MISR JOURNAL OF AGRICULTURAL ENGINEERING
https://mjae.journals.ekb.eg/
ISSN-Print: 1687-384X
ISSN-Online: 2636-3062
Misr J. Ag. Eng., 39 (1): 1 – 14
DOI: 10.21608/MJAE.2021.109214.1055

PERFORMANCE OF A MACHINE FOR SHALLOW HOEING AROUND PLANTS

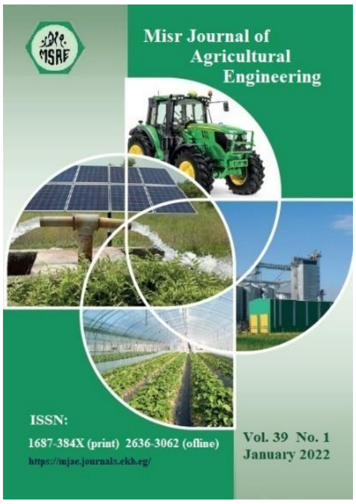
Nabil. S. Elkaoud[1&*], Wael A. Mahmoud[2] and Ahmed. M. Mousa[3]

[1] Assoc. Prof., Fac. of Ag. Eng., Al-Azhar U. (Assiut Branch), Egypt.

[2] Assist. Prof., Fac. of Ag. Eng., Al-Azhar U. (Assiut Branch), Egypt.

[3] Assoc. Prof., Dept. of Ag. Mach. and Power Eng., Fac. of Ag. Eng., Al-Azhar U., Cairo, Egypt.

[*] E-mail address: NabilElkaoud.50@azhar.edu.eg.



Keywords:
Weeder; Weed control; Brush cutter; Power weeder; Cultivator; Mowing; Hoeing.

ABSTRACT

The main aim of this research was to evaluate the performance of a hand steering brush cutter for shallow hoeing around plants in order to achieve both very accurate transverse and longitudinal positional control to avoid crop damage. Field tests were carried out in the cucumber field under average three values of the soil moisture contents 31.2 %, 25.4 and 20.1 %. The brush cutter was tested using three types of hoeing blades (standard, weed brush and weeding plate) at average possible forward speed for the labor to maintain continuous operation 0.1 m/s (0.36 km/h). The field experiments of the machine showed that, in the case of using the hoe blade standard, the weeds were mowed only without soil agitation after hoeing. While in the case of using weed brush and weeding plate, the weeds were uprooted or killed with shallow agitation of the soil after hoeing. The weed control efficiency ranged from 61 to 98 % according to the used hoeing blades and the soil moisture contents. Injured plants percentage was always less than 0.5 % and may rarely be more than 1.0 %. The actual field capacity was 0.118, 0.111 and 0.108 fed/h by using hoe blade standard, weed brush and weeding plate, respectively. The total cost to hoe one feddan (Shallow hoeing around plants for raking weeds) by using the hoe blade standard, weed brush and weeding plate were 180, 190 and 200 L.E, respectively.

