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Evaluation of Cutting Blades Impact on Productivity and Performance of Sugar Cane Harvesting Machine

Hassan, M. A. *

Agric. Eng. Res. Inst., Giza, Egypt



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ABSTRACT

Field experiments were carried out to determine effects of cutting blade types on sugar cane mechanical harvest. The evaluation of used sugar cane harvester is carried out through four levels of forward harvesting speed of 2.4, 3.2, 4.1 and 5.2 km/h, three cutting blade types namely: smooth blades, serrated blades and fast exchange blade, and four levels of blade angles of 0, 10, 17.5 and 22.5° on the area of sugarcane cutting, productivity, percent of sugarcane cut stalks, percent of damage cutting blades, total losses, total cost and criterion function cost. The results concluded the following: maximum of the area of sugarcane cutting was 4522.8 m²/h and productivity of 49.6 ton/h and percent of sugar cane cut stalks of 96.1% were recorded at using serrated blades type with 17.5° tilt angle. Also, the minimum of percent of damage cutting blades was 9.7%, total losses of 1.9%, losses cost of 18.9 L.E/h and criterion function cost of 192.4 L.E/h. Finally, the performance characteristics of used machine were influenced by the investigated variables.

Keywords: sugarcane, the area of sugarcane cutting, productivity, percent of sugarcane cut stalks, total losses and criterion function cost



INTRODUCTION

In Egypt, sugar cane is harvested by hand or sometimes mechanically. Hand harvesting accounts for more than half of world production, and is particularly dominant in the developing world. With reed blades or machetes, the harvesters then cut the reeds standing above the ground. Through mechanical harvesting, the sugarcane machine shears the sugarcane at the base of the cane, separates the cane from its leaves, places the cane in a hauling truck while the garbage blows back into the field. Morris *et al* (1980) told that, a mechanized pruner has been developed which not only reduces the labor required for pruning, but also properly shapes the hedgerow for maximum harvesting efficiency of erect cane fruits. Meyer (2005) reported that, harvesting is currently the most labor intensive and one of the most costly operations in the production of sugarcane. Meyer (2001) explained that two separate harvesting experiments were conducted to evaluate the performance of machines and to determine cane losses associated with different types of mechanical loaders and combine harvester during two seasons. The results of these studies showed that the performance of the mechanical bucket and combine harvester varied considerably by machine type, sugarcane productivity, crop and field conditions. Instant loading rates and mechanical harvest rates ranged from 60 to 100 tons/hour. Mello and Harris (2000) noted that the 22.7° blade angle is most effective at cutting or cutting sugar cane. Kroes (1997) showed a major problem with mechanical harvesting is the base cutter damage sustained by the cane during harvesting, damage to the butt of the stalk results in the first and possibly, the

second billet being damaged by splitting and shattering. Splitting of the stalk may cause billets to separate into two or more fragments, or shattering may cause the cane to break along apportion of the billet. In addition, stool damage increases the exposure to fungal attacks and diseases. Mello and Harris (2003) evaluated the impact of the cutting blade type on the cutting of sugarcane stems and concluded that the tilt blade and a 3 mm serrated step yielded the best result (ie, minimal leg damage). Mello(2005) reported that the 3 mm serrated step offers the lowest specific cutting force, but no different from the smooth cutting shape, for both 450 and 600 rpm of transverse blade speed. Muscat and Agnew (2004) observed that, There are a wide range of factors that sugarcane growers should consider when considering moving from a manual to a fully automated harvesting system. The most important factors must be practical for implementation as well as based on sound economic assessments and principles.

Zhang *et al.*, (2010) reported that, Loss of reeds and foreign matter is higher with harvesting of green reeds, especially under poor harvest conditions, which may include high moisture from leaves and soil or heavily carved reeds. Habib *et al.* (2002) conducted a study to classify the various parameters that affect the performance of the cutting process into four predominant groups: the cutting tool, the plant, the machine, and the mixed group. They showed that the main parameter of the cutting tool is the angle of the knife edge, and the plant material is the moisture content, while the machine's working performance, the main parameter is the cutting speed of the cutting. Finally, they stated that the cutting energy consumed in the harvesting process is much lower than the energy consumed in the crushing process due

* Corresponding author.

