J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 7 (4):289 - 298, 2016

Performance Evaluation of New Sugarcane Peeling Machine Prototype

El-Yamani, A. E. and M. A. Basiouny
Agric. Eng. Res. Inst. (AEnRI), ARC, Giza, Egypt.

ABSTRACT

The present investigation was carried out to develop and evaluate the performance of a new small-scale sugarcane peeler machine. The developed machine prototype was tested through real experiments carried out at a sugarcane private store in Kafrelsheikh province during 2014/2015 season. The experiments illustrated the effects of the main design and operating parameters, on the machinery performance and finished product quality. The investigated parameters included three different peeling drum brush types namely: zigzag, straight and spiral, four peeling drum speeds of 3.53, 5.30, 7.47 and 9.18m/s, three peeling drum clearances of 1.0, 1.5 and 2.0cm and three feeding rates of 3, 6 and 9 canes/min. The developed machine performance were evaluated in terms of: machine production efficiency, cane stalks peeling efficiency, peel retention on peeled stalks, cane stalks weight losses, machine power consumption and machine unit cost. The gained results revealed in general that using the zigzag peeling drum brush type tends to improve the peeling performance of the developed machine, compared to straight and spiral brush types. In addition, the obtained results indicated that, the maximum machine production efficiency (88.85%) and the minimum electrical power consumption (5.56kW), were achieved at peeling drum speeds of 9.18 and 3.53m/s, peeling drum clearance of 2cm and No. of feeding canes per minute of 3 canes, respectively. Moreover, the maximum peeling efficiency, the minimum cane stalks losses and the lowest percentage of the peel retention on peeled stalks were 91.40%, 3.02% and 2.46%, respectively. These percentages were recorded at peeling drum speed of 9.18m/s, peeling drum clearance of 1cm and 3 canes/min feeding rate. Also, the minimum machinery unit cost was 67.49LE/Mg at peeling drum speed of 3.53m/s, drum clearance of 1.5cm and 9 cans/min feeding rate.

Keywords: Peeling, sugarcane, sugarcane peeler.

INTRODUCTION

Sugarcane is one the world's best established industrial crops that is efficiently grown and harvested to produce both food and bio-energy *(Cane growers, 2012).* Peeling is the first process from harvest to processing which is a very important operation. The operation of sugarcane peeling has been investigated by many researches and studies such as: Sugarcane stems are collected from the field during harvest. At harvest, minimum trash is collected from the farmland, along with the desired sugarcane to the mills *(Naturland, 2000). Sandhar (1995)* showed that, for optimization of the variables of the mechanical cleaner, the mill trash should not exceed 3% and maximum acceptable cane loss should be 2%. This was based on the fact that, even in the manual cleaning of sugarcane, the trash percentage is more than 2%. *Srivastava and Singh (1990)* made efforts to establish the mechanism suitable for de-trashing the whole cane. However they reported that, at that time, an appropriate machine for successful mechanization of this operation is not available. *Zhang Delhi (2015)* reported that, in view of the difficult in the process of sugarcane peeling, a kind of automatic sugarcane peeling machine based on the motion controller was designed. That machine implemented the automation of the whole process of feeding, peeling and discharging. It can replace manual labor, greatly improve the production efficiency and reduce the production cost. *Ge Xinfeng (2015)* reported that, in order to solve the problem that appeared in hand peeling sugarcane, the sugarcane peeling machines have been designed. In general, the sugarcane peeling machine includes motor, groove wheel, cutting room, slider crank mechanism, reducer (including belt drive, chain drive) and so on. The designed sugarcane peeling machine was simulated, the results show that the machine could peel sugarcane successfully with convenient, fast and uniform. *Shukla et al., (1991)* reported that, in raw sugar production, natural defoliation at the maturation stage affects the efficiency of the sugarcane harvesting process, especially in countries growing mountain sugarcane. Few machines can be used for harvesting sugarcane in China because this crop is planted mainly on hillsides. In manual sugarcane processing, manual peeling of the leaves accounts for 65% of the entire labor involved in the harvest process. *Ivin and Doyle (1989)* explained that, the traditional method of reducing the extraneous matter of cane, namely burning, is becoming unacceptable because of the environmental consequences. Dry cleaning is a means of removal of a significant proportion of this material before the cane is shredded, thus avoiding the negative effects on sugar processing. Dry cleaning also provides the potential to supply large quantities of energy-rich fiber which can be used directly at a sugar factory for activities such as off-crop refining, the generation of electricity or the manufacture of by-products. An in-depth economic analysis is essential before large scale adoption of dry cleaning. *Khedari et al., (2004)* reported that, the massive amount of the peel is disposed as waste which could lead to environmental problems. Durian peel could be further utilized as a source of valuable materials of commercial importance; such as particle board component of construction panels for energy conservation in building. The main components of the sugarcane plant are the stalk about 81%, top (6%) and Leaves (13%). The trash component is typically separated during harvesting due to the higher ratio of non-sucrose to sucrose components *(Ivin and Doyle, 1989 and Yadav et al., 1994)*. Recovery of additional sucrose from juice extracted from trash. Research reported by *Gil and Saska (2005)* indicated that one quarter of sucrose derived from cane stalk is present in discarded sugar cane trash. To optimize yields, a balance between extraneous matter (EM) removal and cane loss must be achieved. Increasing primary extractor fan settings can reduce EM, but excessive fan speeds can also remove mature billets additional sucrose is expected to increase raw sugar yield if the level of impurities can be reduced through an appropriate clarification strategy *(Richard et al., 2001)*. Results in Australia from *Shaw and Brotherton (1992)* indicate that a 1% reduction in EM resulted in a 4.2Mg/ha cane loss; often when fan speed is increased to remove leafy material, billet pieces are also removed. The present work aimed to improve the mechanical sugarcane peeling process, especially for small farm holders in Egypt. Therefore, the following specific objectives were studied:

- Developing an economical small-scale sugarcane peeling machine which, exhibited three new designed peeling drum/brush types.
- Evaluate the performance of the developed machine under the effects of the main design and operating parameters.