1. INTRODUCTION

Mechanical weed control is the most important method used in controlling weeds where it helps reducing the drudgery involved in manual hoeing but selective inter-row weeding operation by mechanical method requires both accurate transverse and longitudinal positional control to avoid crop damage. So far, commercial automated mechanical methods are not spread for operation in the inter-row area. **Tiwari, et al. (2021)** summarized that hand weeding is a common method of weed control on vegetable farms, especially in developing countries. It requires considerable physical labor and is a significant economic burden; yet comparative studies on hand weeding tools are rare. Viable hand weeding strategies require the optimization of tools for ergonomic performance and careful attention to the timing of operations, thus benefiting economic performance. **Chandel**, **et al. (2021)** reported that weeding is critical to eliminate non-native plants that compete with main crops and adversely affect their production quality and quantity. Numerous prototypes exist for inter-row weeding but are very limited for intra-row weed eradication. **Beka, (2018)** mentioned that weeds tend to reduce yields due to infestation, related to the deterioration of the quality of crops. Weeding with a manual is labor-intensive, time consumption and chemical control weeding method also affect on environment pollution and kill specific species of weeds. **Rajaperumal, et al. (2021)** said that grass and weeds are common difficulties faced by farmers which affect the nutrition and growth rate of plants. They implemented a project, the purpose of this project was to develop a manual weed removing machine (weeder). They mentioned that the development of a dual-purpose manual weeder using chain and the pedal mechanism is to remove weeds in the fields and lawns. **Saha, et al. (2021)** studied the design, construct, and testing of a two-wheeled power tiller multi-row weeder (MRW) for effective weed control in the wheat production field and other narrow-row crops. This concept was conceived from the high cost and labor-intensive methods required for hand weeding (HW) and the restrictions in chemical weed control borne by the resource-poor smallholder farmers. **Uemura, et al. (2014)** said that a small engine brush cutter is a kind of agricultural machine for cutting weeds, and a lot of people use the machine all over the world by the low price and easy handling. **Okubo, et al. (2014)** said that the brush cutter powered by an engine is a widely used agricultural machine for not only forest operation but also mowing of road shoulders and gardens on a daily basis. **Mohite, et al. (2021)** reported that automation is quickly advancing in today's technologies, and agriculture is no exception. Agriculture will benefit from automation in terms of progress as well as farmer comfort. Brush cutter / grass cutting machine/ power weeder/harvester are the names of single multipurpose agricultural equipment. This equipment is very useful to all farmers for them inter tillage operations. It makes it possible to do tedious farming jobs easily in a very short span of time and with lesser cost. This equipment is also fuel-efficient consumes very little fuel. Weed cutter is the first machine widely accepted by the farmer in recent times. It has become multipurpose equipment on farms for performing different operations with various blade attachments. It has been concluded that the weed cutter machine will save a lot of money and time for the farmers as their income of the farmers grows. It can conclude that the work will meet the needs of small-scale ranchers who cannot afford to purchase expensive agrarian equipment. It took less labor and time than traditional methods, so if a farmer uses it on a large scale, his costs will be cut in half. **Falana, et al. (2020)** reported that the brush cutters are implements that is readily available and easily serviced. It usually consists of a two or four-stroke petrol engine driving an attachment/blade via a shaft. It has a lightweight aluminum body (7 – 8 kg), hence, the operator never feels its heavyweight, vibration is less, hence, exerting fewer strains on the operator. The handle of the brush cutter comprises a clamp mounted centrally about the aluminum that houses the driveshaft. The handle holds the throttle trigger, stop switch, and clutch/throttle trigger lockout of the brush cutter. The direction and height of the handle can be adjusted with respect to the ergonomics of the operator. **Sedara and Sedara, (2020)** pointed out that weeds can be thought of as plants growing in the wrong habitation, place and time thereby, doing further damage than improving the crop. Taking out weed growths is a vital practice but in the same way, it's time-consuming. An increase in the use of machine-like intra-row weeders is of much interest around the world today because of its impact on the environment and a growing request for healthy foods produced. Today the agricultural industry wants non-chemical weed control that can safeguard consumers' demand for high-quality food crops and pay special attention to food safety. Through the mechanical development of different devices for weeding manually, such as accurate inter-row and intra-row weeders, weeds can be mitigated. Through these mechanical means, food production safety can be guaranteed. There is a need to review existing mechanical weeders to know their merits and demerit. Accordingly, the main objective of this research was to evaluate the performance of a hand steering brush cutter for removing weeds from row planted crops in order to achieve both very accurate transverse and longitudinal positional control to avoid crop damage.

2. MATERIALS AND METHODS

The field experiments were conducted on the farm of the Faculty of Agriculture, Al-Azhar University, Assiut Governorate in the summer season of 2021. The machine was tested for weed control of the cucumber crop. The cucumber crop was planted by hand in beds, two rows per bed. The width of the beds was 100 cm and the width of the furrow was 80 cm. The distance between the plants on the furrow was ranged from 30 to 40 cm. The field experiments were carried out after 28 days from the planting date. Fig. (1) shows the brush cutter during field experiments.

Fig. (1): The brush cutter during field experiments.

Mechanical analysis of the soil:

Soil samples were collected from the experimental field at different soil depths. The results are an average of several core samples taken down to the deepest cultivation depth achieved. The mechanical analysis was carried out in the soil and water Department, Faculty of Agriculture, Al-Azhar University, Assiut Governorate. The average of the obtained data of distribution and soil textural class and real density is shown in Table (1).

Table (1): Average values of soil mechanical analysis.

Particle size distribution, %			Texture	Real density, g/cm^3
Sand	Silt	Clay		
38	33	29	Clay loam	2.6

Description of the brush cutter:

The machine used in this study for hoeing is brush cutter 42011 Bagnolo in Piano Italy. Detailed descriptions of the essential parts of the brush cutter are shown in Fig. (2).

