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DEVELOPMENT OF A CHOPPING MACHINE FOR AGRICULTURAL RESIDUAL (A CASE STUDY ON GRAPE TRASHES)

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ABSTRACT

The chopping mechanism of a stationary Japanese chopper has been developed at the workshop of Rice Mechanization Center, Meet El-Dyha, Kafr El-Sheikh Governorate during summer season of 2005. The modified chopping mechanism was proposed to avoid the continued vibrations as a result to extend the feeding interval and non-uniformity the distribution of dynamic load on the chopper i.e overload or no load which causes decrease the expected life time of chopper, productivity and efficiency of the machine as well as using a high levels from operating speeds to increase the chopper capacity and to improve its overall efficiency.

The feeding mechanism has been modified throughout using two drums to uniform the feeding and distribute the dynamic load consequently, reduce the vibrations and increase the machine stability. The cutting system has been modified throughout fixing an electrical motor, its power 5 kW 1500 r.p.m on the frame to obtain four different operating speeds by using two fabricated polleys with different diameters. A moving frame by three wheels was used instead of the fixed frame to facilitate the convaying, adjusting and operation of the chopper. The field experiment were conducted at four cutting speeds of 0.75, 1.19, 1.33 and 1.81 m/s as well as four feeding speeds of 0.28, 0.45, 0.75 and 1.22 m/s. Two different Shapes of cutting knives (straight sided-edge shaped and serrated edge) had been used for cutting the grape residuals. The cutting efficiency, productivity, cutting length and energy consumed compared with energy of local cutting tools were been studied. The obtained **results can be summarized as follows:**

Developing the feeding and cutting mechanisms of stationary Japanese chopper improved its performance through, increasing its productivity and efficiency as well as decreasing cutting energy and chopping lengths. The maximum value of machine efficiency (93.16%) and capacity (4.192 Mg/h) have been accomplished with feeding mechanism and cutterhead speeds of 1.22 and 1.88 m/s respectively, using serrated-edge shaped. But, at 0.28 m/s feeding mechanism speed and 1.88 m/s cutterhead speed gave the highest value of cutting efficiency (93.85%).

The minimum value of chopping length was 1.0 cm at feeding mechanism speed of 0.28 and 0.75 m/s using cutting knives of serrated-edge shaped while, the lowest value of energy consumed was 0.776 kW.h/Mg at 1.22 m/s feeding mechanism speed and cutterhead speed of 0.75 m/s. The optimum performance of the developed chopper was obtained at feeding mechanism speed of 0.28 m/s and cutterhead speed of 1.88 m/s by using cutting knives of serrated-edge shape.

INTRODUCTION

The increase of quantity of many kinds of agricultural crop residues is considered one of the problems which faces the farming and the environmental life. Crop residues are the plant materials that remain after crop have been harvested, they include cotton stalk, maize and its shells, rice straw, been straw, residues of vegetables and residues of horticulture productions, etc. where, the accumulation of these residues, if not treated in suitable wags, will have a bad effect on the environment such as economic losses, pollution of environment, public health hazard, possibility of five eruption of these residues and shelter for many pests.

The total cultivated area of fruit in Egypt trees is about 907000 feddan (Ministry of Agriculture, 2003). Cutting fruit tree branches may be performed either individually during pruning or in bindles during chopping. Pruning is considered as an important practice in fruit production. However, pruning affects canopy division and clust exposture, invigorates sheets growth and improves light penetrations. The suitable number of buds, which are lifted after pruning would contribute for producing high yield and good quality (Denesin, 1979; Janick, 1979 and Norman, 1985).

The Egyptian fruit growers have still currently adopted the manual pruning method using special clippers or portable saws. This practice requires a great deal of labors, equivalent to 3-8% of production costs. Mechanical pruning devices are widely used in some foreign countries than in Egypt. Over recent years, some researchers directed interest to the mechanical pruning devices such as mobile pruning plate forms and pneumatic or hydraulic pruners.

Glammetta and Zimbalatti (1997); Lisa and Parena (1997); Branckoro and Marmugi (1997); Intrieri and Poni (1998) and Sperandio and Vetani (1998) found that mechanical pruning reduces the labor requirements and lowers the utilized time of the process. They added that the cut which is done by the pruning machines, causes a negligible damage comparing with the manual pruning. Moreover, if either mechanical or manual pruning was adopted, negligible difference in the fruit production was found.

