.2 %. Meanwhile the percentage cutting-length of rice straw for 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% at 4 cm² oval slots concave, 18.3m/s drum speed,14.3 % moisture content and 3 cm drum-concave clearance. El-fatih et al (2010) modified and evaluated chopper for rice straw composting. They indicated that the relationship between cutting drum speed and chopper productivity, power requirement and consumed energy at different concave holes diameter. By increasing the cutting-drum speed from 56.6 m/s to 70.7 m/s, the productivity increased from 489 kg/h to 1150 kg/h, from 430 kg/h to 976 kg/h, and from 350 kg/h to 600 kg/h for 35 mm, 25 mm, and 9 mm concave hole diameter, respectively. Also, by increasing the cutting-drum speed from 56.6 m/s to 70.7 m/s, the consumed power increased from 2.15 kW to 3.4 kW, from 3 kW to 4.2 kW, and from 4.3 kW to 6.71 kW for 35 mm, 25 mm, and 9 mm concave holes diameter, respectively. Meanwhile, by increasing the cutting drum speed from 56.6 m/s to 70.7 m/s, the consumed energy decreased from 4.4 kW.h/ton to 2.96 kW.h/ton, from 6.98 kW.h/ton to 4.3 kW.h/ton, and from 12.29 kW.h/ton to 11.18 kW.h/ton for 35 mm, 25 mm, and 9 mm concave holes diameter respectively. The objective of this study is to develop and evaluate the performance of a rice-straw bales chopper to produce the suitable straw lengths for the manufacture of animal feed and compost.

MATERIALS AND METHODS

Materials:

The developed rice-straw bales chopper:

The elevation and side views of the developed rice-straw bales chopper are shown in fig.1. The developed rice-straw bales chopper consists of the following parts:

Main frame:

The main frame of the developed rice-straw bales chopper is made from iron sheet with 5 mm thickness. The main frame consists of two welded parts (horizontal base and vertical part). The horizontal base has dimensions of 118 x 90 x 29 cm, length, width and height respectively. The main dimensions of the vertical part are 90 cm length, 47 cm width and 175 cm height. To keep the static and dynamic balance of manufactured chopper parts, it was regarded that the vertical frame part should be inclined by tilt angle of 75° with respect to the horizontal frame base.

Feeding platform:

The feeding platform is made from iron sheet with 5 mm thickness, 4 cm height, 100 cm length and 80 cm width mounted on the machine frame by means of two arms with two threads. The two threads are welded of the two arms to control feeding platform tilt-angle. Two movable wings are fitted with the two sides of the feeding gate to guide the rice straw bales towards the cutting mechanism. Each wing is made from sheet iron with 5 mm thickness, top length of 15 cm, bottom length of 50 cm and height of 24 cm.

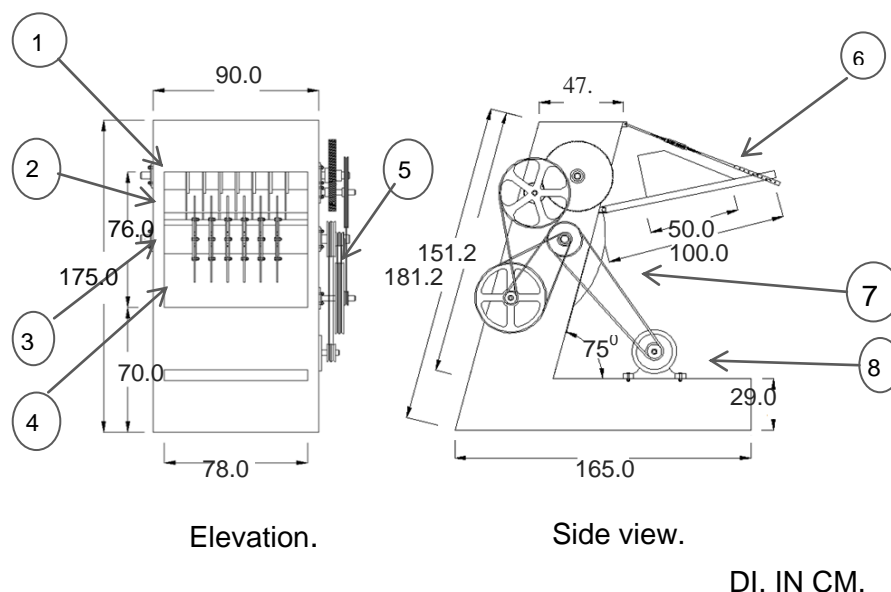
Cutting mechanism:

