Effect of Cutting angle for a Locally Assembly Motorized Vibration Cutter on Some Operational Characteristics Used for Date Palm Fronds Cutting

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ABSTRACT

The experiment was conducted to evaluate the effect of cutting angle for locally assembly motorized vibration cutter on some operational characteristic used for date palm frond cutting. An implement was fabricated to cut the fronds around the date palm tree trunk. Three cutting angles included 45, 60 and 90° was used in this study. One frond cutting time, One palm frond cutting time, cutting level, noise level, vibration, productivity 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 45° cutting angle gave a lower time in cutting one frond and one palm fronds stood 2.65 sec and 2.40 min respectively, also gave less differences in surface cutting level, level of noising and vibration stood 5.28 mm, 79.37 db and 5.22 m.sec⁻² respectively. Also it gave the same amount of productivity with 60° cutting angle stood 8.01 palm/h. 45° cutting angle gave a high efficiency it got 80.23%, using a manufacturing equipment for cutting date palm frond was successfully done.

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1. Introduction

Date palm (*Phoenix dactylifera* L.) considers as a major fruit crop in most Arab countries, it has been conducted with sustaining human life from long history. The tradition of the people in the old world is a major agricultural crop commercial tree (Ahmad and Andrzej, 2012). It has along trunk ,with about 30m height and lives about 100 years (Morton,1978). There are a numbers of operation that need to performed during several times of the year to maintain the date palm crown (Anoon,2002).So,each tree need to climbed many time a year to carry out many hand operations. Cutting the dry and dead fronds is one of important date palm maintenance because,it impedes the worker to climb the trunk to do many operation like pollination and harvesting (Ahmed and Andrzej,2012).Traditional tool are used to cut the palm fronds like knives and saws. These tools has many disadvantages ,normally they need more energy for frond cutting .It is mainly comes from worker ,this effort can be reduce by sharpness the tool edge and worker self-skill, therefore, the worker should be strong enough to maintain his body energy .a long time day generally,workers con not be able to maintain his energy for the whole day and normally stop when they fell tired ,(Jelani,1998).So, tools and Implements are playing a big role to reduce effort ,cost and operation time.Therefore,farmers have to think for manu facturing new equipment used a motorized power to cut the palm frond in minimum effort and cost. There are many factors are affecting in cutting plant material,(Ahmed et al.2000).The physical properties of plant material,react against the cutting tool,method of cutting, cutting angle and speed of cutting (Person,1978 and Feller,1959).

Cutting angle considers as one of significant factor in the cutting force and energy requirement. Experiment was conducted on oil palm frond showed the 45° angle required less force than 90°.Therfore, increase in cutting angle lead to increase in cutting force (Jelani,1998). According the important of using and testing a local assembly motorized cutter for date palm fronds in decrease the time and effort in different cutting angle to know which angle the best,this study was conducted.

2. Materials and Methods

The experiment was carrying out for testing a palm fronds motorized cutter. Three cutting angle included 45°,60°and 90° were used in this experiment.Time of one frond cutting,three rows of frond time cutting, level of surface cutting,hand tool vibration,noise and field productivity was measured in the experiment.Randomized complete block design (CRBD) with three replications was used in this study,least significant different (L.S.D) and 0.05 levels were used to compare the mean of treatment.

A new motorized vibrator cutter was manufactured and assembled at the local mechanical workshop in the department of agricultural machines and equipment,college of agriculture university of Baghdad, the implement consist of many main parts.

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

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

1. Engine, it has 2 hp, gasoline fuel, 3000-5000 rpm.
2. Flexible connection, it consists of rubber tube and rotary flexible shaft 0.5 cm rectangle section.
3. Fixed connection, consist of rotor circle section shaft with radius of 6.8 mm inside of aluminum pore with 2.5 cm diameter.
4. Bevel gear case, used to convey the rotary motion to vibration motion.
5. Cutting tool, it is considers as a rigged curved knife.

3.2 cutting for one date palm time. (min).
The Table 1 shows the effects of cutting angle on time of cutting three rows of date palm tree. 90° cutting angle showed the superiority in the cutting time stood 2.72 min compared with 60° and 45° which they got 2.43 and 2.40 min respectively. So, the 45° cutting angle got less time to cut the three rows of date palm fronds, the reason for that because the 45° cutting angle need less force and energy required than 90°; this results agree with the results of (Jelani, et al.1998).

3.3. Variation in surface cutting level, (mm).
The result in table 1 showed the effects of cutting angle in cutting leveling. 45° cutting angle showed the superiority in the variation of cutting level stood 5.28 mm compared with 60° and 90° which they got 5.61 and 6.17 mm respectively. The 45° cutting angle got less differences in leveling of cutting, the reason for that may be because the 45° cutting angle need less force and energy required than 90°.

3.4. Noise level (db).
Table 1 showed the result of noise level test of an equipment. 45° cutting angle got less amount of noiseing level stood 79.39 db compared with 60° and 90° which they got 78.65 and 80.66 db respectively. The reason for that may be due the less power required to cut fronds.

3.5. Vibrating level (m/sec²).
The results in table (2) showed the effect of cutting angle in level of vibration that translate to the worker hand, the effect of 45° cutting angle showed the superiority to get lower vibration stood 5.22 m/sec² compared with 60° and 90° which they got 5.34 and 5.28 respectively.

3.6. Productivity (palm/h).
The relationship of cutting angle to the one date palm fronds, cutting productivity is shown in table 2, the 45° and 60° did not differ on the field productivity, which they stood 8.01 palm per hour but the 90° got 7.62 palm per hour. The result noticed that increased the cutting angle from 45° to 90° decreased productivity.

3.7. Field productivity efficiency (%).
Table 2 shows significant effect of used cutting angle 45, 60, 90° on the field efficiency, 45° cutting angle got a highest efficiency stood 80.23% compared with 60° and 90° which they got 89.51 and 75.51% respectively. The result showed increase in cutting angle led to decrease to field efficiency, the reason due to the increase of cutting angle which lead to increase cutting force also increase of cutting time.

4. Conclusion and Recommendation
Using the locally assembling equipment for cutting date palm fronds is successfully done. Due to the above results it is clear that cutting angle got the lower time in one frond.

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

<table>
<thead>
<tr>
<th>Angle</th>
<th>One frond cutting time</th>
<th>One palm fronds cutting time/min</th>
<th>Cutting surface level/mm</th>
<th>Noise/db</th>
</tr>
</thead>
<tbody>
<tr>
<td>45°</td>
<td>2.65</td>
<td>5.28</td>
<td>80.23</td>
<td></td>
</tr>
<tr>
<td>60°</td>
<td>3.87</td>
<td>5.61</td>
<td>78.65</td>
<td></td>
</tr>
<tr>
<td>90°</td>
<td>4.15</td>
<td>6.17</td>
<td>80.66</td>
<td></td>
</tr>
<tr>
<td>LSD</td>
<td>0.09</td>
<td>0.129</td>
<td>1.030</td>
<td></td>
</tr>
</tbody>
</table>

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Fig 1. Motorized vibration date palm fronds cutter.
cutting, cutting one date palm, also got lower vibration in cutting level, noise and vibration compared with the other angles. On the other hand, 45° cutting angle got a highest field productivity and field efficiency; therefore using 45° cutting angle to cut date palm fronds which gave the best results was recommended.

References