FAO (1998) remembered that, in Egypt, about 400.000 Mg fruit tree branches are pruned and burned annually. It is possible to utilize pruning residues in many industries such as baskets, cages, hencoops, breadboards, simple furniture and paper (Halwagi, 1982).

Leger *et al.* (1991); Rynk (1992) and Barington *et al.* (1997) stated that there is an interest to compost the agricultural residues. Also, it is economically to treat, stabilize and compost the pruning residues. Chopping of agricultural materials is commonly employed using rotary cutters and flail shredders.

Kanafojski and Karwowski (1976) indicated that in the cutting operation of the agricultural materials, the cutting process initiates when the cutting edge of the knife makes a contact with the plant stem. Then during the continued motion of the knife through the plant stalk, the contact forces and stresses increase and a stress pattern is built up inside the stem until failure conditions are reached.

Culpin (1981) indicated that two general types of cutterhead, known as flywheel type and cylinder type, have been employed on conventional field choppers. With either type, the mounting or shape of the knives is such that cutting occurs progressively from one end to the other to minimize peak torque requirements.

Hennen (1971) reported that the energy requirements at normal feed rates ranged from 1.0 to 1.5 kW.h/Mg for a 13 mm theoretical cut with corn silage at 60 to 80% moisture content and from 1.5 to 2.0 kW.h/Mg for a 6 mm theoretical cut with mature corn silage at 40 to 60% moisture content. Generally the total energy requirements per ton for a forage chopper decrease somewhat as the feed rate is increased, primarily because the power for blowing air and some minor power requirements are relatively independent of feed rate.

The objective of the present study is to develop, fabricate and evaluate technically and economically the feeding and cutting mechanisms of a chopping machine to be used for cutting the different crop residuals and pruning the fruit tree branches.

MATERIALS AND METHODS

Field experiments had been conducted during the agricultural season of 2005 at Rice Mechanization Center, Meet El-Dyba, Kafr El-Sheikh Governorate. While, the development process has been carried out in the engineering workshop of Rice Mechanization Center. Japanese make forage chopper was developed in this study and was used for cutting the grape branches. It consists of the following main parts:-

a- Feeding mechanism with spring-loaded rolls to compress and hold the material for chopping.
b- Cutterhead or chopping unit.
c- A flywheel-type cutterhead has 2 impeller blades around the periphery that throw or impel the chopped material up the discharge pipe and into the wagon.

The cutting mechanism of the chopper has been modified in this study through using two fabricated pulleys (driving and driven) with different diameters for operating the chopper with four different cutting speeds. On the other hand, a new feeding mechanism, consisted of two fabricated drums, has been used to obtain uniform feeding of the residuals and attain the uniformity of the dynamic load on the engine, consequently, increase the machine stability and the expected life time of machine. On the other side, a moving frame by three wheels has been fabricated and used instead of the fixed frame to facilitate the conveying operation which decreases the vibrations during the chopping operation. A motor, of 5 kW power, has been fixed on the frame to operate the developed chopping machine.

The developed chopper which was used in this work, is illustrated schematically in Figure 1 and photographed in Figure 2. The technical specifications of the Japanese chopping machine are summarized in Table 1. Moreover, the cutting mechanism of the chopper before development is shown in Figure 1.

Study parameters:

Field experiments were conducted to evaluate the developed chopping machine before and after development under the following parameters:-

1. Four different levels of cutting speed (0.75, 1.19, 1.33 and 1.81 m/s).
2. Four different ranges of feeding speed (0.28, 0.45, 0.75 and 1.22 m/s).
3. Two different shapes of cutting knives are serrated and straight sided-edge shapes.

Table 1: Technical specifications of chopping machine:

Item	Specifications
Source of manufacture	Japan
Model	Yanmar SFC 1810
Overall length, cm	180
Overall width, cm	125
Overall height, cm	175
Net weight, kg	160
Width of roll, cm	18
Working capacity, kg/h.	1000-4500
Power requirement, hp	2-6

Miscellaneous equipment:

a. Digital vernier, (with an accuracy of about 0.01 millimeter).
b. Mettler balance (sensitive to 0.01 g).
c. Weighing balance with a maximum reading of 50 kg and accuracy of 0.5 kg.
d. Stop watch.