The cutting mechanism consists of the following parts:

Claw-discs drum:

- (a) **Claw discs:** Seven claw-discs are made from iron sheet with 7 mm thickness and 40 cm diameter. Each disc has eight fingers. The claw disc has a sleeve ring in the center of disc. The sleeve ring of 2 cm width, 16.1 cm inside diameter and 20 cm outside diameter is welded with claw disc. The claw discs are fitted with claws drum by means of four counter sunk-head bolts.
- (b) **Claws drum:** Claws drum is made from steel pipe with 16 cm diameter, 84 cm length and 3 mm thickness. Two flanges each of 15.4 cm diameter and 2.5 cm thickness are welded on the two sides of the claws drum. The claws drum mounted on the machine frame by shaft with 40 mm diameter. The shaft consists of two parts welded in two flanges of the drum. The first and second parts of the claws-drum shaft have lengths of 10 and 20 cm. The claws-discs spacing can be adjusted by means of four counter sunk head bolts.

The claws-discs spacing is ranged between 6 and 9 cm. The claws drum is fitted on the front of feeding platform to catch and drag the rice straw from bale and feed it into cutting mechanism.



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No.	Items	No.	Items
1	Claws drum	5	power transmission unit
2	fixed knives	6	feeding platform
3	flail-knives drum	7	solid concave
4	flail cutting-knives	8	Electrical motor

Fig. 1: Sketched views of the developed rice-straw bales chopper.

Cutting knives:

(a) **Flail knives:** Twenty four flail knives are made from spring steel with thickness of 7 mm, length of 14 cm, width of 5 cm, and sharp-edge thickness of 1 mm. The flail knives statically and dynamically were balanced with respect to the cutting drum at private workshop. Four flail knives are bolted between two flanges. The two flanges are assembled with sleeve ring by welding. The diameter and thickness of flange were 24 cm and 7 mm respectively. The diameter, thickness and width of sleeve ring were 20 cm, 2.1 cm and 4 cm respectively. Each flail knife was assembled with two flanges by bolt. Knives drum was made from steel pipe with 16 cm diameter, 84 cm length and 5 mm thickness. The knives drum is mounted on the machine frame by shaft with diameter of 50 mm. The shaft consists of two parts which is welded in two drum-flanges. The first and second parts of the knives-drum shaft have lengths of 10 and 20 cm respectively.

(b) **Fixed knives:** Four U-shape fixed knives were made from steel plate with 10 cm, 4 cm and 7 mm length, width and thickness respectively. The fixed knives are assembled with a U-angle with 87 cm, 4 cm and 2 mm length, width and thickness respectively. The U-angle is bolted with solid concave underneath claws. The U-shape fixed knives assist claws to

catch the two edges of rice-straw bale to be cut by flail knives. Flail knives rotate inside the U-shape fixed knives.

Power transmission system:

The power is transmitted from an electrical motor of 15.4 kW (20 hp) and 1500 rpm. It was assembled with the frame to drive all mechanisms of the developed rice-straw bales chopper by means of pulleys and v-belts. The motor pulleys transmit power to double-grooves pulley. The diameters of the pulley on the motor shaft are 10, 12.3, 14.5, and 16.8 cm. The motor pulley shaft is equipped the knives pulley at first groove diameter of 20 cm, and at second groove diameter of 8 cm, which is connected with the first groove of idler pulley with diameter of 40 cm. The second groove of idler pulley of 8 cm is connected with another idler pulley with diameter of 40 cm. The small gear with diameter 12 cm and number of teeth of 31 is bolted in the same shaft of last idler pulley. The small gear is connected with the claws gear with diameter of 40 cm and number of teeth 108. The above mentioned power transmission arrangement allowed, knife speeds and claw speeds as shown in table (1).

Table (1): Tested motor-shaft pulley diameters, knife speeds and claw speeds.