E-mail address: mabdallah8@yahoo.com

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to the impact of moisture content. Scandalares *et al.* (2004) explained that, it has cane of 3.6% to 5.8% with a new model harvester compared with 4.8% to 7.7% with the older model harvester in a 1000 rpm fan setting. Meyer *et al.* (2011) reported that mechanical harvesting was replaced by intensive manual labor harvesting, which included a series of unit operations, such as incineration or waste disposal, basic cutting, topping, stacking, punching, and loading. In contrast, mechanical combine harvesters combine separate processes, including boarding, collecting, feeding, basic cutting, cutting, cleaning and loading in dump trucks that run next to the combine harvester, in a single process thus greatly increasing ground productivity and labor. Ma *et al.* (2014) said that mechanical sugarcane harvesters are classified as full-leg or minced harvesting systems and are equipped with single-row or double-row cutting mechanisms. Mathanker *et al.* (2015) reported that higher radical damage and an increase in energy cane residues compared to burnt sugar cane at harvest using regular straight blades. In this study, four cutter blade designs (straight blade, angle blade, serrated blade, and patented laser blade) were tested in the field and evaluated with respect to the quality of reeds in green reeds. Cutting quality indicators were leg damage caused by fragmentation and division, damage to the root system of stems removed from the soil, and high adhesion. Mello and Harris (2003) evaluated the performance of the primary cutter disc with blades with smooth and serrated cutting edges. They noticed that blades with serrated cutting edges caused less damage to the cutting legs than smooth-edged blades. In addition, 3mm short toothed blades require less cutting power than smooth-edge blades. Makarand and Patil (2013) reported that, a special cutting system was designed and developed for

Table 1. Some of used sugarcane properties.

Item	Length, mm	Head diameter,mm	Middle diameter,mm	Tail diameter, mm	Average diameter, mm	Mass, g
Average	1682	32.8	36.2	39.2	36.06	958.33
S. D.	38.93	1.93	2.30	2.66	2.19	169.99

Sugar cane harvesting machine description and operation

A single-row mounted sugarcane chopper harvester was used for the tests. Figure 1, presents its schematic diagram contain the main components of machine. Details of the harvester specifications are shown in Table 2. The mounted sugar cane harvester is simple to operate, maintain and compact machine operated by hydraulic system. It was also made in such a manner that it can easily be transported to and from the narrow farm roads. It comprises of three major operating systems; the hydraulic, the cutting and the gathering systems. The hydraulic system which contain of the hydraulic tank, filter, pump, motor, control valves and the hoses. The cutting system has rotary cutting blades arranged in series at overlap positions in order to have effective cutting without missing any sugar cane stem. This covers an effective cutting width of 980 mm of the harvester. It derives from hydraulic system by means of chains and sprockets. The gathering system consists of four rotary grabbing fingers mounted right on top of the cutting system, this grabs the sugar cane stems keeping them upright and guides them towards the cutter and subsequently guides the stems backwards after cutting. The gathering system obtains its operating power from the tractor hydraulic system which drives the grabbing fingers via a mild steel shaft by means of chains and sprockets. Cutting system and cutting mechanism selection.

sugarcane harvesting. It can be concluded that the cutting system has a cutting disc (60 cm diameter) with four blades that completely cut the stems with impact force. This system has a simple rod mechanism to guide the cutting stalks to one side to stop crushing under the tires. Harvest sugarcane grown in small or large farms. Harvest sugarcane grown in small or large farms. Wang *et al.* (2010) have a research of the dynamics simulation of one-blade cutting sugarcane process. Patil M. and P. Patil (2013) developed a 50cm rotary disc cutting mechanism and four clockwise blades. The stems are cut with impact forces and inertia at a linear speed of 27 m / s, by cutting blades. This system has a simple bar mechanism to direct the entire leg to one side. Cutting quality tests were achieved by two series of blades with 30 ° and 45 ° blade angles on the stem. The results showed that the stubble surface with a blade angle of 30 ° was smooth and unbreakable on the vascular elements and tissues, compared to the blade angle of 45 °. Blade penetration was achieved very well at a 30 degree angle to the blade.

The objectives of this present study were to determine and evaluate three cutting blade types on productivity and performance of mounted sugarcane harvesting machine under Egyptian conditions

MATERIALS AND METHODS

Experiments were conducted on the sugar cane farm in Kafr El-Sheikh during the growing season 2017/2018 to examine the mounted sugar cane machine (Giza 85-166, Miscellaneous). Table 1 shows some of the physical properties of the sugar cane used.