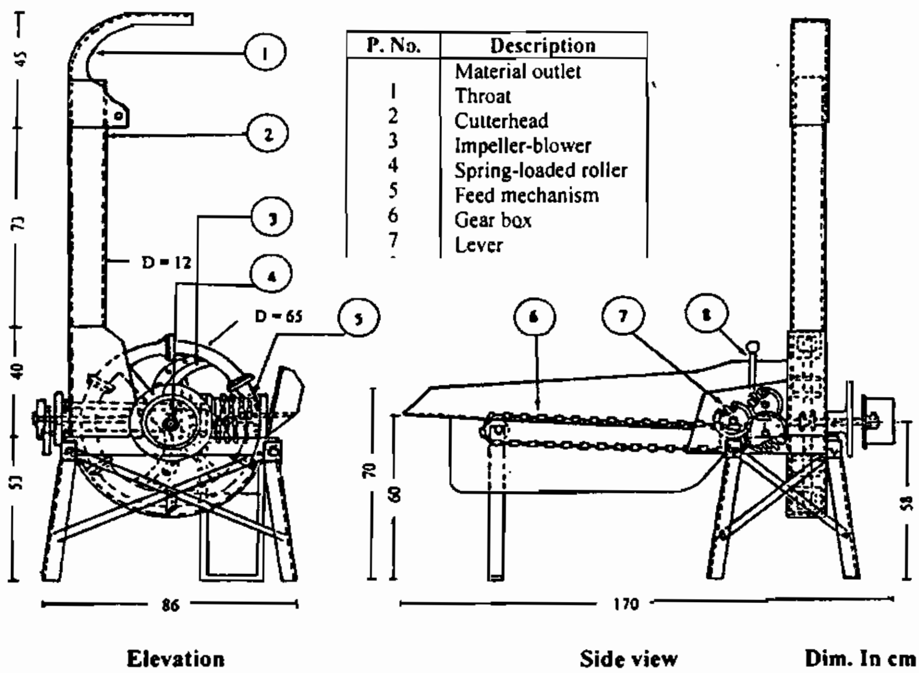
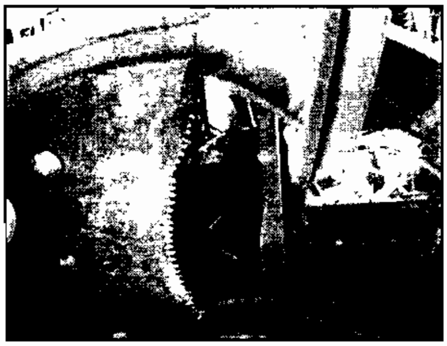
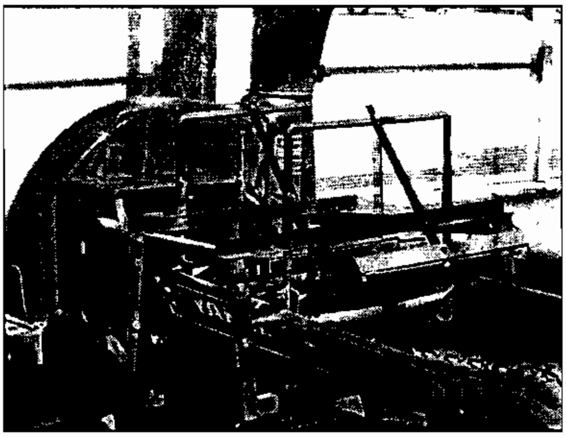


Fig. 1: An elevation and side view for stationary chopper.

a) Straight-edge shape



b) Serrated-edge shape



c) Feeding

Fig. 2: The stationary shopping machine after modification.

Measurements of machine performance:

1. Cutting efficiency:

The cutting efficiency can be calculated according to following equation:

$$\eta_c = \frac{W_{i,a}}{W_b} \times 100, \% \quad \text{------------------------} (1)$$

Where:

η_c = Cutting efficiency, %

W_b = Mass of chopped materials on top sieve before segregation, g

$W_{i,a}$ = Mass of chopped materials after segregation.

2. Capacity of chopper:

The actual length of cut will approximate the theoretical length only when stalks feed in straight , as with row crops such as corn (Kepener *et al.*, 1982). The theoretical capacity T_t, in Mg / hour, may be expressed by the relation:

$$T_t = 6 \times 10^{-9} \rho \times A \times L \times N \times R, \text{ Mg/h} \qquad (2)$$

Where:

ρ = Density of material as it passes between the feed drums, kg/m^3

A = Throat area, cm^2;

L = Theoretical length of cut, mm;

N = Number of knives on cutterhead, and

R = Speed of cutterhead, r.p.m.