Motor pulley diameter, cm.	Knives speed, rpm.	Knives speed, m/s.	Claws speed, rpm.	Claws speed, m/s.
10.0	750	15.71	9	0.19
12.3	920	19.28	11	0.23
14.5	1090	22.84	13	0.27
16.8	1260	26.4	15	0.31

Rice-straw bales.

The straw-bales were collected using conventional baler which picks up straw from the windrow left by the combine harvester and storage in safety place. The tested bales are automatically wrapped and knotted with two single twine ties.

The specifications of tested straw-bales were as follows:

- Mean dimensions of tested straw-bales were 100 cm length, 50 cm width and 40 cm height.
- Average moisture-content of 14.2 % was obtained after one year storage time.
- Average density was of 45.46 kg/m³.
- The range of stem length was 30 - 40 cm.
- The range of bale mass was 10 - 13 kg.

Instrumentations:

Speedometer (tachometer): Digital photo / contact tachometer (Taiwan manufacture) ranged from 0,5 to 19999 rpm with accuracy (± 0.05 %) was used to measure the rotation speed of the machine shafts.

clamp meter: Super clamp meter 700k 600v~Ac 50 Hz. (Japanese manufacture) with accuracy (± 0.5 Ampere) was used to measure the current intensity and voltage respectively.

Hay-moisture tester: Model (HTM-1) ranged from 13 to 40% was used to measure the moisture content of the straw bales.

Digital balance: (Japanese manufacture) ranged from 0 to 200 g. with accuracy (± 0.001 g.) was used to weight the chopped samples of rice straw.

Stop watch: (Japanese manufacture) with accuracy (0.01s.) was used to measure the operation time for each investigated treatments.

Methods:

The developed rice-straw bales chopper was tested in Rice Mechanization Center, Meet El-Deeba, Kafr El-Sheikh Governorate, Egypt during summer season of 2015.

Studied parameters:

Experiments were conducted to study three main factors that affecting the performance of the developed chopping machine. The studied parameters were as follows:

- (a) **Flail cutting knives and claws speeds:** The investigated levels of flail cutting-knife speeds were 750, 920, 1090 and 1260 rpm (15.71, 19.28, 22.84 and 26.4 m/s). Meanwhile, the claw speeds levels were 9, 11, 13 and 15 rpm (0.19, 0.23, 0.27 and 0.31 m/s) respectively.
- (b) **Number of flail cutting knives:** 12 and 24 flail cutting-knives were tested.
- (c) **Feeding platform tilt-angle:** The tested feeding platform tilt-angles were 20, 25 and 30 degree.

Measurements:

- (1) **Average and percentage of cutting-length:** Average of cutting length was measured from chopped rice-straw sample of 200 g for each treatment. The four categories of < 4 cm, > 4 - 8 cm, 8 – 12 and > 12 cm were measured. Also each cutting length in the sample was weighed and calculated as a percentage from the total weight of the sample (Iraqi and Khawaga, 2003).
- (2) **Machine productivity:** Machine productivity was calculated by using the following equation (Mady, 1999).

$$P = W / t \dots\dots\dots(1)$$

Where:

- P : Machine productivity, kg/h,
- W: Mass of the rice straw bale, kg and
- t = Time, h.

- (3) **Power requirement and Specific energy:** The electrical power requirement (kW) was calculated by using the clamp meter to measure the line current strength in Amperes (I) and potential difference values (v). The required power of developed machine with and without load (p) was calculated according to Kurt, 1979 by using the following equation:

$$P = \sqrt{3} \times I \times V \times \eta \times \text{Cos } \theta / 1000 \dots\dots\dots (2)$$

Where:

- P : Power requirement for the cutting machine in kW,
- I : Line current strength in amperes,
- V : Potential difference (Voltage) being equal to 380 V,
- Cos θ : Power factor (being equal to 0.85),

$\sqrt{3}$: Coefficient current three phase (being equal 1.73) and
 η : Mechanical efficiency assumed (95 %).

The Specific energy was calculated by using the following equation:

$$\text{Specific energy, kW. h/ton} = \frac{\text{Power, kW}}{\text{Productivity, ton/h.}} \dots\dots\dots(3)$$

(4): Estimating the costs of using the machines.