Fig. (2): Detailed descriptions of the essential parts of the brush cutter.

Table (2) shows the detailed specification of the brush cutter engine. The engine is a 2-stroke model (Single cylinder, forced air cooling) that has a 2.2 hp (1.65 kW) lightweight aluminum body gasoline engine. It consumes 500 to 900 ml oil mixed petrol per hour depending on the operation. The machine is hanging on the shoulder and it is driven and steered manually. Cutting blades are weed brush, 3 point blade (Standard) and weeding plate. The blades are attached to the front of the machine coupled with the gearbox and rotate at a speed of up to 7500 rpm. A straight shaft is used to connect the power unit with a gearbox at the cutting head end. Handles similar to bike handles connected to the straight shaft are used to control and guide the machine. The brush cutter comes in a variety of sizes and shapes of cutting blades.

Table (2): Detailed specification of the engine.

Engine model	King 30.CS electronic brush cutter Italy
Engine type	Air-cooled 2-stroke
Fuel	Gasoline
Displacement	52 CC
Dimension	330 × 280 × 270 mm
Weight	7.0 kg
Rated Power	1.65 kW / 2.2 hp.
No-load speed	7500 rpm.

Variables of field experiments:

The brush cutter was tested at a constant forward speed of 0.36 km/h and considering the possible variables related to its performance to realize the purpose of this research. Variables of field experiments are as follows:

I. Soil moisture content:

Field tests were carried out under three values of the moisture contents given an indicator of the state of the soil. Soil moisture content was recorded at the beginning of each field experiment, which resulted in the three different values of moisture as follows: M_1= 31.2 %, M_2= 25.4 %, and M_3= 20.1 %.

II. Hoe blades:

The performance of brush cutter was tested under three different blades of cultivation tines. The blades are shown in Fig. (3). Hoe blade (standard) and wedding plate were made of tool steel K100 (Alloy steels) with 3 mm thickness and 15^o cutting angle. Weed brush was made of a twisted steel wire.

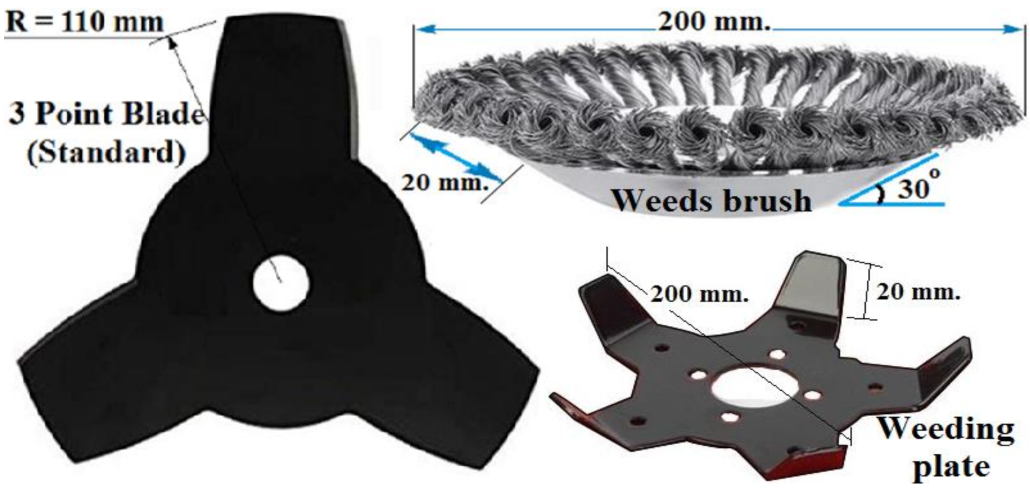


Fig. (3): Three different blades of cultivation tines.