3. Power consumption:

An ammeter and voltameter were used for measuring current strength and potential difference, respectively before and during experiments. Readings of ampere(I) and volt (V) were taken before and during each treatment. The power consumption (W) was calculated from the values of Ampere (I) and Volt (V) by using the following formula (Lockwood and Dunstan, 1971).

$$\text{Power consumption (W)} = \sqrt{3}.\,I.\,V.\,\cos\theta.\eta \qquad (3)$$

Where:

I = current strength, Amperes;

V = potential difference, Volt;

Cos θ = power factor, decimal (being equal 0.71), and

η = mechanical efficiency of motor assumed 90%.

RESULTS AND DISCUSSION

1. Efficiency of stationary chopper:

The cutting length of final production is an important parameter to evaluate the performance of cutting process. Where, the suitable cutting length that can be used to produce the compost and animal organic (forage) is $L_c \leq 50$mm (36 and 52). Standard sieves with holes diameter from 10 to 100 mm are used to segregate a charge of final chopping production.

Table 2 and Figure 3 shows the efficiency of developed chopping machine as affected by feeding speed, cutterhead speed and cutting knife type. Data indicated that the increment in feeding mechanism speed from 0.28 to 1.22 m/s tends to increase the efficiency of the developed chopper from 75.86 to 86.63% and 74.96 to 81.42% for serrated and straight edge shapes respectively, while, the increase of cutterhead speed from 0.75 to 1.88 m/s tends to increase the efficiency of chopper from 77.71 to 86.6% and from 73.76 to 82.16% for serrated and straight edge shapes respectively.

Generally, it is clear that the feeding mechanism speed of 1.22 m/s and cutterhead speed of 1.88 m/s gave the maximum value of chopper efficiency 93.16% with serrated edge shape compared with the other speeds under study. On the other hand, the obtained values of chopper efficiency were 81.47 and 77.95% for serrated and straight edge shape, respectively.

The efficiency of developed chopper increased by 4.52% as a result to use the cutting knives of serrated edge shape instead of the straight edge shape.

Table 2: Effect of cutting knife type, feeding and cutting mechanism speeds on cutting and machine efficiencies

Knife type	Cutting speed, m/s	Average machine efficiencies					Average cutting efficiencies				
		Feeding speed, m/s					Feeding speed, m/s				
		0.28	0.45	0.75	1.22	Mean	0.28	0.45	0.75	1.22	Mean
Serrated edge shape	0.75	73.50	76.75	78.15	82.46	77.71	82.50	80.08	77.16	75.13	78.72
	1.19	75.28	78.81	80.20	84.30	79.65	85.66	82.62	80.31	77.80	81.60
	1.33	78.50	80.25	82.31	86.62	81.67	89.40	84.99	82.70	80.17	84.31
	1.88	80.15	84.19	88.90	93.16	86.60	93.85	89.71	86.02	84.67	88.56
	Mean	75.86	80.00	82.39	86.63	81.47	87.85	84.35	81.55	79.44	83.30
Straighte dge shape	0.75	71.15	72.34	74.25	77.32	73.76	80.46	78.03	75.40	73.15	76.76
	1.19	73.92	75.32	77.16	80.42	76.71	83.93	81.06	78.30	75.20	79.62
	1.33	75.88	77.91	80.01	82.88	79.17	86.45	83.21	80.65	78.42	82.18
	1.88	78.90	81.29	83.40	85.06	82.16	90.20	86.46	83.77	81.12	85.39
	Mean	74.96	76.71	78.70	81.42	77.95	85.26	82.19	79.53	76.97	80.98

2. Cutting efficiency:

The effect of cutting-edge sharpness, feeding mechanism speed and cutterhead speed on the cutting efficiency has been illustrated in Table 2 and Figure 3. The cutting efficiency of chopping processes increases by decreasing feeding mechanism speed and increasing the cutterhead speed for two types of cutting-edge shape. The cutting efficiency increased by 10.6 and 12.08% as a result to decrease feeding mechanism speed from 1.22 to 0.28 m/s for cutting knives of serrated and straight edge shape, respectively.