Cost of operation was calculated according to the equation given by Awady (1978), in the following form:

$$C = p/h (1/a + i + t/2 + r) + (Ec * Ep) + m/144 \dots\dots\dots (4)$$

Where:

- C : hourly cost, LE/hr.
 - p : price of machine, LE.
 - h : yearly working hours, h.
 - a : life expectancy of the machine, year.
 - i : interest rate/year
 - t : taxes, (0.05).
 - r : overheads and indirect cost ratio,(0.03).
 - Ec : Electricity consumption kW,
 - Ep : Electricity price L.E/kW.h,
 - m : Monthly wage and "144" are estimated monthly working hours.
- Notice that all units have to be consistent to result in L.E/h.

$$\text{Production cost, L.E./ton} = \frac{\text{Operation cost (L.E./h)}}{\text{Machine productivity, ton/h.}} \dots\dots\dots (5)$$

RESULTS AND DISCUSSION

Effects of studied parameters on average cutting-length of rice straw.

Figs. 2 and 3 shows the effect of cutting-knives speed, platform tilt-angle and number of knives on average cutting-length of rice straw.

The results in fig. 2 indicated that increasing of cutting-knives speed number of knives and decreasing of platform tilt-angle reducing the average cutting-length of rice straw.

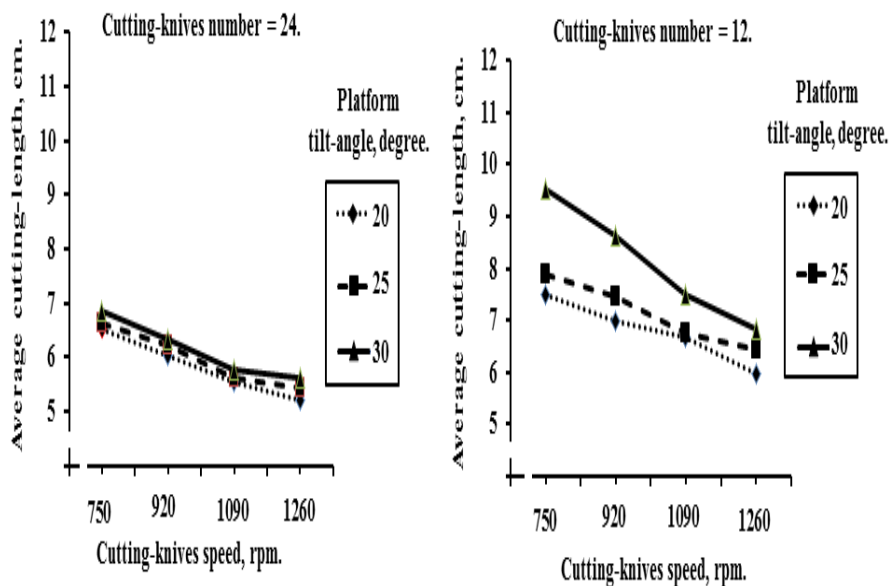


Fig. 2: Effects of studied parameters on average cutting-length of rice straw.

Data in fig. 3 indicated that the maximum percentage of rice-straw size less than 8 cm (< 4 and 4 – 8 cm) about “74.54, 70.39, 65.26 %” and “65.85, 62.53, 58.42 %” were obtained by using knives speed of 1260 rpm (26.4 m/s) at No. of 24 and 12 cutting knives for platform tilt-angle 20, 25 and 30 degree respectively. Meanwhile, the minimum percentage of rice-straw size less than 8 cm (< 4 and 4 – 8 cm) of “63.01, 58.66, 53.79 %” and “50.56, 46.91, 43.27%” was obtained by using cutting-knives speed of 750 rpm (15.71 m/s) at 24 and 12 cutting knives for platform tilt-angle 20, 25 and 30 degree respectively.

It can be noticed that the decreasing of average cutting-length of rice straw and percentage of rice-straw size less than 8 cm by increasing cutting-knives speed and number of knives is due to increasing number of impacts of flail knives to rice stalks. Meanwhile, the increasing of average cutting-length of rice straw and percentage of rice-straw size more than 8 cm by increasing platform tilt-angle is due to increasing feeding rate of rice straw according to increasing the weight of rice straw bale on claws drum.