Measurements:

1. Soil moisture content:

Soil moisture content was determined using an electric oven adjusted at (105 ^{o}C) for 24 hours. Soil samples were taken from three different depths (0-5), (0-10) and (10-15) cm by screw auger immediately before cultivation. The moisture content percentage was calculated on dry bases according to **Black, et al. (1965)** by using the following equation:

$$\text{M.C.} = \frac{\text{Wet soil mass } (g) - \text{Dry soil mass } (g)}{\text{Dry Soil mass } (g)} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

2. Weeds control efficiency:

Weeds control efficiency was estimated by using the weeds number in 1 m intra-rows before and after cultivation operation. The weed numbers were recorded in the field immediately before and after the cultivation operation. Weeds control efficiency was calculated according to **Tajuddin, A. (2006)** by using the following equation:

$$\text{Weeds control Eff.} = \frac{\text{No. of weeds removed}}{\text{No. of initial weeds found}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

3. Injured plants percentage:

Injured plants percentage was counted from some rows for a certain distance immediately after cultivation according to **Hemeda and Ismail, (1992)** by using the following equation:

$$\text{I.P.}(\%) = \frac{J_1 - J_2}{J_1} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where:

I. P. = Percentage of injured plants.

J_1 = The total number of plants within an adjusted distance before cultivation.

J_2 = The total number of injured plants within the same distance.

4. Theoretical field capacity:

The theoretical field capacity (T. F. C.) was determined by using the following equation according to **Hancock, et al. (1991)**:

$$\text{T.F.C.} = \frac{\text{The theoretical width (m)} \times \text{Average forward speed (km/h)}}{4.2} \ldots\ldots\ldots\ldots(4)$$

5. Actual field capacity:

The actual field capacity (A.F.C.) was determined by using the following equation:

$$\text{A.F.C.} = \frac{1}{\text{Actual time (min)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

6. Field efficiency:

The Field efficiency (η_f) was determined by using the following equation:

$$\eta f = \frac{\text{Actual field capacity (fed/h)}}{\text{Theoretical field capacity (fed/h)}} \times 100 \quad \ldots (6)$$

7. Cost analysis:

The cultivation operation cost includes fixed costs (depreciation, interest, shelter, taxes and insurance) and variable costs (repair and maintenance, fuel, oil and lubricants and labor cost) according to **Hunt, (1977)**.

Fixed Costs:

1. Depreciation.

$$D = (Pm – S) / Lm \quad \ldots (7)$$

Where:

D = Depreciation (L.E./year)

Pm = The machine purchase price (L.E)

S = Salvage price (L.E)

Lm = Cultivator life (year)

2. Investment interest.

$$I = (Pm + S)\, i / 2 \quad \ldots (8)$$

Where:

I = Investment interest (L.E./year)

I = Interest is compounded annually (decimal)

3. Shelter, taxes and insurance.

Shelter, taxes and insurance costs were assumed 2 % of the machine purchase price according to **Pflueger, (2005)**.

Variable costs:

1. Repair and maintenance = 100 % of depreciation cost.
2. Fuel: Fuel costs (L.E./year) = Fuel consumption (l/h) × fuel price (L.E./l)
3. Oil and lubricants.
   Oil and lubricants costs = 50 % of fuel costs.
4. Labor cost.
   Is defined as payment for the operator who operates the machine (L.E./h).

Total costs:

The total costs, (L.E./h) are a summation of the fixed costs (L.E./h) and variable costs (L.E./h).

To estimate the total cost (L.E./fed) multiple the total costs (L.E/h) by the actual time (h/fed).

Basic assumption:

Table (3) shows assumed values for the performance of the machine according to the observations during the test.

Table (3): Data assumed for the performance of the machine.

Item	Values
Initial cost.	8500 L.E.
The machine life.	10 years.
Operation days.	200 day/year
Salvage price.	Zero
Fuel consumption.	0.4 l/h
Fuel price (Gasoline).	7.0 L.E./l
Interest rate (i)	0.08
The number of laborers required.	One laborer.
Labor wage.	15 L.E/h.
Operation hours.	8 hours/day.

3. RESULTS AND DISCUSSION

Through field experiments, it was found that the forward speed for the labor depends on the actual weed density in the field and the used hoeing blades. To obtain a high efficiency of weed removal requires consuming more time and effort to eliminate most of them around the seedlings before proceeding to another seedling. The average forward speed for the labor to maintain continuous operation was 0.1 m/s using the three different hoeing blades. So it was decided that brush cutter performance calculated at possible forward speed for the labor to maintain continuous operation 0.1 m/s (0.36 km/h) to study the effect of the type of the hoeing blades on the performance of the machine under one forward speed for the labor and regardless of weeds density in the field. The evaluation of the hoeing machine will discuss under the following items:

1. Weeds control efficiency, (Eff.):

Table (4) shows the number of weeds after and before hoeing under three values of soil moisture contents. The initial number of weeds were counted and recorded before hoeing. After hoeing, the weeds left behind without uprooting or mowing were also counted. It was repeated every ten meters and the average number of weeds per meter was calculated. While maintaining the aforementioned average forward speeds for the labor. In the case using hoe blade (standard), the average number of weeds per meter included as many as 126, 131 and 141 weeds of different varieties.