Table 2. Technical details of used mounted sugar cane machine.

Parameters	Specifications
General Dimensions	
Overall length	2968 (mm)
Overall width	1685 (mm)
Overall height	920 (mm)
Ground clearance	150 (mm)
Total weight	400 (kg)
Transmission source	
Power source	Tractor PTO
Tractor required	55 (hp)
Transmission	PTO
Harvesting Head (Cutting System & Gathering)	
Length	980 (mm)
Width	1630 (mm)
Height	920 (mm)
Cutting system width	980 (mm)
Cutting system height	100 (mm)
No. of grabbing fingers	4
No. of rotary shaft	1

The first stage of a special cutting system for this plant was carried out with attention to the physical properties of the sugarcane stalk. All mechanisms used in harvesters are designed according to the operation of the rotary cutting system (with impact and shear method).

The rotary cutting system uses inertial force, shock force to cut stems and blade movement to cut stems. With due attention to the specifications of these systems and the

physical properties of the sugarcane leg, a rotary cutting system was selected. We use three cutting blade types in this experiment named smooth blades, serrated blades and fast exchange blades as shown in Fig. 2. Where, used blades in the machine were deaf blocks separating sticks by collision only, which caused a lot of damage and loss, so it was replaced by three new types with sharp edges and serrated to increase the efficiency of cutting with the least loss and damage.

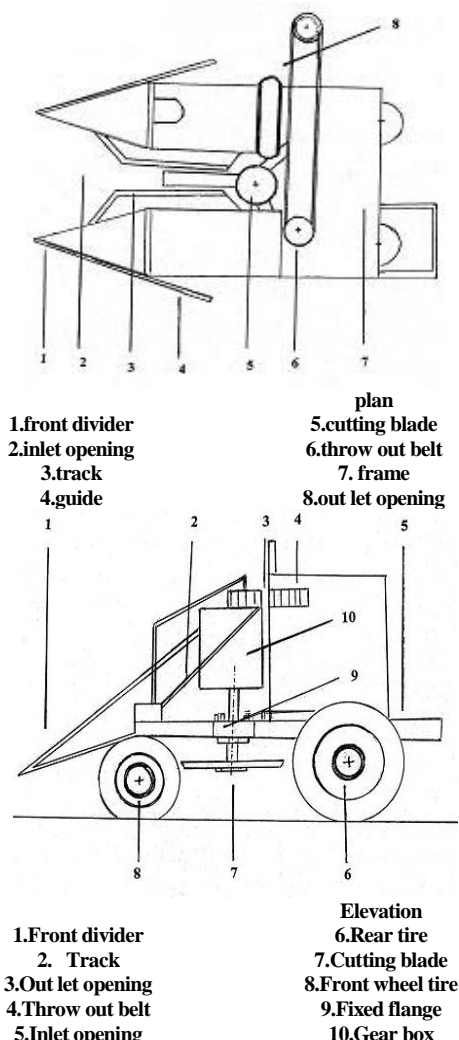


Fig. 1. Schematic view of mounted sugarcane harvesting machine.

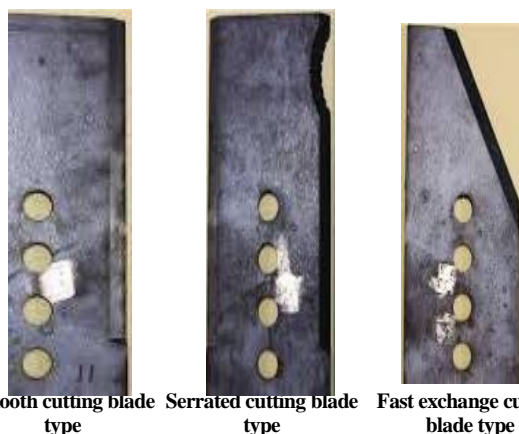


Fig. 2. A new three types of used blade Investigated variables:

Present study was carried out to determine the effects of forward harvesting speed, cutting blade type, blade angle on sugar cane quality properties and productivity during testing a mounted machine for harvesting sugar cane under Egyptian conditions. The following procedures were taken for evaluation test:

- 1- Four levels of machine forward harvesting speed of 2.4, 3.2, 4.1 and 5.2.Km/h,
- 2- Three types of blades of smooth blades, serrated blades, and fast exchange blades, and
- 3- Four levels blade angles of 0, 10, 17.5 and 22.5° angle were used in this study. Different combination of treatments were done at blade speed of 13.8m/s and replicated three times.