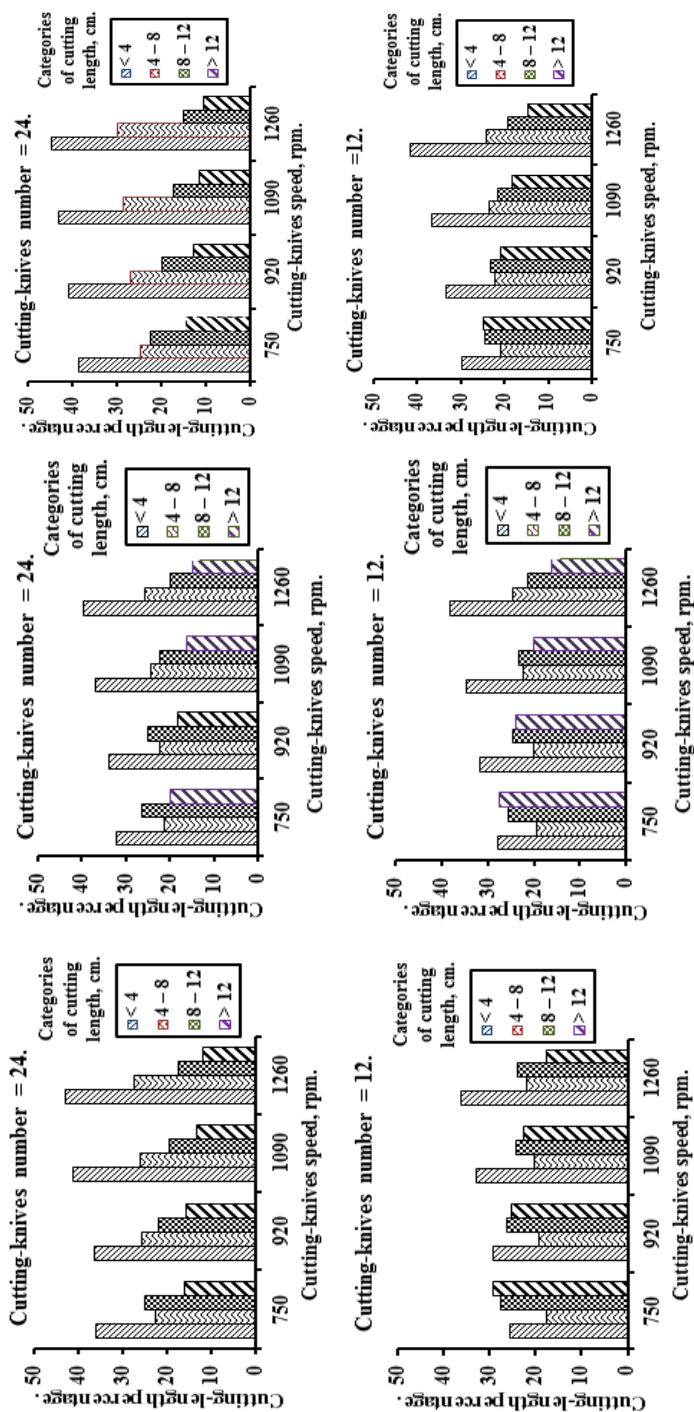


Fig. 3: Effect of cutting-knives speed on cutting-length percentage of rice straw at different platform tilt-angles and number of knives by using claws (or cutting-knives) spacing of 6 cm.

Effects of knives speed and platform angle on machine productivity.

Fig. 4 shows the increase of cutting-knives speed and platform tilt-angle increasing of machine productivity.