After hoeing, 49, 48 and 50 weeds were still without mowing with a weed removal efficiency of about 61.1, 63.4 and 64.5 % under soil moisture contents of 31.2, 25.4 and 20.1 %, respectively. In the case of using weed brush, the average number of weeds per meter included as many as 118, 259 and 244 weeds. After hoeing, 39, 68 and 28 weeds were still without uprooting or killing with a weed removal efficiency of about 66.9, 73.8 and 88.5 %

under soil moisture contents of 31.2, 25.4 and 20.1 % respectively. In the case of using the weeding plate, the average number of weeds per meter included as many as 291, 277 and 264 weeds. After hoeing, 19, 14 and 5 weeds were still without uprooting or killing with a weed removal efficiency of about 93.5, 95 and 98 % under soil moisture contents of 31.2, 25.4 and 20.1 %, respectively.

Table (4): The number of weeds after and before hoeing.

Hoe blades	Soil moisture contents, %.								
	31.2			25.4			20.1		
	Before	After	Eff.,%.	Before	After	Eff.,%.	Before	After	Eff.,%.
Standard	126	49	61.1	131	48	63.4	141	50	64.5
Weed brush	118	39	66.9	259	68	73.8	244	28	88.5
Weeding plate	291	19	93.5	277	14	95	264	5	98

The effect of the **hoe blades** on the weed control efficiency:

Fig. (4) shows the effect of the hoe blades on the weed control efficiency under three values of soil moisture contents. These results indicated that the machine's performance in terms of weed control efficiency improves with low soils moisture content using any type of blade cultivation tines.

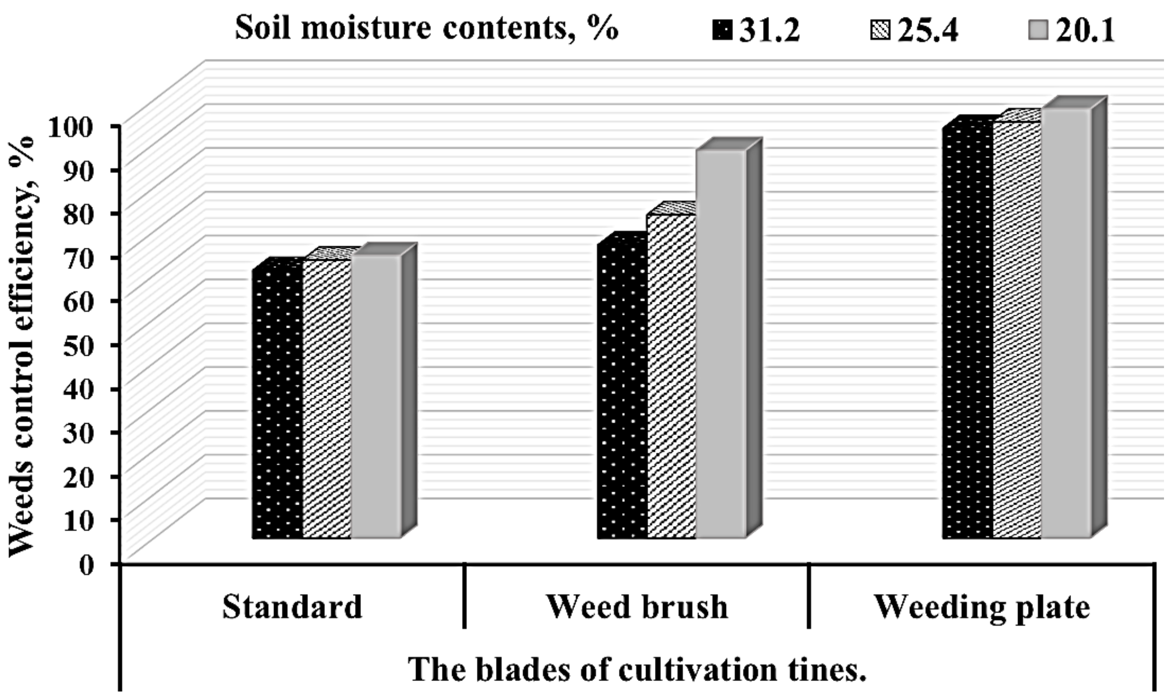


Fig. (4): Effect of the hoe blades on the weed control efficiency.

