

Effect of Knives Type on Some Operational Characteristics for a Locally Assembly Motorized Vibration Cutter Used for Date Palm Fronds Pruning

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Abstract— The experiment was conducted to evaluate the effects of pruning cutting knives for locally assembly motorized vibration cutter on some operational characteristic used for date palm fronds. An implement was fabricated to cut the fronds around the date palm tree trunk. Three types of knife included A,B and C was used in this study. One frond cutting time, One palm frond cutting time, cutting level, productivity, noise level, vibration and efficiency was measured in this experiment. Complete block design with three replications was used in this study. Least significant differences (L.S.D) under 0.05 level was used to compare the mean of treatment.

The results showed that B type gave a lower time in cutting one frond stood 3.11 sec. A type got lowest time of cutting three rows of fronds stood 1.74 min, also gave less differences in surface cutting level and level of noising stood 5.66 mm and 78.04 (db) respectively. B type knife got less vibration stood 5.25 m.sec⁻². Also it gave the higher amount of productivity stood 8.80 palm /h. A type gave a high efficiency, it got 78.76%. Using manufacturing equipment for cutting date palm frond was successfully done.

Keywords— Knives type, cutting time, fronds cutting, vibration, productivity, noise, cutting level, and efficiency.

I. INTRODUCTION

Date palm (*Phoenix dactylifera* L.) can be considered as one of many oldest trees which human has derived benefit and it has been cultivated since long ancient time [11], also considered as oldest known fruit and only desert plant defiantly domesticated in its harsh environments [15]. Date palm tree has been cultivated for at least 5000 years in north Africa and the middle east [4]. Date palm tree has along trunk, with about 30m height and lives about 100 years [10]. Many operations that need to be performed during several times of the year to maintain the crown of the date palm [6]. Therefore, Cutting the dry and dead

fronds is one of important date palm crown maintenance because, they hinder the worker to climb the palm trunk to do essential operations like pollination and harvesting [1]. Frond base is the strongest part of palm frond irrespective of moisture content and maturity [3]. Numerous of traditional tool are used to cut the palm fronds like knives and saws tools [12], these tools has many disadvantages, generally, need more energy for cutting, this energy mainly comes from worker and this effort can be reduced by sharpness the tool edge and man self-skill, therefore, the worker should be strong enough to maintain his energy all day, generally workers cannot be able to maintain his energy for the whole day and normally stop when they feel tired [8]. So, tools and implements are playing a significant role to reduce effort, cost and operations time, also Frond analysis could provide the basic parametric requirements of the blade for efficient cutting [14]. Farmers looking for tools and equipment used motorized power to cut the palm frond in least of effort and cost.

Pruning is an important agricultural operation to remove date palm tree leaves; leaf bases and the fiber also remove spines and high offshoot [1]. Many factors are affecting in cutting plant material like physical properties of plant material, react against the cutting tool, method of cutting, cutting angle and speed of cutting also sharpness and shape of cutting tool [13]. Development of a more effective, efficient and ergonomic cutting mechanism for palm frond cutting is important in facing future global competition [2].

Chisel, sickle and curved knife are widely used as cutting tools in many countries and still effective because there's no new tools have surpassed them [8]. Thus, if there's a mechanical equipment that requires less power for date palm pruning would be able to work longer and increase of productivity, this study was conducted.

II. MATERIALS AND METHODS

The experiment was carrying out for testing a local assembly manufacturing palm fronds motorized cutter with three types of locally forged knives A,B and C were used in this experiment. Knives were forged by using high temperature oven at 790°C for 30 min after that doing water cooling to give them good hardness, then, tested the knives hardness by using Rockwell test, it is stood 65 HR. Time of one frond cutting, three rows of frond time cutting, level of surface cutting, field productivity, hand tool vibration, equipment noise and field efficiency was measured in the experiment. Randomized complete block design (CRBD) with three replications was used in this study, lest significant different (L.S.D) and 0.05 levels were used to compare the mean of treatment.