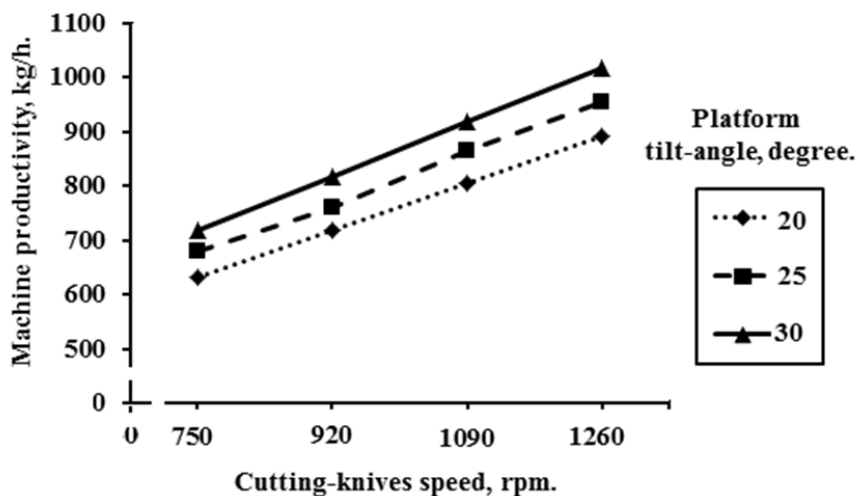


Fig. 4: Effects of knives speed and platform angle on machine productivity.

The maximum value of machine productivity about 1017 kg/h was obtained by using cutting-knives speed of 1260 rpm (26.4 m/s) and platform tilt-angle of 30 degree. Meanwhile, the minimum value of machine productivity arranged 631 kg/h was obtained by using cutting-knives speed of 750 rpm (15.71 m/s) and platform tilt-angle of 20 degree.

Increase the claws speed and platform tilt-angle led to increased feeding rate resulting in increased machine productivity.

Effects of the studied parameters on power requirement and specific energy.

Figs. 5 and 6 shows the effect of cutting-knives speed, platform tilt-angle at different number of cutting knives on power requirement and specific energy.

The maximum value of power requirement and specific energy about 7.17 kW and 7.75 kW. h/t were obtained by using cutting-knives speed of 1260 rpm (26.4 m/s) and 750 rpm (15.71 m/s), platform tilt-angle of 30 degree with using 24 cutting knives, respectively. Whereas, the minimum value of power requirement and specific energy about 3.72 kW and 5.07 kW.h/t were obtained by using cutting-knives speed of 750 rpm (15.71 m/s) and 1260 rpm (26.4 m/s), platform tilt-angle of 20 degree with using 12 cutting knives, respectively.

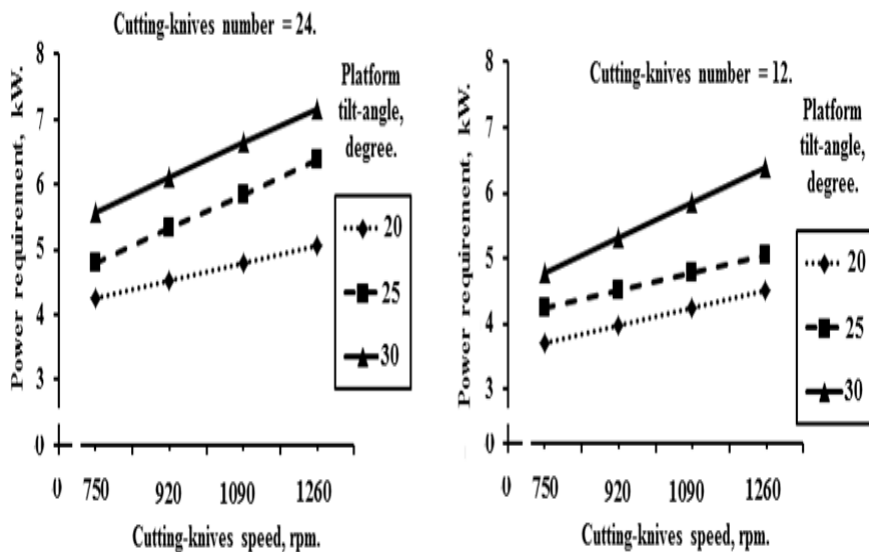


Fig. 5: The effects of cutting-knives speed, platform tilt-angle and number of knives on power requirement.

By increasing cutting-knives speed from 750 to 1260 rpm (from 15.71 to 26.4 m/s) the power requirement increased by 22.71 %. Meanwhile, the specific energy decreased by 8.32 %, for all tested number of knives and platform tilt-angles

By increasing number of knives from 12 to 24 the power requirement increased by 13.57 %. Meanwhile, the specific energy decreased by 13.48 % for all tested cutting-knife speeds and platform tilt-angle.