The maximum percentages of the weed control efficiency were 93.5, 95 and 98 % under soil moisture contents of 31.2, 25.4 and 20.1 %, respectively using the weeding plate. While the minimum percentages of the weed control efficiency were 61.1, 63.4 and 64.5 % under soil moisture contents of 31.2, 25.4 and 20.1 %, respectively using hoe blade (standard). Observation of the machine's performance showed that, in the case of using hoe blade standard, weeds after hoeing were mowed only without soil agitation. While in the case of using weed brush and weeding plate, weeds after hoeing were uprooted or killed with shallow agitation of the soil.

2. Injured plants percentage:

The main reason for using this brush cutter in weeds control is the accuracy in directing towards the weeds and looking while working to avoid damage to the seedlings. Thus, the brush cutter simulates the hand hoe, but it reduces the suffering and pain of the farmer who uses the hoe. The data showed that changing the blades did not have a noticeable effect on injured plants' percentage, but the skill of a laborer will affect the damage rate. Several accidents of seedling damage could be avoided if well-trained labor operated the machine. Damage percent may slightly be increased due to more fatigues of the labor which may cause less control on the brush cutter steering. In general, the field experiments of the machine showed that injured plants' percentage was always less than 0.5 % and may rarely exceed 1.0 %.

3. The brush cutter performance:

The brush cutter was tested in the cucumber field to weeds control in the zone around the plants and as close to them as possible. Cucumber crop was planted by hand in beds, two rows per bed. The width of the beds was 100 cm and the width of the furrow was 80 cm. The distance between the plants on the furrow was ranged from 30 to 40 cm. Forward speed for the labor varied according to the different hoeing blades, due to the difference in the time required to carry out the weed control operation in a satisfactory. The field performance of the brush cutter is shown in Table (5).

Table (5): Field performance of the brush cutter.

Productivity		**Hoe blades**		
		Standard	weed brush	Weeding plate
Operating time h/fed.		6.5		
Lost time h/fed.		2	2.5	2.8
Field capacity fed/h	Theor.	0.154		
	Actual	0.118	0.111	0.108
Field efficiency (%)		76	72	70

The lost time includes breaks, the turns at the end of the furrow, refilling the fuel tank, adjusting and maintaining the hoeing tool. The theoretical field capacity for the brush cutter was 0.154 fed/h while the effective time to hoe one feddan of the cucumber crop was 8.5, 9 and 9.3 h, therefore the actual field capacity was 0.118, 0.111 and 0.108 fed/h by using hoe blade (standard), weed brush and weeding plate, respectively. Thus, the field efficiency to hoe Cucumber crop using the brush cutter ranged from 70 to 76 % according to the used hoeing blades.

4. Cost estimation:

Table (5) shows the estimation of hoeing costs using the brush cutter. The costs were calculated according to data assumed for the performance of the brush cutter in the methods section. As shown in the table, the total costs to hoe one feddan (Shallow hoeing around plants for raking weeds) for Cucumber crop by using hoe blade (standard), weed brush and weeding plate were 180, 190 and 200 L.E, respectively.

Table (5): Estimation of hoeing costs using the brush cutter.

Items		Costs
Fixed cost	Deprecation. (LE./year)	850
	Investment interest. (LE./year)	340
	Shelter, taxes and insurance	170
Total fixed costs (LE./year)		1360
Total fixed costs (LE./h)		0.85
Variable costs.	Repair and maintenance. (LE./h)	0.53125
	Fuel costs (LE./h)	2.8
	Oil and lubricants costs (LE./h)	1.4
	Labor cost (LE./h)	15
Total Variable costs (LE./h)		19.73125
Total costs (LE./h)		20.6
Hoeing costs (LE/fed)	Hoe blade (standard)	180
	Weed brush	190
	Weeding plate	200