Measurements:

- 1- Sugarcane cutting stems percentage was calculated by:

$$\text{Sugarcane cut stems, \%} = \frac{A1}{A2} \times 100 \dots\dots 1$$

Where: A1 = cutting amount of sugarcane stems, kg.
A2 = uncutting amount of the sugarcane stems, kg.

- 2- Machine productivity: machine productivity (Pm) in Mg h⁻¹ was calculated using the following formula:

$$P_m = \frac{W}{T} \dots\dots\dots 2$$

Where: W = is the weight of cutting sugarcane stems, Mg.
T = is the harvesting time, h.

- 3-Damage sugarcane cutting blade percentage was calculated by:

$$\text{Damage sugarcane cutting blade, \%} = \frac{C1}{C2} \times 100 \dots\dots\dots 3$$

Where: C1 = is yield of breakage sugarcane from cutting blade, kg.
C2 = is yield of sugarcane from cutting blade, kg.

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

$$C = p/h (1/a + i/2 + t + r) + (0.9 w.s.f) + m/144 \dots\dots\dots 4$$

Where:

- c = Hourly cost , L.E/h.
- p = Price of machine , L.E.
- 0.9= Factor accounting for lubrication
- a = Life expectancy of the machine .h.
- i = Interest rate/year.
- t = Taxes ratio
- r = Repairs and maintenance ratio
- h = Yearly working hours, h/year.
- w = Engine power, hp
- s = Specific fuel consumption, l/hp. h.
- f = Fuel price , L.E/l
- m= Monthly average wage ,L.E.
- 144= Reasonable estimation of monthly working hours.

- 4- Criterion function cost : it was determined by the following equation(Hunt, 1983):

$$\text{Criterion function cost} = (\text{unit operating cost} + \text{losses cost}) \text{, LE/Mg} \dots\dots 5$$

Where in:

$$\text{Unit operating cost} = \frac{\text{Machine cost}}{\text{Machine productivity}} \text{, LE/Mg} \dots\dots\dots 6$$

$$\text{Losses cost} = (\text{price of sugarcane losses value} + \text{fewness in sugarcane price according to sugarcane damage}) \text{, LE/Mg} \dots\dots\dots 7$$

RESULTS AND DISCUSSION

Performance rate of sugar cane cutting area

Result in Fig. 3 shows the relationship between machine forward harvesting speed and both of cutting blade types and blades tilt angle on the area of sugar cane cutting. Where the area of sugar cane cutting was increased with increasing both of forward harvesting speed from 2.4 to 5.2 km/h and with increasing tilt angle from 0 to 17.5° then beginning to decrease with 22.5°. So, at increasing forward harvesting speed from 2.4 to 5.2 km/h, use serrated cutting blade type with 17.5°(tilt angle), the area of sugar cane cutting increased from 2311.2 m²/h (0.55 feddan/h) to 4522.8 m²/h (1.076 feddan/h), also, at using the same type of blade with forward harvesting speed 2.4Km/h and increasing blade angle (tilt angle) from 0° to 17.5°, the area of sugar cane cutting increased from 1711.6 m²/h (0.407 feddan/h) to 2311.2 m²/h (0.55 feddan/h) then decreased with increasing blade angle from 17.5 to 22.5°. This action happened with all cutting blade types. On other hand, serrated cutting blade type recorded high amount of the area of sugar cane cutting at the same conditions. Result indicated generally that, the area of sugar cane cutting consider the best type in working and Achievement. The maximum value of the area of sugar cane cutting 4522.8 m²/ h recorded at using serrated cutting blade type and 17.5° tilt angle. While, the low value of the area of sugar cane cutting was 1335.6 m²/h (0.318 feddan/h) recorded at using smooth cutting blade type and 0° tilt angle.