Increasing the number and speed of cutting-knives increased the mass of flail cutting knives and also the torque on cutting-knives shaft. Meanwhile, increasing platform tilt-angle due to increased of rice straw resistance faced to cutting-knives. Therefore, the power requirement was increased. In spite of increasing power required due to increased speed and number of knives, nevertheless, increase the machine productivity decreasing the specific energy.

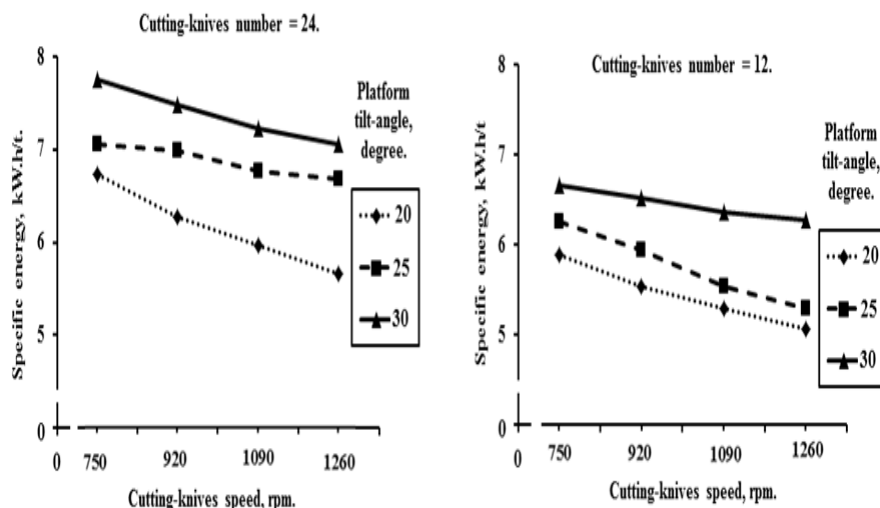


Fig. 6: The effects of cutting-knives speed, platform tilt-angle and number of knives on specific energy.

Cost estimation of using the developed rice-straw bales chopper.

The operation costs of the developed rice-straw bales chopper was calculated with using equation (4) according to prices of year 2015.

The results recorded that the operation costs about 13,63 L.E. / h and production costs under optimum operation condition (1260 rpm cutting knives speed, platform tilt-angle 20 degree with using 24 flail cutting knives) was about 15,27 L.E./ ton.

SUMMARY AND CONCLUSIONS

The present study indicated that the developed machine is suitable for cutting rice-straw bales in the appropriate lengths for the manufacture of animal feed and compost directly without the need to disassemble the necessary bales of labor and feed the machine, which reduces time and costs.

The optimum operation parameters were cutting-knives speed of 1260 rpm (26.4 m/s), number of cutting knives 24 and platform tilt-angle of 20 degree. The obtained results after using the optimum parameters were the average cutting-length of rice straw about 5.19 cm, cutting-length percentage of rice straw for small-size (< 8 cm) of 74.54 %, machine productivity of 892 kg/h, power requirement about 5.05 kW and specific energy 5.67 kW.h/t. The operation and production costs according to prices of year 2015 were 13.63 L.E./h and 15.27 L.E./ton at optimum conditions.

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تطوير آلة لفرم بالات قش الارز

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للاستفادة من قش الأرز والذي يبلغ مقداره أربعة ملايين طن سنوياً وتجنباً لمشكلة حرقه في الحقل، فيتم تجميعه في صورة بالات حتى يسهل نقله وتخزينه في مناطق التصنيع. وعند الاستخدام يراعى فك أربطة البالات وتلقيح الآلات لتقطيع القش مما يحتاج إلى عدد كبير من العمالة بالإضافة إلى الإنتاجية المنخفضة لآلات الفرمة المستخدمة مما يزيد من تكاليف الإنتاج. لذا يهدف هذا البحث لتطوير واختبار اداء آلة لفرم بالات القش مباشرة والتوصل إلى قطع قش أطولها تناسب تصنيع أعلاف الحيوانات وكذلك أنتاج السماد العضوي (الكومبوست).