MATERIALS AND METHODS

The experiments of the present study were carried out at a private sugarcane store in Kafrelsheikh province during the growing season of 2014/2015. These experiments were deduced to examine the performance of developed sugarcane during peeling sugarcane crop variety (Giza 85-166). Table 1 illustrates the main dimensions of the of the sugarcane specimens under study.

Table 1: Main dimensions of the tested sugarcane specimens.

Item	Length, mm	Head Diameter, mm	Middle Diameter, mm	Tail Diameter, mm	Average Diameter, mm	Mass, g
Average	682	32.8	36.2	39.2	36.06	958.33
S. D. (±)	68.93	1.93	2.30	2.66	2.19	169.99
Max. value	780	36	40	43	39.7	1301.3
Min. value	540	30	33	35	33.3	725.6

MACHINE PROTOTYPE DESCRIPTION:

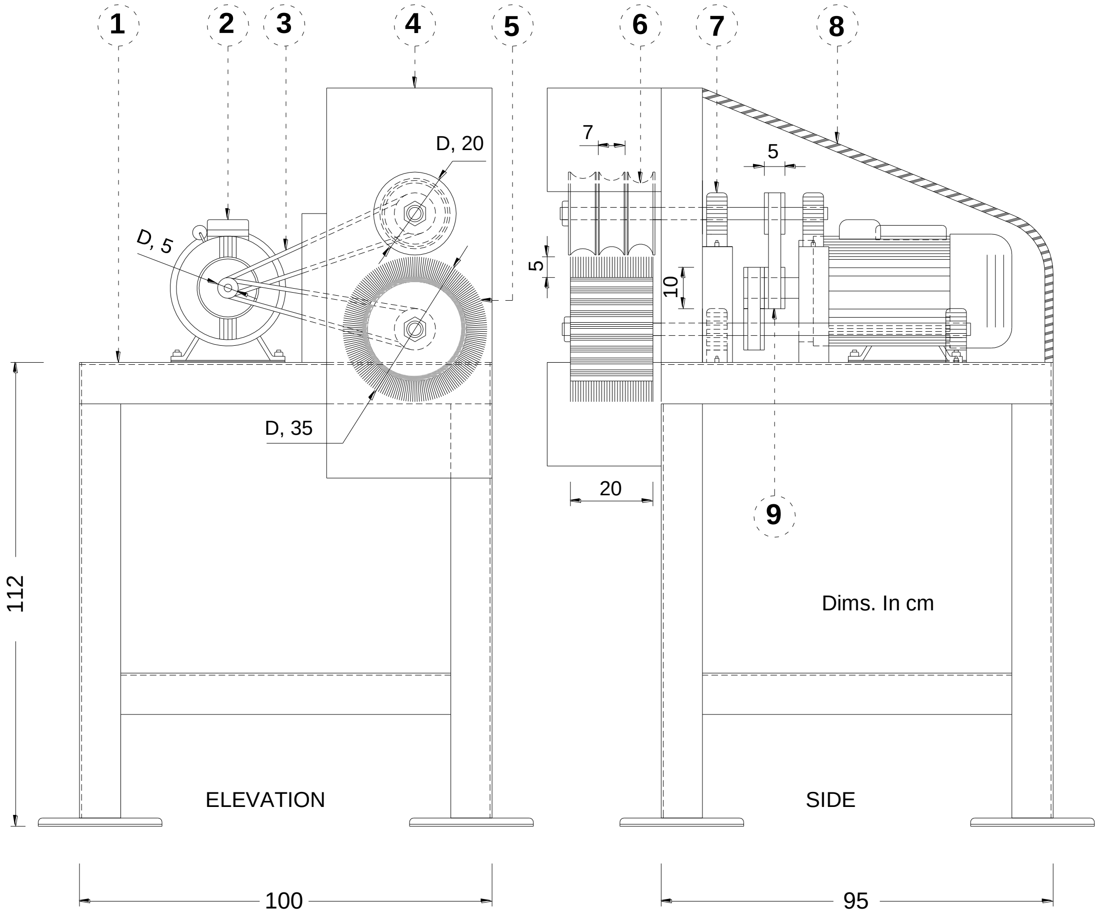
Fig. 1 represents the schematic diagram described the composition, and the structure of the developed sugarcane peeling machine. While, the photography view of the developed peeler is shown in Fig. 3. As shown in Fig. 1, the machine structure is mainly contains: main frame, electric motor of 20hp (14.91kW), designed peeling drum/brush mechanism, and a pair groove rollers (upper and lower), rollers installing in front of the machine directed canes stalks to peeling drum/brush mechanism. Also they grip the sugarcanes stalks and push them forward. Other components of the developed machine include the transmission system which receives motion from the electric motor. That transmission system consists of belt and pulley arrangement whereas, four peeling drum speeds of 3.53, 5.30, 7.47 and 9.18m/s, were considered for the experiment. The working principle of the developed machine prototype was based on the abrasive action of peeling drum/brush mechanism. Whereas, the rotating brushes removed upper surface of canes stalks and peeled them. The peeling action in the case of the rotating brushes is beginning on the natural weak point at the joint of the immature top at mature cane stalks. The developed sugarcane peeler made use of this principle. Hence three different design of peeling drum/brush types were locally manufactured and tested in the present study. These types included: zigzag, straight and spiral peeling drums as shown schematically in Fig. 2. The manufacturing description of the machine components may be drawn as follows:

Machine frame:

The frame of the sugarcane peeler under study was made of (62.5x62.5x6)mm M. S. angle. It was supported by four 770mm high columns. The overall dimensions of the frame were (1000x950x1120)mm. All other components were fixed to the main frame. An intermediate shaft was used for transmitting power from electric motor to peeling drums which were attached to the frame. Two additional (62.5x62.5x6)mm angle irons were welded to the frame. The inclined platform was welded to these angle irons.

The upper roller:

The upper roller consists of three rings of 20mm thick mounted on the shaft and bolted around the periphery of the rings at equal spacing. The function of the upper roller and the lower roller are to grip the stalks and push them forward as they rotated. Adjustable vertical clearances of 10, 15, and 20mm were provided between upper and lower rollers that allowed the cane to pass without damage. The surface of each flat of the upper roller was covered with wires made from metallic and synthetic material. The synthetic material came in contact with the cane, while, the synthetic material was used to protect the wires.