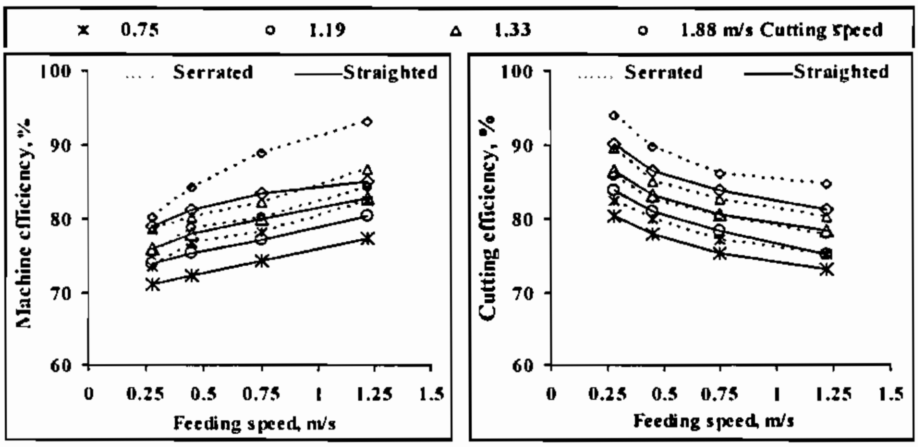


Fig. 3: Effect of cutting knife type, feeding and cutting mechanism speeds on cutting and machine efficiencies.

On the other hand, it is clear that the increment percentage of cutting efficiency were 12.5 and 11.24% when the cutterhead speed was increased from 0.75 to 1.88 m/s by using cutting knives of serrated and straight-edge shape, respectively. The data also demonstrated that the obtained values of cutting efficiency were 83.3 and 80.98% for serrated and straight-edge shapes, respectively. Generally, the cutting knives of serrated-edge shape gave the highest values of cutting efficiency compared with the straight-edge shape for all feeding mechanism and cutterhead speeds.

Finally, it could be observed from the previous discussions that the feeding mechanism speed of 0.28 m/s, cutterhead speed of 1.88 m/s and cutting knives of serrated-edge shape achieved the maximum values of cutting efficiency compared with the other ranges of parameters under study.

3. Capacity of stationary chopper:

Theoretical and actual capacity of the developed chopping machine as affected with cutting knife type, feeding and cutterhead mechanism speeds are presented in Table 3 and Figure 4. It is obvious that increasing both feeding and cutting speeds tended to increase the actual capacities of chopping machine with two different types of cutting knife shape.

Table 3: Effect of cutting knife type, feeding and cutting mechanism speeds on actual capacity of chopping machine

Knife type	Cutting speed, m/s	Average actual capacity of chopping machine, Mg/h				
		Feeding speed, m/s				
		0.28	0.45	0.75	1.22	Mean
Serrated edge shape	0.75	1.562	1.914	2.467	3.172	2.279
	1.19	1.613	2.096	2.691	3.450	2.462
	1.33	1.815	2.225	2.897	3.651	2.647
	1.88	1.946	2.382	3 210	4.192	2.932
	Mean	1.734	2.154	2.816	3.616	2.580
Straighte dge shape	0.75	1.422	1.802	2.227	2.861	2.078
	1.19	1.514	1.900	2.587	3.275	2.319
	1.33	1.714	2.102	2.698	3.460	2.493
	1.88	1.801	2.210	3.045	3.616	2.668
	Mean	1.613	2.003	2.639	3.303	2.389

The actual capacity of developed chopping machine increased by 28.6% when the cutting speed increased from 0.75 to 1.88 m/s, while it decreased by 52.05% as a result to decrease the feeding speed from 1.22 to 0.28 m/s with the cutting knife of serrated edge shape. On the other hand, for all feeding and cutting speeds, the obtained values of actual capacities were higher in case of cutting knife of serrated edge shape comparing with the straight edge shape.

Generally, the maximum values of actual capacities is 4.192 Mg/h at feeding speed of 1.22 m/s and cutterhead speed of 1.88 m/s by using cutting knife of serrated edge shape.

4. Chopping lengths:

There was a significant effect of feeding mechanism speed, cutterhead speed and cutting knife type on the chopping lengths as shown in Table 4 and Figure 5. It is evident that, the increment to increase the chopping length for cutting knives of serrated and straight-edge shapes respectively. While, the increase of cutterhead speed from 0.75 to 1.88 m/s tends to increase the chopping length by 24.1 and 60.5% for serrated and straight-edge shapes.

The obtained mean values of chopping lengths were 2.42 and 2.88

cm for cutting knives of serrated and straight-edge shapes, respectively. However, the serrated-edge shape gave the lowest values of chopping lengths for all different values of feeding and cutting speeds.