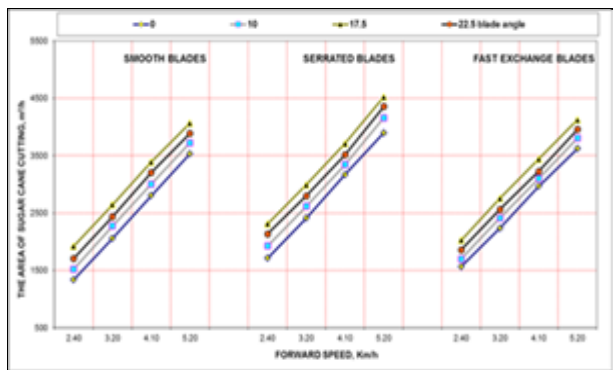


Fig. 3. Effects of cutting blade types, machine forward harvesting speed and blade angles on the area of sugar cane cutting, m²/h at sugar cane harvesting

Productivity

Results as shown in Fig. 4 indicate the effect of forward harvesting speed on machine productivity at different harvesting cutting blade types and blade angles (tilt angle). The values of productivity were higher with using serrated cutting blade type at all testing points compared with other types. Also, productivity was increased with increasing all of forward harvesting speed from 2.4 to 5.2 km/h and tilt angle from 0 to 17.5° while, it was decreased with increase tilt angle from 17.5 to 22.5°.

The maximum value of productivity was 49.6 ton/h recorded at using serrated cutting blade type with forward harvesting speed of 5.2 km/h, tilt angle of 17.5°, respectively. Also, the minimum value of productivity was 25.12 ton/h recorded at using smooth cutting blade type with forward harvesting speed of 2.4 km/h and tilt angle of 0°, respectively

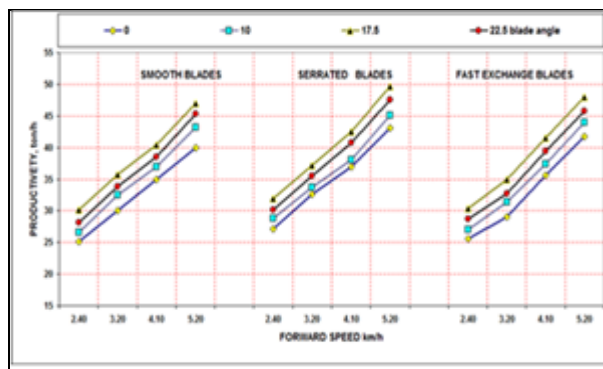


Fig. 4. Effects of cutting blade types, machine forward harvesting speed and blade angles on sugar cane productivity, ton/h at sugar cane harvesting

Percentage of Sugar cane cutting stalks

Fig. 5 illustrates the percent of sugar cane cut stalks. Which was inversely proportional to forward harvesting speeds and directly proportional to blade angle (tilt angle). Also, results noticed that, serrated cutting blade type recorded high value of percent of sugar cane cut stalks compare with smooth and fast exchange blades.

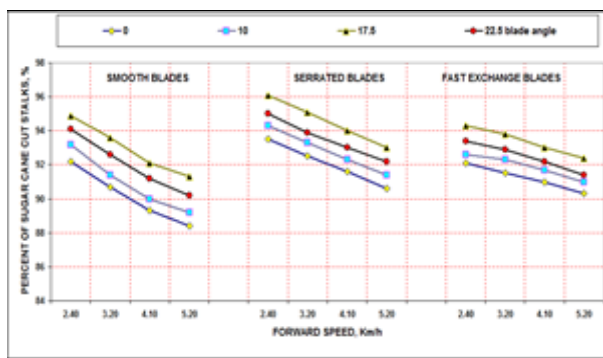


Fig. 5. Effects of cutting blade types, machine forward harvesting speed and blade angles on percent of cut stalks, % at sugar cane harvesting

The maximum value of percent of sugar cane cut stalks was 96.1% recorded at using serrated cutting blade type at machine forward harvesting speed of 2.4 km/h and tilt angle of 17.5°. While, the minimum value of percent of sugar cane cutting stalks was 88.4%, recorded at using smooth cutting blade type with machine forward harvesting speed of 5.2 km/h and tilt angle of 0°, respectively. This shows that, using of serrated cutting blade type was given the highest efficiency for harvesting and then see the high level of friction with the surface of the sticks compared to other types of fast exchange and smooth blades respectively.