The motorized vibration date palm fronds cutter and three types of knives was manufactured and assembled at the mechanical workshop in the department of agricultural machines and equipment, college of agriculture, university of Baghdad. The equipment consists of many main parts.

2.1-Components of equipment, (Fig.1).

The motorized vibrator palm frond cutter consists of the essential following parts:-

- 1- Gasoline engine has 2 hp, two stroke engine, and 3000-5000 rpm.
- 2-Flexible shaft connection, it consists of rubber tube and rotary flexible shaft 0.5 cm rectangle section.

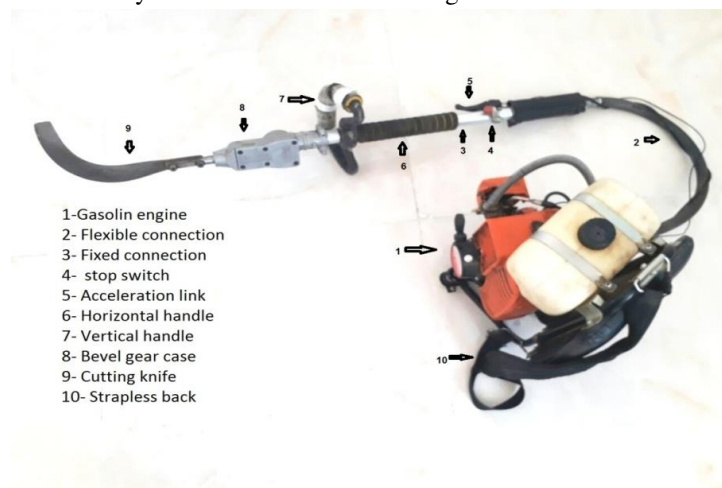


Fig.1: Motorized vibration date palm fronds cutter

3-Fixed connection ,consist of rotor circle section shaft with radius of 6.8 mm inside of aluminum pore with 25mm diameter.

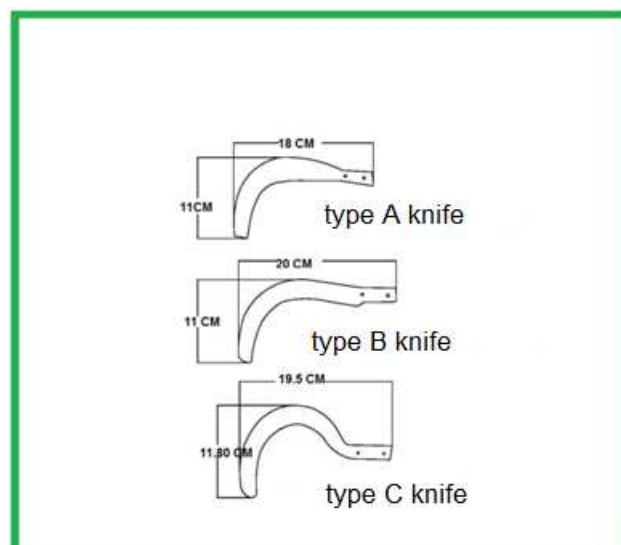
4- Gear case, used to convey the rotary motion to vibration motion.

5- Cutting tools, it is considers as a rigged curved knives include:-

A-Type A knife is a classic knife has length 18 cm, width 11cm and 1mm thickness in the front.

B- Type B knife with open end has length 20 cm, width 11cm and thickness 1 mm.

C- Type C shape knife, it has length 19.5 cm, width, 11.80 cm and 1 mm thickness (Fig.2)



2.2- Studied Properties

2.2.1. Time of cutting one frond

Cutting time measured by using stop watch when used equipment to cut the fronds in date palm field, (frond. Sec).

2.2.2 Time of cutting three rows frond.

Time measured by using same method in 2.2.1.

2.2.3 Differences of cutting surface level .

Was measured the different in cutting surface level (mm).