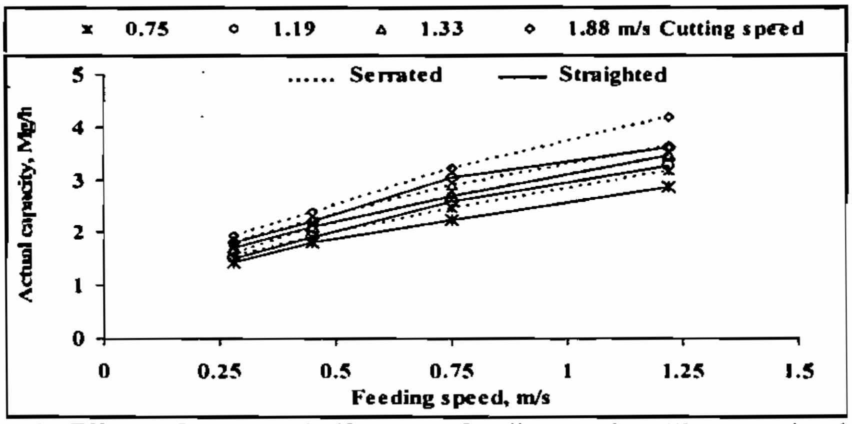


Fig. 4: Effect of cutting knife type, feeding and cutting mechanism speeds on actual capacity of chopping machine.

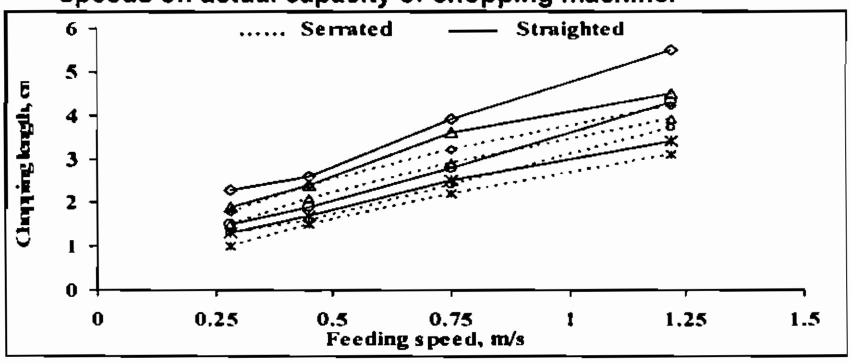


Fig. 5: Effect of cutting knife type, feeding and cutting mechanism speeds on the chopping length.

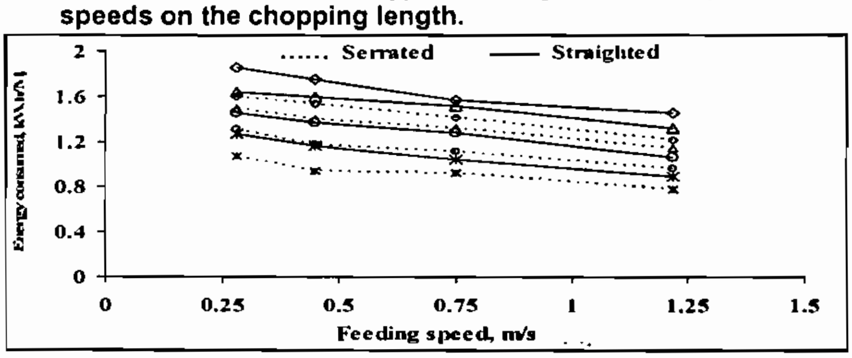


Fig. 6: Effect of cutting knife type, feeding and cutting mechanism speeds on the energy consumed.

Table 4: Effect of cutting knife type, feeding and cutting mechanism speeds on the chopping length

Knife type	Cutting speed, m/s	Average chopping length, cm				
		Feeding speed, m/s				
		0.28	0.45	0.75	1.22	Mean
Serrated-edge shape	0.75	1.0	1.5	2.2	3.1	1.95
	1.19	1.3	1.6	2.4	3.7	2.25
	1.33	1.5	2.1	2.9	3.9	2.60
	1.88	1.8	2.4	3.2	4.2	2.90
	Mean	1.4	1.90	2.68	3.72	2.42
Straigh-edge shape	0.75	1.3	1.7	2.5	3.4	2.23
	1.19	1.5	1.9	2.8	4.3	2.62
	1.33	1.9	2.4	3.6	4.5	3.10
	1.88	2.3	2.6	3.9	5.5	3.58
	Mean	1.75	2.15	3.20	4.43	2.88

Finally, it can be observed that the feeding mechanism speed of 0.28 m/s, cutterhead speed of 0.75 m/s and cutting knives of serrated-edge shape recorded the minimum values of chopping lengths.