1- Frame	**4- Safety cover**	**7- Bearing**
2- Electric motor	**5- Brush cylinder**	**8- Safety barrier**
3- Belt	**6- Smooth cylinder**	**9- Operating shaft**

Fig. 1: Schematic diagram of sugarcane Peeler.

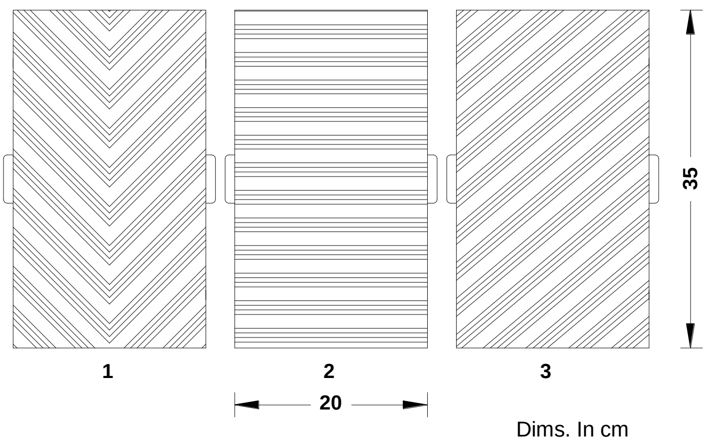


Fig. 2: Plane view for: 1) Zigzag brush 2) Straight brush, and 3) Spiral brush.

Fig. 3: Photography view of the developed sugarcane peeler.

The lower roller:

Three different cylinder shape lower rollers have been developed and investigated in the present study. The outer surfaces of these rollers have been made from fibers and deformed in three different external surface shapes namely: zigzag, straight and spiral type**.** Each roller was made of M. S. pipe 250mm in diameter, 200mm length, and 12mm thick. The outer surfaces had groves that increased the surface roughness and allowed more abrasive force. Each outer surface has a length of 50mm and included many high pressure fiber pipes distributed along the periphery of the rollers to suit the sugarcane peeling action. The axis of a side roller was fixed at 25mm below the axis of the lower roller. Both shafts of the lower and side rollers were mounted by means of bearing having an inner bore of 25mm.

The above described machine structure permit the sugarcanes stalks to pass through the rotating hollow shaft. Consequently due to the actions brushes and blades inside the hollow shaft, the upper skin surface of sugar cane is removed while the and peeled sugarcane is pulled out of the machine by means of discharging rollers.

The Investigated Variables:

The developed peeler performance was tested under the following operational factors:

- Three different types of peeling drum/brush namely: zigzag, straight and spiral:
- Four peeling drum speeds of 3.53, 5.30, 7.47 and 9.18 m/s:
- Three peeling drum clearances of 1.0, 1.5 and 2.0cm and,
- Three sugarcane feeding rates of 3, 6 and 9 canes/min. It should be denoted that the different studied treatments were replicated three times.

Performance Evaluation of The Machine:

The sugarcanes stalk was fed into the machine three by three and the results were evaluated for each pass in each investigated treatments. The performance evaluations of the machine performance were determined using the following parameters:

Machine production efficiency ($M.P.E.$): It was calculated according to the following formula:

$$M.P.E. = \frac{A.M.C.}{T.M.C.} x100, \% \quad \ldots\ldots\ldots\ldots 1$$

Where:

$A.M.C.$ actual machine capacity, kg/h and:

$T.M.C.$ theoretical machine capacity, (stalks feed rates x stalk mass), kg/h

Peeling efficiency ($P.E.$): It could be calculated according to the equation of *Tagare et al.* (*2013)*:

$$P.E. = \frac{T_d}{T_i} x100, \% \quad \ldots\ldots\ldots\ldots 2$$

Where:

T_d difference between sugarcane diameters before and after peeling (thickness of sugarcane peeled by machine), mm and:

T_i ideal thickness to be peeled by machine, mm.

Peel retention on peeled stalks: It was estimated by collecting all of peel retention on peeled stalks by hand from yield output sample consists of three stalks of sugarcane. The samples were taken randomly from the produced stalks and repeated three times to estimate result average under different treatments, and it was calculated by division mass of peel retention on peeled stalks by total mass of sample.

Cane stalks weight losses ($S.W.L.$): Stalk losses were calculated as follow:

$$S.W.L. = \frac{M_{sl}}{M_d} x100, \% \quad \ldots\ldots\ldots\ldots 3$$

Where:

M_{sl} mass of split portion of stalk losses in ground during peeling operation, kg.

M_d total mass of cane stalks in yield input, kg.

Machine power consumption ($M.P.C.$): It was calculated according to the following formula:

$$M.P.C. = \sqrt{3}\,(I.V.\cos\theta.\eta)/1000, kW \quad \ldots\ldots\ldots 4$$

Where:

I current intensity, Amperes;

V potential difference, Volts;

$\cos\theta$ electrical power factor, decimal (being equal to 0.71), and,

η mechanical efficiency of motor assumed to be 80%.

Total cost: It was determined by using the following equation (*Hunt*, *1983*):

$$C = p/h(1/a + i/2 + t + r) + (0.9\, w.s.e.) + m/144 \quad \text{......5}$$

Where:

C operation hourly cost, LE/h.

p price of machine, LE.

a life expectancy of the machine, h.

h yearly working hours, h/year.

i interest rate/year.

t taxes ratio

r repairs and maintenance ratio

0.9 factor accounting for lubrication

w engine power, kW

s electricity energy consumption, kW/h.

e electricity energy price, LE/kW.h

m monthly average wage, LE.