2.2.4- Productivity

It was measured by calculate the total time of cutting including the lost time for rest and moving in the field also the time of refuel the engine and maintenance in one palm per hour (palm.h).

2.2.5 –Noise

Measured by using noise meter (db)

2.2.5- Vibration

Measured by using vibration meter ($\text{m}.\text{sec}^{-2}$).

2.2.7 Field efficiency

Field efficiency was measured by using the following question which proposed by [7]

$$\text{Fe} = \text{P}_p / \text{P}_t \times 100$$

Whereas: **Fe**= Field Efficiency % , **P_p**= Practical productivity , Palm/ h

P_t= Theoretical productivity Palm/ h

III. RESULTS AND DISCUSSION

3.1 Cutting for one frond time, (Sec).

Table 1 shows the effect of knife type on time for one front cutting , A and B type of knives showed no significant different in the time of cutting one frond stood 3.11 and 3.22 sec respectively compared with C type witch got 3.34 sec .

3.2 cutting for one date palm time.(min).

Table 1 shows the effects of knife type on time of cutting three rows of date palm tree, the results showed no significant difference between A and B type, they got 1.74 and 1.76 min respectively, but there's a significant difference with C type, it got 4.04 min.

3- Variation in surface cutting level, (mm).

The result in table 1 showed the effects of type of knife in cutting leveling. Type A showed the superiority in the

variation of cutting level stood 5.66 mm compared with B and C type which they got 5.81 and 5.92 mm respectively.

3.4 Productivity (palm/h)

The relationship of type of cutting knife to the one date palm frond cutting productivity is shown in table 1, the B type got highest field productivity amounted 8.80 palm/h, compared with A and C type which they got 8.77 and 6.09 palm/h respectively.

Table.1: The effect of the cutting angle on the time of frond cutting, one palm fronds cutting time, cutting surface leveling and productivity

Knife type	One frond cutting time sec	One palm fronds cutting time /min	Cutting surface leveling/mm	Productivity Palm/h
A	3.11	1.74	5.66	8.77
B	3.22	1.76	5.81	8.80
C	4.34	4.04	5.92	6.09
LSD	0.11	0.10	0.11	0.13

3.5- Vibration level,(m.sec⁻²).

The results in table (2) showed the effect of type of knife in level of vibration that translate to the worker hand, the effect of B type showed the superiority to get lower vibration stood 5.25 m.sec⁻² compared with A and C which they got 5.36, 5.27 respectively.

3.6- Noise ,(db).

Table 2 showed the result of noise level test of an equipment. A type got less amount of noising level stood 78.04db compared with B and C type which they got

78.48 and 82.44db respectively. the reason for that may be due to the less power required to cut fronds.

3.7- Field productivity efficiency, (%).

Table 2 shows no difference between A and B type of cutting knife on the field efficiency which they got highest amount stood 87.76 and 87.36 %, but the C type got a lowest efficiency stood 60.90 % compared, the result showed change the knife type from A and B to C type led to decrease in field efficiency, the reason due to the increase of cutting force which lead to increase cutting time.

Table.2: The effect of the cutting angle on the noise level, vibration level, and cutting efficiency.

Knife type	Vibration level m.sec ⁻²	Noise db	cutting efficiency%
A	5.36	78.04	87.76
B	5.25	78.48	87.36
C	5.27	82.44	60.90
LSD	0.19	0.93	1.747

IV. CONCLUSION AND RECOMMENDATION

Using the locally assembling equipment for cutting date palm fronds with three types of cutting knives is successfully done. Due to the above results it is clear that A and B knife types got the lower time in one frond cutting, cutting one date palm. Type B knife got highest productivity compared with others type. But they don't have difference between all types in level of vibration in cutting operation. On the other hand, C type got a lowest amount of field efficiency, therefore using A and B type of cutting knives to cut date palm fronds which gave the best results was recommended.

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