4. CONCLUSION

A brush cutting machine was tested to be capable of shallow hoeing around plants. The most important goal was controllability and hand steering of the brush cutter inside the furrow or row and hoeing around the plants, which means achieving both very accurate transverse and longitudinal positional control to avoid crop damage. The field experiments showed that the machine is capable of uprooting, killing, or mowing the weeds according to the used hoeing blades. The results showed that the maximum percentages of the weed control efficiency were 93.5, 95 and 98 % under soil moisture contents of 31.2, 25.4 and 20.1 %, respectively using the weeding plate. The percent damage may slightly be increased due to more fatigues of the labor which may cause less control on the brush cutter steering. Injured plants' percentage was always less than 0.5 % and may rarely exceed 1.0 %. The effective time to hoe one feddan of the Cucumber crop was 8.5, 9 and 9.3 h by using hoe blade (standard), weed brush and weeding plate, respectively. The field efficiency ranged from 70 to 76 % according to the used hoeing blades. The total costs to hoe one feddan (Shallow hoeing around plants for raking weeds) by using a hoe blade standard, weed brush and weeding plate were 180, 190 and 200 L.E, respectively. It is recommended to use the machine for Shallow hoeing around seedlings to reduce labor fatigue. Brush cutter may represent a successful machine that achieves acceptable hoeing efficiency and performs at low costs with smallholdings and greenhouses.

5. REFERENCES

Beka, A. (2018). Development and performance test of motorized rotary weeder for row planted cereal crops. 2018. Ph.D. Thesis. ASTU.

Black, C.A., Evan, D. D., White, J. L., Ensimenger, L. E. and Clark, F. E. (1965). Methods of soil analysis (part1), Physical and mineralogical properties, including statistics of measurements and sampling, American Society of Agronomy, Inc., Pub. Madison, Wisc., U.S.A.: 375-377 and 552-557.

Chandel, N. S., Chandel, A. K., Roul, A. K., Solanke, K. R., and Mehta, C. R. (2021). An integrated inter-and intra-row weeding system for row crops. Crop Protection, 145, 105642.

Falana, O. B., Aluko, O. B., Adetan, D. A., and Osunbitan, J. A. (2020). Adaptation of a Brush Cutter for Kenaf (Hibiscus cannabinus) Harvesting. Agricultural Engineering International: CIGR Journal, 22(2), 59-67.

Hancock, J. N., Swetnam, L. D., and Benson, F. J. (1991). Calculating farm machinery field capacities.

Hemeda, M. N., and Ismail, Z. E. (1992). Developing a cultivator for inter-row cotton cultivation. Misr J. Ag. Eng, 9(4), 575-587.

Hunt, D. (1977). Farm power and machinery management. Iowa State University, Press Ames, U.S.A.: 51-65.

Mohite, D. D., Agrawal, K., Kumar, K., and Deb, A. (2021). Technical aspects of multipurpose weed cutter or power weeder. International Journal of Enhanced Research in Science, Technology & Engineering, Vol. 10 Issue 7.

Okubo, N., Nakagawa, H., Furuya, K., and Toi, T. (2014). Vibration reduction of brush cutter. In Topics in Modal Analysis, Volume 7 (pp. 225-233). Springer, New York, NY.

Pflueger, B. (2005). How to calculate machinery ownership and operating costs. Extension Circulars. Paper 485. http://openprairie.sdstate.edu/extension_circ/485.

Rajaperumal, C. V., Chidambaram, P. K., Bibiana, M. A., and Arun, G. (2021). Development of dual-purpose manual weeder. Materials Today: Proceedings. https://doi.org/10.1016/j.matpr.2020.12.915.

Saha, K. K., Hossain, A., Hoque, M. A., Jahan, M. A. H. S., Ahmed, S., and Timsina, J. (2021). Development and performance evaluation of a two-wheeled power-tiller multi-row weeder. Journal of Biosystems Engineering, 46 (1), 36-47.

Sedara, A. M., and Sedara, O. S. (2020). Review on inter-row crops mechanical weeder. Turkish Journal of Agricultural Engineering Research, 1(1), 200-221.

Tajuddin, A. (2006). Design, development and testing of engine-operated weeder. Agricultural engineering today, 30 (5 and 6), 25-29.

Tiwari, S., Sindel, B. M., Smart, N., Coleman, M. J., Fyfe, C., Lawlor, B. Vo. and Kristiansen, P. (2021). Hand weeding tools in vegetable production systems: an agronomic, ergonomic and economic evaluation. International Journal of Agricultural Sustainability, 1-16.