5. Energy consumption:

The influence of feeding mechanism and cutterhead speeds as well as cutting knives type on the energy consumed has been shown in Table 5 and Figure 6. It is clear from the data that there was a positive effect of feeding mechanism speed, type of cutting knives and cutterhead speed on the energy consumed during the cutting processes of grape branches.

The energy consumed decreased by 25.1 and 23.95% when the feeding mechanism speed was increased from 0.28 to 1.22 m/s for cutting knives of serrated and straight-edge shape, respectively. However, the feeding mechanism speed of 1.22 m/s achieved the lowest values of energy consumed during the cutting processes of grape branches for all cutterhead speeds and types of cutting knives.

Table 5: Effect of cutting knife type, feeding and cutting mechanism speeds on the energy consumed

Knife type	Cutting speed, m/s	Average energy consumed, kW.h/Mg				
		Feeding speed, m/s				
		0.28	0.45	0.75	1.22	Mean
Serrated edge shape	0.75	1.077	0.947	0.927	0.776	0.932
	1.19	1.311	1.179	1.121	0.960	1.143
	1.33	1.496	1.402	1.318	1.147	1.341
	1.88	1.602	1.537	1.412	1.223	1.443
	Mean	1.371	1.266	1.195	1.027	1.215
Straighte dge shape	0.75	1.276	1.169	1.045	0.890	1.095
	1.19	1.460	1.379	1.280	1.071	1.297
	1.33	1.639	1.599	1.521	1.318	1.519
	1.88	1.855	1.749	1.570	1.458	1.658
	Mean	1.557	1.474	1.354	1.184	1.392

The data also indicated that increasing the cutterhead speed from 0.75 to 1.88 m/s caused an increase in the energy consumed for all feeding speeds and types of cutting knives. The energy consumed increased by 54.8 and 51.4% when the cutterhead speed was increased from 0.75 to 1.88 m/s for serrated and straight-edge shapes, respectively. Generally, the cutterhead speed of 0.75 m/s recorded the minimum values of energy consumed for all feeding mechanism speeds and cutting knives.

The obtained mean values of energy consumed were 1.215 and 1.392 kW.h/Mg for serrated and straight-edge shapes, respectively. Finally, it can be concluded from the previous results that the feeding speed of 1.22 m/s cutterhead speed of 0.75 and serrated-edge shape recorded the minimum values of unit energy.

CONCLUSIONS

In this study, the cutting mechanism of the Japanese forage chopper has been developed through pruning the grape tree branches. Throughout this study the following conclusion could be drawn:

1. Development of feeding mechanism and system of a Japanese stationary chopper tended to decrease the vibrations and cutting energy as well as increase the productivity efficiency and expected life time of chopper compared with the chopper before development.
2. The feeding mechanism and cutting speeds of 1.22 and 1.88 m/s accomplished the highest value of machine efficiency 93.16% by using the serrated-edge shape but, the maximum cutting efficiency has been attained at feeding mechanism speed of 0.28 m/s and cutterhead speed of 1.88 m/s using cutting knives of serrated-edge shape.
3. The maximum value of chopper capacity was 4.192 Mg/h at feeding mechanism speed of 1.22 m/s, cutterhead speed of 1.88 m/s and cutting knife of serrated-edge shape.
4. The results demonstrated that the minimum value of chopping length was 1.0 cm using cutting knife of serrated-edge shape at feeding mechanism and cutterhead speeds of 0.28 and 0.75 m/s respectively.
5. From the energy point of view it can be concluded that the lowest value of unit energy 0.776 kW.h/Mg was obtained at 1.22 m/s feeding mechanism speed and 0.75 m/s cutterhead speed using chopping knife of serrated-edge shape.
6. The data also indicated that the cutting tools (knives) of serrated-edge shape are considered better than the cutting tools of straight-edge shape because the first one achieved the maximum values of productivity, machine and chopping efficiency as well as the minimum values of chopping energy and lengths.
7. It is recommended for the operators of pruning and chopping fruit tree branches machines to operate the developed Japanese chopper at feeding mechanism speed of 0.28 m/s and cutterhead speed of 1.88 m/s by using cutting tools of serrated sided-edge shape to obtain the optimum performance.