تم اختبار الآلة المطورة في مركز ميكنة الأرز بميت الديبة - محافظة كفر الشيخ. وقد تم تقييم الآلة من خلال مجموعة من المتغيرات يمكن توضيحها فيما يلي:

- أربعة مستويات سرعة لسكاكين التقطيع هي ٧٥٠، ٩٢٠، ١٠٩٠، ١٢٦٠ لفة/دقيقة (١٥، ٢٨، ١٩، ٢٢، ٢٦، ٤٠ متر/ثانية).

- ثلاث مستويات لزوايا ميل طبلية التغذية هي ٢٠°، ٢٥°، ٣٠°.

- مستويان لعدد سكاكين التقطيع هي ١٢، ٢٤ سكين على درفيل التقطيع.

و قد تم التوصل إلى مجموعة من النتائج يمكن توضيحها أهمها فيما يلي:

١- زيادة سرعة سكاكين القطع مع تقليل زاوية ميل طبلية التغذية أدت إلى تقليل طول القش المقطع، حيث بلغ متوسط طول القش المقطع ١٩،٥ سم عند استخدام ٢٤ سكينه قطع بسرعة دوران ١٢٦٠ لفة/د. مع زاوية ميل طبلية التغذية ٢٠°. في حين كان متوسط طول القش المقطع ٩،٥٤ سم عند استخدام ١٢ سكينه بسرعة ٧٥٠ لفة/د. مع زاوية ميل طبلية التغذية ٣٠°.

٢- أعلى نسبة مئوية للقش المقطع بطول أقل من ٨ سم كانت (٧٥، ٧٠، ٦٥%) تحققت باستخدام سرعة سكاكين القطع ١٢٦٠ لفة/د. وعدد سكاكين ٢٤ سكينه عند زوايا ميل طبلية التغذية ٢٠°، ٢٥°، ٣٠° على الترتيب. في حين أقل نسبة مئوية للقش المقطع بطول أقل من ٨ سم كانت (٥١، ٤٧، ٤٣%) تحققت باستخدام سرعة سكاكين القطع ٧٥٠ لفة/د. وعدد سكاكين ١٢ سكينه عند زاوية ميل طبلية التغذية ٢٠°، ٢٥°، ٣٠° على التوالي.

٣- أقصى إنتاجية للآلة كانت ١٠١٧ كجم/ ساعة تم الحصول عليها باستخدام سرعة سكاكين قطع ١٢٦٠ لفة/د. وزاوية ميل طبلية التغذية ٣٠°. بينما أقل إنتاجية للآلة كانت ٦٣٢ كجم/ ساعة تم الحصول عليها باستخدام سرعة سكاكين قطع ٧٥٠ لفة/د. وزاوية ميل طبلية التغذية ٢٠°.

٤- قدرت أقصى متطلبات قدرة لازمة لتشغيل الآلة عند سرعة تشغيل ١٢٦٠ لفة/د. وعدد سكاكين ٢٤ سكينه وزاوية ميل طبلية التغذية ٣٠° فكانت ٧،١٧ كيلو وات، بينما بلغت أقصى طاقة نوعية ٧،٧٥ كيلو وات. ساعة/طن عند نفس ظروف التشغيل مع سرعة دوران ٧٥٠ لفة/د. في حين سجلت أقل قدرة لازمة لتشغيل الآلة عند سرعة تشغيل ٧٥٠ لفة/د. وعدد سكاكين ١٢ سكينه وزاوية ميل طبلية التغذية ٢٠° فكانت ٣،٧٢ كيلو وات، بينما بلغت أقل طاقة نوعية ٥،٠٧ كيلو وات. ساعة/طن عند نفس ظروف التشغيل مع سرعة دوران السكاكين ١٢٦٠ لفة/د.

وبناء على ما سبق يوصى البحث الحالي بأن الآلة المطورة مناسبة جداً لفرم بالات قش الأرز مباشرة والتوصل بالقش المقطع إلى الأطوال المناسبة لتصنيع أعلاف الحيوانات والسماد العضوي (الكومبوست).