144 reasonable estimation of monthly working hours.

$$\text{Criterion function cost} = (\text{unit operating cost} + \text{losses cost}), LE/Mg \quad \text{......6}$$

Wherein:

$$\text{Unit operating cost} = \frac{\text{Machine cost}}{\text{Machine productivity}}, LE/Mg \quad \text{......7}$$

$$\text{Losses cost} = (\text{price of sugarcane losses value} + \text{fewness in sugarcane price according to sugarcane damage}), LE/Mg \quad \text{.....8}$$

RESULTS AND DISCUSSION

Machine production efficiency:

The results shown in Fig. 4 indicate the effect of peeling drum speed on machine production efficiency at different peeling drum brush types, drum clearances and No. of canes fed in minute. The values of machine production efficiency were higher with using zigzag drum brush at all testing points compared with other types. Also, machine production efficiency was increased with increasing all of peeling drum speed from 3.53 to 9.18m/s, drum clearances from 1 to 2cm but it was decreased with increasing No. of canes fed from 3 to 9 canes/min. The maximum value of machine production efficiency was 88.85% recorded at using zigzag drum brush type with peeling drum speed of 9.18m/s, drum clearance of 2cm and No. of canes fed of 3 canes/min. This is due to that increase each of the cylinders rotation speed and size of the clearance was increasing the pace of withdrawing the sticks through the machine and also increase the feed rate was increased losses in feeding canes. Also, the minimum value of machine production efficiency was 65.17% recorded at using spiral drum brush type with peeling drum speed of 3.53m/s, drum clearance of 1cm and No. of canes fed of 9 canes/min.

Cane stalks peeling efficiency:

Fig. 5 illustrate that, cane stalks peeling efficiency, which was directly proportional to peeling drum speeds and inversely proportional to drum clearance and No. of canes fed in minute. Also, results noticed that, zigzag drum brush type recorded high value of cane stalks peeling efficiency compare with straight drum brush and spiral drum brush. The maximum value of cane stalks peeling efficiency was 91.40% recorded at using zigzag drum brush type with peeling drum speed of 9.18m/s, drum clearance of 1cm and No. of canes fed of 3 canes/min. On the other hand, the minimum value of cane stalks peeling efficiency was 68.52% recorded at using spiral drum brush type with peeling drum speed of 3.53m/s, drum clearance of 2cm and No. of canes fed of 9 canes/min. This shows that, the use of zigzag drum brush type was given the highest efficiency for peeling efficiency and then see the high level of friction with the surface of the sticks compared to other types of straight and spiral drum brush.

Peel retention on peeled stalks:

From Fig. 6, the results indicated that, increasing peeling drum speed led to decrease peel retention on peeled stalks, while increasing of peeling drum clearance and No. of feeding canes per minute led to increase peel retention on peeled stalks. The results indicated also that, using zigzag drum brush type recorded low percentage of peel retention on peeled stalks. The minimum value of peel retention on peeled stalks was 2.46% recorded at using zigzag drum brush type with peeling drum speed of 9.18m/s, peeling drum clearance of 1cm and No. of feeding canes per minute of 3 canes. This is due to increase as a result of the incident friction force between zigzag cylinder surface and stalks canes peeling surface. And this is due to the system of the order of the cylinder wired fiber peeling zigzag circumference compared to other species. On other hand, the maximum value of peel retention on peeled stalks was 10.87% recorded at using spiral drum brush type with peeling drum speed of 3.53m/s, peeling drum clearance of 2cm and 9 canes/min feeding rate.

Cane stalks weight losses:

Cane stalks weight losses as related to the peeling drum speed, drum clearances and No. of feeding cane stalks per minute is shown in Fig. 7. It is clear that, cane stalks weight losses was increased with increasing both of peeling drum speed and No. of feeding canes in minute, while it was decreased with increasing of drum clearance. Results also show that, zigzag drum brush type was recorded low value of cane stalks weight losses and spiral drum brush type was recorded high value compared with other used brush types. Generally, results reported that, the minimum value of cane stalks weight losses was 3.02% recorded at using zigzag drum brush type with peeling drum speed of 3.53m/s, drum clearance of 2cm and No. of feeding canes per minute of 3 canes. On other hand, the maximum value of cane stalks weight losses was 7.65% recorded at using spiral drum brush type with peeling drum speed of 9.18m/s, drum clearance of 1cm and No. of feeding canes per minute of 9 canes.

Machine power consumption:

Fig. 8 illustrates the effects of peeling drum speed, peeling drum clearance and No. of feeding cane stalks per minute on machine power consumption. Generally, power consumption was increased with increasing peeling drum speed and No. of feeding canes per minute, while it was decreased with increasing of drum clearances. Also, results indicated that, at all investigated point with using zigzag brush type power consumption was recorded low values, while using spiral drum brush types was recorded high values. . Finally, the minimum value of power consumption was 5.56kW recorded at using zigzag drum brush type with peeling drum speed of 3.53m/s, drum clearance of 2cm and No. of feeding canes per minute of 3 canes. While, the maximum value of power consumption was 10.51kW recorded at using spiral drum brush type with peeling drum speed of 9.18m/s, drum clearance of 1cm and No. of feeding canes per minute of 9 canes.

Machine unit cost:

Data in Fig. 9 illustrates the effects of peeling drum speed, peeling drum clearance and No. of feeding cane stalks per minute on operating cost and criterion function cost. Generally, the lowest value of operating cost was 17.50LE/h recorded at peeling drum speed of 3.53m/s, peeling drum clearance of 1.5cm and No. of feeding canes per minute of 3 canes with using zigzag drum brush type. While, the highest value of operating cost was 29.68LE/h recorded at peeling drum speed of 9.18m/s, drum clearance of 1cm and No. of feeding canes per minute of 9 canes with using straight drum brush type. Also from Fig. 9, the lowest value of criterion function cost was 67.49LE/Mg recorded at peeling drum speed of 3.53m/s, drum clearance of 1.5cm and No. of feeding canes per minute of 9 canes with using zigzag drum brush type. On other hand, the highest value of criterion function cost was 128.77LE/Mg recorded at peeling drum speed of 9.18m/s, drum clearance of 1cm and No. of feeding canes per minute of 3 canes with using straight drum brush type.