Percentage of damage cutting blades

Fig. 6 illustrates the relationship between of forward harvesting speed, cutting blade types and tilt angle on percentage of damage cutting blades. Generally percentage of damage cutting blades was increased with increasing machine forward harvesting speed, while it was decreased with increasing of tilt angle from 0 to 17.5° then increase with 22.5° tilt angle. Also, results indicated that, at all investigated point with using serrated cutting blade type percentage of damage cutting blades was recorded low value, while using smooth and fast exchange blades were recorded high value, respectively. Finally, the minimum value of percentage of damage cutting blades was 9.70% recorded at serrated cutting blade type and forward harvesting speed of 2.4 km/h and tilt angle of 17.5°. While, the maximum value of damage cutting blades percentage was 39.9% recorded at fast exchange blade type with forward speed of 5.2 km/h and tilt angle of 0°, respectively.

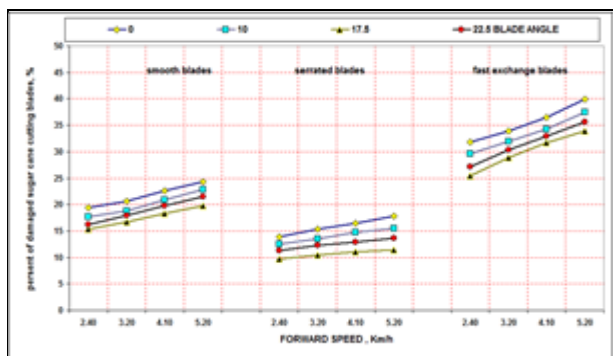


Fig. 6. Effects of cutting blade types, machine forward harvesting speed and blade angles on present of damage cutting blades, % at sugar cane harvesting.

Total cane stalks losses

Total cane stalks losses as related to the forward harvesting speed, cutting blade types and tilt angle are shown in Fig. 7. It is clear that, total cane stalks losses was increased with increasing forward harvesting speed from 2.4 to 5.2 km/h, while it was decreased with increasing tilt angle from 0 to 17.5° then increase with 22.5° tilt angle and serrated cutting blade type recorded low amount of total cane stalks losses at all experiment levels compared with other types of used blades losses and smooth cutting blade type was recorded high value at the same conditions, respectively.

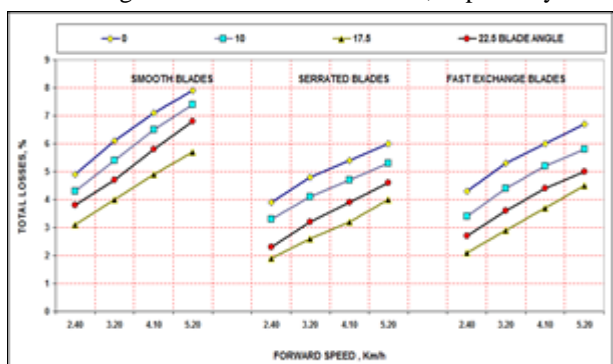


Fig. 7. Effects of cutting blade types, machine forward harvesting speed and blade angles on present of total losses, % at sugar cane harvesting.

Generally, Results also found the maximum amount of total cane stalks losses were 7.9% recorded at using smooth cutting blade type with forward harvesting speed of 5.2 km/h and tilt angle of 0°. While, the minimum amount of total cane stalks losses were 1.9 % recorded at using serrated cutting blade type with forward harvesting speed of 2.4 km/h and tilt angle of 17.5°, respectively.

Sugar cane harvesting losses cost

Data in Fig. 8 explain that, sugar cane harvesting losses cost was increased by increasing of forward harvesting speed, while it was decreased with increasing of tilt angle from 0° to 17.5° then increase with 22.5° one more time.

Also, results show that serrated blade type recorded low amount of sugar cane harvesting losses cost. Generally the lowest amount of sugar cane harvesting losses cost was 18.9 L.E/h recorded at using serrated blade type with forward harvesting speed of 2.4 Km/h and tilt angle of 17.5°. While the highest value of sugar cane harvesting losses cost of 162.6 L.E/h recorded at smooth blade type with forward harvesting speed of 5.2 km/h and tilt angle of 0°, respectively.