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تطوير آلة قطع للمخلفات الزراعية (دراسة على مخلفات العنب)

محمد على متولى[1]، إسماعيل فؤاد سيد أحمد[1] ، نبيل الدسوقى منصور[2] و على بدوى النجار[3]
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٢- قسم الهندسة الزراعية – كلية الزراعة – جامعة الأزهر – فرع أسيوط – مصر.
٣- كلية الهندسة – جامعة الأزهر.

تعتبر آلات تقطيع وفرم مخلفات المحاصيل الزراعية من أهم الآلات الأساسية التى تستخدم فى عمليات تصنيع المخلفات والمنتجات الزراعية حيث أن هذه المخلفات تعتبر واحدة من أكبر المشاكل التى تواجه المجتمع الزراعى والحياة البيئية ولكن عند تقييم أداء هذه الآلات لوحظ من تقارير المشغلين ومهندسى الصيانة لآلة التقطيع اليابانية الصنع (يانمار ١٨٠٠) أن عملية النقل تتم بدون تحكم مما يترتب عليها زيادة نسبة الانزلاق فضلا عن ارتفاع درجة الاهتزازات للآلة بالإضافة إلى أن طول المسافة بين الجرار وماكينة الفرم يترتب عليها زيادة القدرة المستهلكة فى عملية القطع والفرم كما أن للآلة سرعة واحدة للتشغيل مما يؤدى إلى قلة إنتاجية الآلة.

لذا كان الهدف الرئيسى من هذه الدراسة هو تطوير آلية تغذية القطع لآلة تقطيع مخلفات المحاصيل الزراعية اليابانية الصنع وذلك بتصنيع طارتين بكل منهما مجريين لتشغيل ماكينة التقطيع عند أربع سرعات دورانية مختلفة للقطع مع تثبيت موتور قدرته ٥ كيلو وات ليلائم تشغيل ماكينة التقطيع ذات السرعات المتعددة.

وأظهرت النتائج ما يلى:

١- أدى تطوير آلية التغذية القطع لآلة التقطيع والفرم لمخلفات المحاصيل الزراعية إلى انخفاض نسبة الإنزلاق والاهتزازات للآلة فضلاً عن زيادة كفاءة القطع والإنتاجية الكلية للآلة مقارنة بالآلة قبل التطوير ويرجع ذلك إلى استخدام طارتين بكل منهما مجريين للحصول على أربع سرعات للقطع مما أدى إلى ثبات فى عملية التشغيل.

٢- أشارت النتائج إلى أن أعلى قيمة لإنتاجية الآلة كانت ٤,١٩٢ ميجا جرام/ساعة عند سرعة جهاز التلقيم ١,٢٢ م/ث وسرعة سكينة القطع ١,٨٨ م/ث باستخدام السكينة ذات الحافة المشرشرة (المسننة).

٣- أوضحت نتائج الدراسة أن كل من سرعتى التغذية والقطع ١,٢٢ ، ١,٨٨ م/ث على الترتيب حققت أعلى قيمة لكفاءة آلة التقطيع ٩٣,١٦% باستخدام السكينة ذات الحافة المشرشرة ، وأعلى كفاءة قطع ٩٣,١٦% تم الحصول عليها باستخدام سرعة تغذية ٠,٢٨ م/ث وسرعة سكينة القطع ١,٨٨ م/ث .

٤- أظهرت الدراسة أن أقل قيمة لوحدة الطاقة المستهلكة فى تقطيع فروع العنب كانت ٠,٧٧٦ كيلو وات. ساعة/ميجا جرام عند سرعة تغذية ١,٢٢ م/ث وسرعة سكينة القطع ذات الحافة المشرشرة ١,٢٢ م/ث.

٥- تشير النتائج إلى أن أقل قيمة لأطوال القطع كانت ١,٠ سم عند سرعة جهاز التغذية ٠,٢٨ م/ث وسرعة سكينة القطع ٠,٧٥ م/ث باستخدام سكينة القطع ذات الحافة المشرشرة.

٦- توصى الدراسة باستخدام آلة التقطيع اليابانية المطورة فى تقطيع وفرم مخلفات المحاصيل الزراعية عند سرعة تغذية ٠,٢٨ م/ث وسرعة قطع ١,٨٨ م/ث مع سكينة قطع ذات الحافة المشرشرة لتحقيق الأداء الأمثل عند التشغيل.