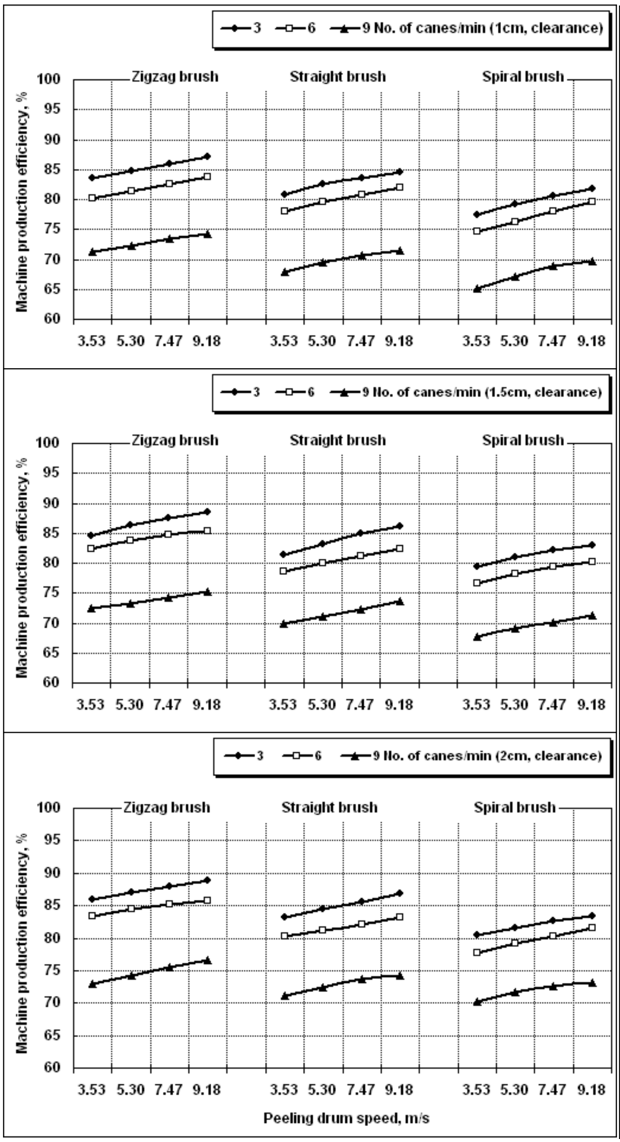


Fig. 4: Effects of peeling drum speed, drum clearance and feeding rate on machine production efficiency at different peeling brush types.

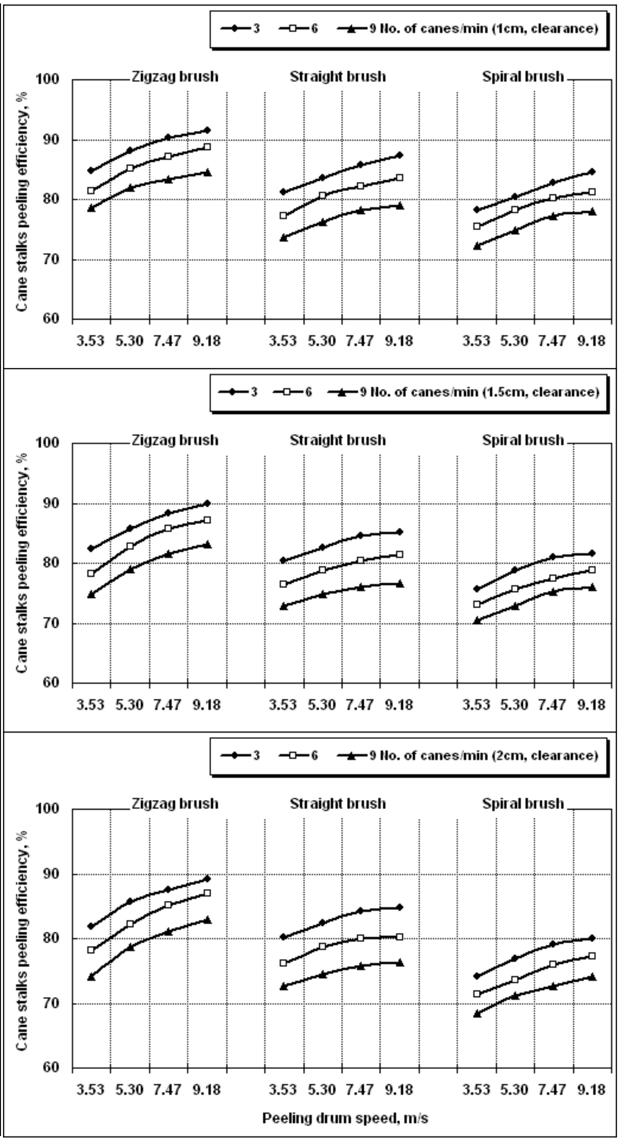
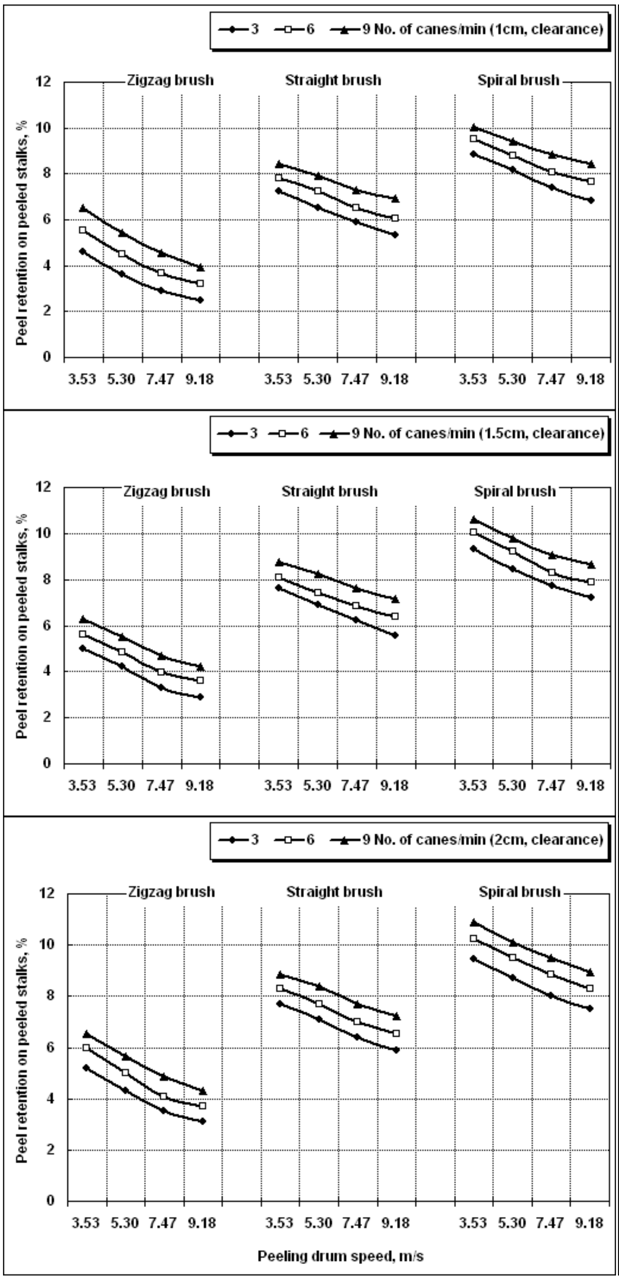