Uemura, M., Miyakawa, S., Oono, T., and Ishikawa, D. (2014). Vibration reduction of brush cutter considering human response characteristics. In INTER-NOISE and NOISE-CON Congress and Conference Proceedings, Vol. 249, No. 6, pp: 2210-2218. Institute of Noise Control Engineering.

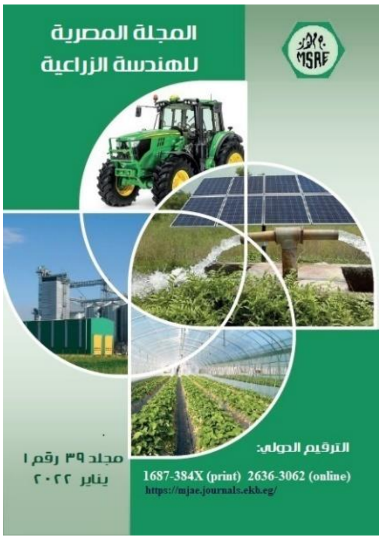
آداء آلة للعزيق السطحي حول النباتات

نبيل شــعبان القاعــود[١]، وائل أبو المجد محمود[٢] و أحـمـد مصطـفى موســى[٣]

[١] أستاذ مساعد - كلية الهندسة الزراعية - جامعة الأزهر (فرع أسيوط) - مصر.

[٢] مدرس - كلية الهندسة الزراعية - جامعة الأزهر (فرع أسيوط) - مصر.

[٣] أستاذ مساعد - قسم هندسة الآلات والقوى الزراعية - كلية الهندسة الزراعية - جامعة الأزهر - القاهرة - مصر.



الكلمات المفتاحية:
آلة محمولة؛ مقاومة الحشائش؛ فرشة القطع؛ عزاقة؛ خربشة التربة؛ عزيق.

الملخص العربي

الهدف الرئيسي من هذا البحث هو تقييم آداء آلة القطع (Brush cutter) ذات التوجيه اليدوي للعزيق السطحي حول النباتات، والتحكم الدقيق عرضياً وطولياً لمقاومة الحشائش داخل خطوط أو صفوف المحاصيل مع تجنب حدوث أي ضرر ميكانيكي للبادرات. أجريت الاختبارات الحقلية لعزيق محصول الخيار تحت متوسط ثلاث قيم لرطوبة التربة ٣١,٢٪، ٢٥,٤ و٢٠,١٪ على أساس جاف. تم اختبار الآلة باستخدام ثلاثة أنواع لشفرات العزيق (القياسية: ذات الثلاث سكاكين، فرشاة الحشائش ولوحة إزالة الحشائش ذات الخمسة أسنان)، مع متوسط سرعة التقدم الممكنة للعامل لاستمرارية العمل ٠,١ م / ث (٠,٣٦ كم/ساعة). أظهرت التجارب الحقلية للآلة أنه في حالة استخدام شفرة العزيق (القياسية)، يتم قطع الحشائش فقط دون حدوث إثارة ملحوظة للتربة، وعند استخدام فرشاة الحشائش ولوحة إزالة الحشائش فقد تم اقتلاع أو قتل الحشائش مع حدوث إثار سطحية للتربة. وأظهرت النتائج أن كفاءة العزيق قد تراوحت من ٦١ إلى ٩٨ ٪ وفقًا لنوع الشفرات المستخدمة للعزق ومحتوى رطوبة التربة. وقد كانت النسبة المئوية للضرر الميكانيكي الحادث للنباتات أقل من ٠,٥ ٪ ونادرًا ما تتجاوز النسبة ١,٠ ٪. كما أظهرت النتائج أن السعة الحقلية الفعلية كانت ٠,١١٨ و٠,١١١ و٠,١٠٨ فدان/ساعة باستخدام شفرة العزيق (القياسية) وفرشاة الحشائش ولوحة إزالة الحشائش، على التوالي. وكانت التكلفة الإجمالية لعزيق الفدان الواحد (عزق سطحي حول النباتات وقطع الحشائش) باستخدام شفرة العزيق (القياسية) وفرشاة الحشائش ولوحة إزالة الحشائش ١٨٠، ١٩٠ و٢٠٠ جنيه، على التوالي. وبالتالي فإنه يوصى باستخدام هذه الآلة للعزيق السطحي لتقليل المجهود، كما أنها تعتبر آلة ناجحة تحقق كفاءة عزيق مقبولة وتعمل بتكاليف منخفضة تناسب الحيازات الصغيرة والصوب الزراعية.