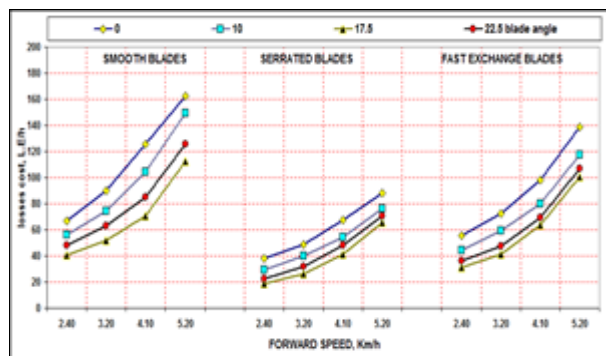


Fig. 8. Effects of cutting blade types, machine forward harvesting speed and blade angles on losses cost, L.E/h at sugar cane harvesting.

Criterion function cost

Fig. 9 illustrates also the effect all of forward harvesting speeds, cutting blade type and tilt angle for blade on criterion function cost. Where, it was increased with increasing forward speed while it was decreased with increasing tilt angle from 0 to 17.5° then increase with 22.5° tilt angle for cutting blades. Also, results recorded low value of criterion function cost at using serrated blade type compared with other types and recorded high value at using smooth blade type. Finally, the lowest amount of criterion function cost of 192.4 L.E/h recorded at serrated blade type with forward harvesting speed of 2.4 km/h and tilt angle of 17.5°, while the highest amount of criterion function cost of 334.8 L.E/h recorded at smooth blade type with forward harvesting speed of 5.2 km/h and tilt angle of 0°, respectively.

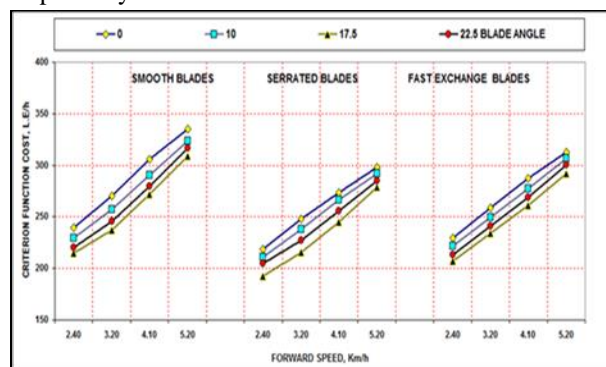


Fig. 9. Effects of cutting blade types, machine forward harvesting speed and blade angles on criterion function cost, L.E/h at sugar cane harvesting.

CONCLUSION

The performances of mounted sugar cane harvester under different three blade types named smooth, serrated and fast exchange blade having four tilt angle values were compared and evaluated under Egyptian conditions. Conclusions include the following:

- 1- An increase in the forward speed within the range of values included in this study increase all of performance rate of sugar cane cutting area and productivity, percentage of damage cutting blades, total cane stalks losses, sugar cane harvesting losses cost and criterion function cost. However, increasing the speed decreased percentage of sugar cane cut stalks at all levels of tilt angle blade and blade types.
- 2- The maximum values of performance rate of sugar cane cutting area and productivity were associated with serrated blade type at 5.2 km/h and 17.5° tilt angle. While, the maximum values of percentage of sugar cane cut stalks were associated with serrated blade type at 2.4 km/h and 17.5° tilt angle

- 3- The minimum values of percentage of damage cutting blades, total cane stalks losses, sugar cane harvesting losses cost and criterion function cost were associated with serrated blade type at 2.4 km/h and 17.5° tilt angle with all other parameters considered in this study.
- 4- Above results showed superiority of the machine when using serrated blade at all levels of experience compared to other types in terms of high performance rate and productivity and efficiency of cutting chopsticks and low loss and damage in the crop yield and low total operating costs, which means that this machine is of good operating specifications and suitable small farms, especially when using tilt blade angle of 17.5 °.

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تقييم تأثير أسلحة القطع على إنتاجية و أداء آلة حصاد قصب السكر.

محمد عبد الله إبراهيم حسن

باحث بمعهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – الجيزة – مصر.