Fig. 5: Effects of peeling drum speed, drum clearance and feeding rate on cane stalks peeling efficiency at different peeling brush types.



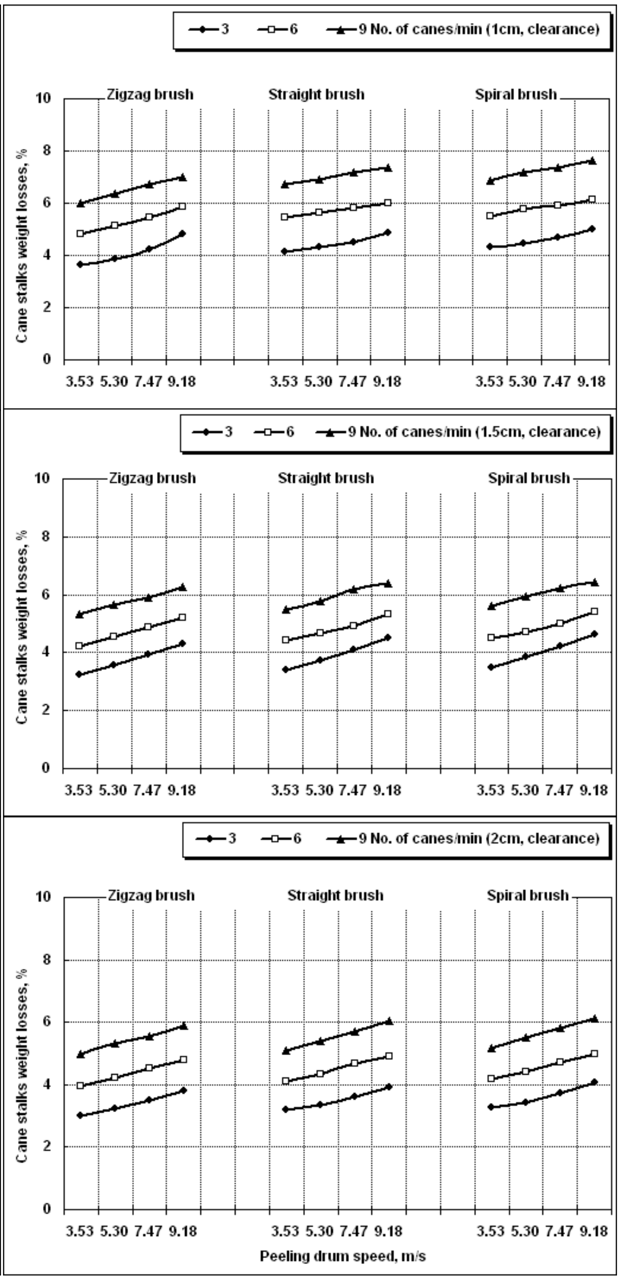


Fig. 6: Effects of peeling drum speed, drum clearance and feeding rate on peel retention on peeled stalks at different peeling brush types.

Fig. 7: Effects of peeling drum speed, drum clearance and feeding rate on cane stalks weight losses at different peeling brush types.

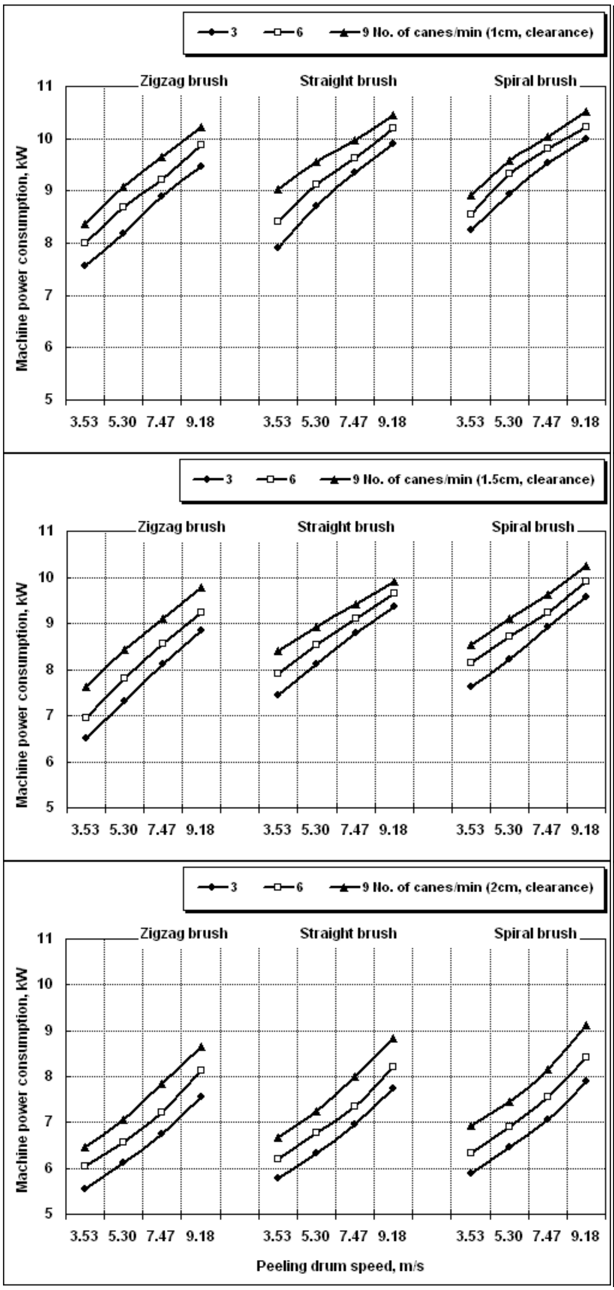


Fig. 8: Effects of peeling drum speed, drum clearance and feeding rate on machine power consumption at different peeling brush types.

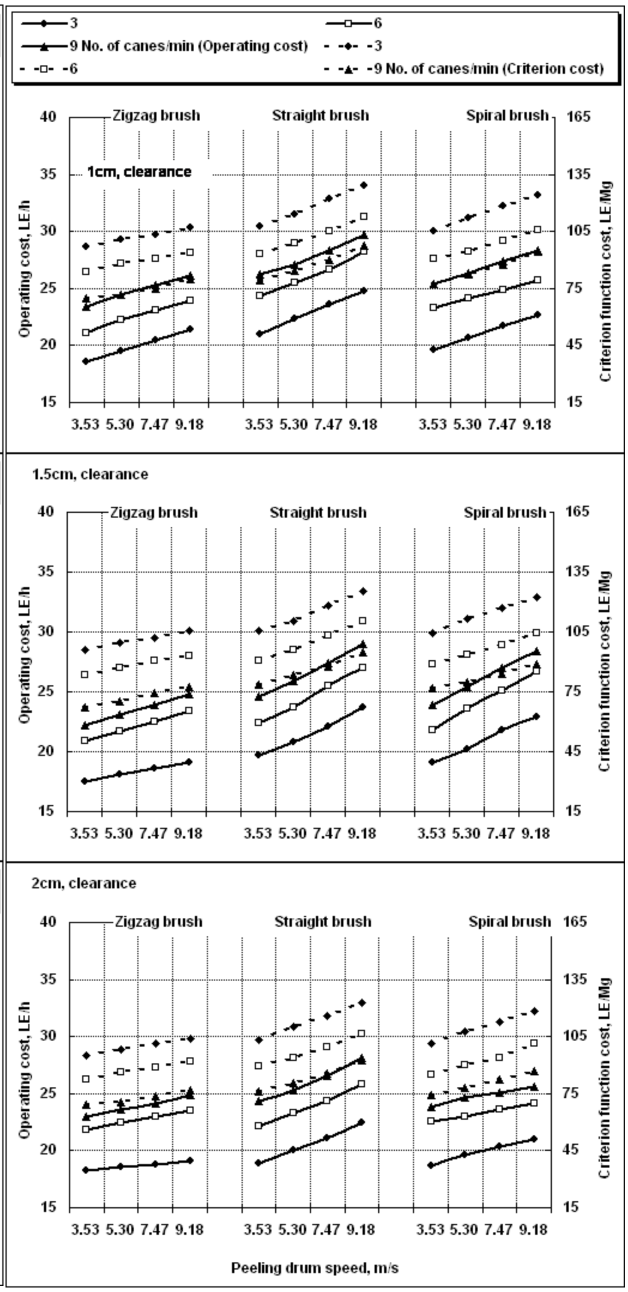


Fig. 9: Effects of peeling drum speed, drum clearance and feeding rate on operating cost and criterion function cost at different peeling brush types.

CONCLUSION

Generally, by using the zigzag peeling drum brush type tends to improve the peeling performance of the developed machine, compared to straight and spiral brush types. Moreover, the maximum machine production efficiency (88.85%) and the minimum electrical power consumption (5.56kW), were achieved at peeling drum speeds of 9.18 and 3.53m/s, peeling drum clearance of 2cm and No. of feeding canes per minute of 3 canes, respectively. Also, the maximum peeling efficiency, the minimum cane stalks losses and the lowest percentage of the peel retention on peeled stalks were 91.40%, 3.02% and 2.46%, respectively. These percentages were recorded at peeling drum speed of 9.18m/s, peeling drum clearance of 1cm and 3 canes/min feeding rate. As well, the minimum machinery unit cost was 67.49LE/Mg at peeling drum speed of 3.53m/s, drum clearance of 1.5cm and 9 cans/min feeding rate.

REFERENCES

Agricultural statistics (2014). Ministry of Agric., Cairo, Egypt. (3): 51-53.

Canegrowers (2012). Canegrowers Australia Annual Report 2011/2012. Tingalpa, QLD, Australia: Harding Colour.

Ge Xinfeng (2015). Design of Sugarcane Peeling Machine. Adv. J. Food Sci. Tech., 7(6): 398-400. ISSN: 2042-4868; e-ISSN: 2042-4876

Gil, N. and M. Saska (2005). Composition and processing of sugarcane green leaves and tops. Sugar J., 68, 32.

Hunt, D. (1983). Farm Power and Machinery Management. 8th ed., Iowa State Univ. Press, Ames., USA: 59-71.

Ivin, P. C. and C. D. Doyle (1989). Some measurements of the effect of tops and trash on cane quality. Proceedings of the Australian Society of Sugarcane Tech., 11: 1-7.

Khedari J.; N. Nankongnab; J. Hirunlabh and S. Teekasap (2004). New low-cost insulation particle- boards from mixture of durian peel and coconut coir. Build Environ., 39: 59-65.

Naturland (2000). Organic farming in the tropics and subtropics: Sugarcane, First Edition.

Richard, C.; W. Jackson, and H. Waguespack, Jr. (2001). Harvester trials and extraneous matter in the Louisiana sugar industry. Proc. Intl. Soc. Sugarcane Tech. 24(2): 263-268.