محصول قصب السكر من المحاصيل الهامة و يزرع سنويا في محافظات صعيد مصر. وقد بلغت المساحة المزروعة منه 330 ألف فدان وكانت الإنتاجية الكلية من المحصول 16.5 مليون طن بمتوسط 50 طن/الفدان أنتجت 1.03 مليون طن سكر (إحصائيات وزارة الزراعة، 2014). وتعتبر عملية حصاد أو تقطيع أعواد القصب في الحقل من العمليات الزراعية الصعبة والشديدة الإرهاق للمزارع وبصفة عامة لا توجد آلة زراعية تقوم بهذه العملية تناسب الحيازات الصغيرة والمتاح بالأسواق بعض الآلات المستوردة بسبب تكبير وفقد أجزاء من الأعواد أثناء عملية الحصاد الميكانيكي وهذا المقدار من الأعواد يعتبره المزارع فقد في العائد نظرا لارتفاع أسعار قصب السكر ولذلك لم يفضلها المزارع البسيط ويعتمد على الحصاد اليدوي. وقد كانت فكرة هذه الدراسة هي تقييم أداء ثلاثة أنواع جديدة من أسلحة الحصاد بحيث تعطى أقل نسبة فقد وتلف أثناء حصاد الأعواد. و أعلى إنتاجية للفدان تحت ظروف التشغيل المحلية. والآلة المستخدمة في البحث كانت من النوع المركب على مقدمة الجرار و تحتوي على إسطوانة نورة في وضع أفقي يركب على محيطها أربعة أسلحة دوارة تصطدم بالأعواد بسرعة دورانها فتسبب فصل الأعواد عن الأرض و يوجد أعلاها سير دوران يحرك الأعواد بعد القطع إلى خارج الآلة لتسقط جانباً على الأرض. وكانت الآلة تدار عن طريق نقل الحركة من عمود الإدارة الخلفي للجرار. وأظهرت النتائج التالي: 1- كانت كل من معدل الأداء للآلة تتناسب طرديا مع سرعة التقدم و زاوية ميل نصل السكينة و كانت النتائج مع السكينة المسننة أعلى ما يمكن بالمقارنة بالأنواع الأخرى. و كانت أقصى قيمة لكل منهما 4522.50 متر/ساعة 2- إنتاجية الآلة كانت تتناسب طرديا مع زيادة كل من سرعة تقدم الآلة وزاوية ميل نصل السكينة و كانت أقصى قيمة للإنتاجية 49.6 طن/ساعة بينما كانت أقل قيمة لها 25.12 طن/ساعة عند استخدام السكينة الناعمة شكل و زاوية ميل نصل سكبينة صفر ° على الترتيب 3- النسبة المئوية لقطع الأعواد كانت تتناسب عكسيا مع سرعة التقدم و تتناسب طرديا مع زاوية ميل نصل السكينة. و كانت أعلى قيمة هي 96.1% سجلت مع السكينة المسننة 4- النسبة المئوية للأعواد التالفة (جزنيا و كليا) كانت تزداد مع زيادة سرعة التقدم و تنخفض مع زيادة زاوية ميل نصل السكينة من 0 إلى 17.5 ° ثم تزداد مع زاوية ميل 22.5. و كانت أقل قيم 9.7% سجلت مع السكينة المسننة 5- النسبة المئوية للأعواد المقفودة كانت تزداد مع زيادة سرعة التقدم بينما كانت تقل مع زيادة زاوية ميل السكينة. و أقل نسبة فقد أثناء التشغيل كانت 1.9% عند استخدام السكينة المسننة 6- الدالة المعيارية كانت تزداد مع زيادة سرعة التقدم و تنخفض مع انخفاض زاوية ميل السكينة. وكانت أقل قيم لهما هي 192.4 جنية/ساعة سجلت عند استخدام السكينة المسننة 7- وقد أظهرت النتائج السابقة تفوق الآلة عند استخدام السكينة المسننة عند جميع مستويات التجربة مقارنة بالأنواع الأخرى من حيث ارتفاع معدل الأداء و الإنتاجية و كفاءة التقطيع للأعواد وانخفاض نسبة الفقد والتلف في المحصول الناتج وانخفاض التكاليف الكلية للتشغيل مما يعني أن هذه الآلة تعتبر ذات مواصفات تشغيل جيدة وتتاسب المزارع البسيط خاصة عند استخدام السكينة المسننة ذات زاوية ميل للحافة 17,5° عند جميع مستويات التشغيل.