Sandhar, N. S. (1995). Investigation on the mechanics of sugarcane cleaner. Ph. D. thesis, Dept. of farm power and machinery. Punjab Agric. Univ., Ludhiana, India.

Shaw, G. R., and G. A. Brotherton. (1992). Green cane harvesting-a dilemma. Proc. Aust. Soc. Sugarcane Tech., 14(1): 1-7.

Shukla, L. N.; S. Irvinder and N. S. Sandhar (1991). Design development and testing of sugarcane cleaner. Agric. Mechanization in Asia, 22: 55-58.

Srivastava, A. C. and K. Singh (1990). Development of power drawn sugarcane detrasher. AMA 21(2): 49-52.

Tagare V. S.; V. B. Patil; S. P. Talaskar and S. D. Wadar (2013). Design and manufacturing of sugarcane peeling machine. International J. of advanced scientific and technical research, ISSN 2249-9954, 3(3): 70-83. http://www.rspublication.com/ijst/index.html.

Yadav, R. L.; S. R. Prasad; S. R. Singh; R. and V. K. Srivastava (1994). Recycling sugarcane trash to conserve soil organic carbon for sustaining yields of successive ratoon crops in sugarcane. Bioresource Tech., 49: 231-235.

Zhang Dehui (2015). Design of sugarcane peeling machine based on motion controller. Adv. J. Food Sci. Tech., 7(10): 824-826.

تقييم أداء نموذج أولى جديد لتقشير قصب السكر

عاطف عزت اليماني ومحمد عبد الحميد بسيونى

معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – الجيزة – مصر.

محصول قصب السكر من المحاصيل السكرية الهامة و يزرع سنويا في محافظات صعيد مصر بغرض الحصول على السكر. وقد بلغت المساحة المزروعة منه 330 الف فدان وبلغت الإنتاجية الكلية من المحصول 16.5 مليون طن بمتوسط 50 طن/للفدان أنتجت 1.03 مليون طن سكر (إحصائيات وزارة الزراعة، 2014). وتعتبر عملية تقشير أعواد القصب في الحقل أو خارجة من العمليات الزراعية الصعبة والشديدة الإرهاق والمكلفة للمزارع المصرى. وبصفة عامة لا توجد آلات محلية الصنع لكى تقوم بهذه العملية وتناسب الحيازات الصغيرة بالاضافة الى ان المتاح من الآلات المستوردة يتسبب فى تكسير وفقد أجزاء من عيدان القصب أثناء عملية التقشير. ولذلك لا يفضل المزارع البسيط استخدام الآلات المستوردة لان تكسير وفقد أجزاء من عيدان القصب يعتبر فقد في العائد للمزارع نظرا لارتفاع أسعار قصب السكر. لذلك كان الهدف من الدراسة الحالية هو تطوير آلة صغيرة تناسب عملية تقشير أعواد قصب السكر بحيث تعطى اقل نسبة فقد وتلف أثناء عملية تقشير قصب السكر. والآلة المطورة موضوع هذا البحث تحتوى على اسطوانتين في وضع افقى. الاسطوانة العليا منها تحتوى على عدد ثلاثة تجاويف تستخدم لإدخال الأعواد إلى الآلة. بينما الاسطوانة السفلي فقد تم تغطية محيطها الخارجي بطبقة من الألياف بحيث يشكل سطحها الخارجي باشكال هندسية مختلفة تناسب عملية التقشير. والأجزاء المتحركة لهذه الآلة تدار عن طريق مجموعة من الطارات والسيور متغيرة السرعات تستمد حركتها من موتور كهربي. وتتلخص نظرية عمل الآلة المطورة موضوع البحث فى انة يتم تلقيم عيدان القصب فى الخلوصات بين الاسطوانتان السفلي والعليا وعندما تدور الاسطوانتان في اتجاهين متضادين إلى الداخل تعملان على تقشير الأعواد والتخلص من الأوراق والشوائب الموجودة عليها. وبعد ذلك يتم اخراج الأعواد المقشرة من الجانب الأيمن للآلة عن طريق حركة اسطوانات أفقية الوضع. وتضمنت تجارب اختبار أداء النموذج الأولى للالة المطورة كل من المتغيرات الآتية:- شكل سطح اسطوانة التقشير: (الزجزاجى , المستقيم , الحلزوني).- سرعة اسطوانة التقشير: (3,53 , 5 , 30 ,7,47 , 18 ,9م/ث). - الخلوص بين اسطوانات التقشير: (1 ، 1.5 ، 2سم).- معدل تلقيم أعواد قصب السكر: (3 ، 6 ، 9عود/ د). وقد تم دراسة وتقييم مدى تأثير معاملات تجارب اختبار النموذج الأولى للالة المطورة على كل من: الكفاءة الإنتاجية للآلة وكفاءة تقشير الأعواد ونسبة القشور المتروكة على الأعواد بعد التقشير والفاقد الكلى للمحصول والقدرة المستهلكة ووحدة تكلفة التشغيل. وقد أظهرت النتائج تفوق الآلة عند استخدام الشكل الزجزاجى لاسطوانة التقشير مقارنة بالشكلين المستقيم والحلزوني. وأوضحت النتائج أن أعلى قيمة للكفاءة الإنتاجية لآلة هي 88.85% واقل قيمة للقدرة المستهلكة هي 5.56كيلووات عند ظروف تشغيل للآلة هي 9.18 و3.53م/ث سرعة اسطوانات التقشير و2سم خلوص و3 أعواد/د معدل تلقيم على التوالي. كما بينت النتائج أن أعلى قيمة لكفاءة التقشير واقل نسبة فاقد للتقشير وكذا اقل نسبة للقشور المتروكة على الأعواد بعد التقشير هي 91.4% و3.02% و2.46% على الترتيب حيث تحققت عند 9.18م/ث سرعة اسطوانة التقشير و1سم خلوص و3 أعواد/د معدل تلقيم. وكانت اقل قيمة من تكاليف التشغيل هي 67.49جنية/ميجاجرام عند 3.53م/ث سرعة اسطوانة التقشير و1.5سم خلوص و9 أعواد/د معدل تلقيم.