CLEANING UNIT DEVELOPMENT OF EXTRACTING MACHINE FOR WATERMELON SEEDS

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ABSTRACT

A field experiment was carried out to study the effect of feeding rate, drum speed and time span after harvesting, on seed losses, average visible seed damage, and seed productivity. The fabricated equipment has been tested and evaluated considering number of knives on drum 4 knives, different feeding rates (45, 60, 75 and 90 kg/ min) different drum speeds (3.53, 5.30, 7.07 and 8.84 m/s) clearances between the concave and drum 40 mm, different numbers of cleaning brushes (8, 12 and 16 brushes) and different brushes rotation speeds (1.77, 2.36, 2.95 and 3.53 m/s). Results indicated that, increasing feeding rate decrease the visible seed damage, cleaning efficiency, net profit, seed losses. At feeding rate of about 90 kg / min the machine productivity was 238.12 kg/h, while visible seed damage 0.427 %, and seed losses 5.43 %, respectively. The maximum cleaning efficiency was obtained at brush speed of 3.53 m/s and number of brush of 16. However, the feeding rate of 45 kg/min and drum speed of 3.53 m/s had been attained the minimum values of seed losses. Also the cleaning efficiency reached to 90.69 at brush speed of 3.53 m/s and feeding rate 90 kg/min.

The average unit power required for accomplishing all processes of the fabricated equipment may be amounted as 9.88 kW. While, the average net profit due to replacing the fabricated equipment instead of the manual extraction method of watermelon seeds may be amounted as 3010.9 L.E/fed.
INTRODUCTION

Watermelon crop is one of the vegetables crops which are planted to obtain the seeds. Watermelon (*Cocosynthia Citrullus*) is cultivated in the arid and semiarid areas. It is a strategic vegetable product in Egypt that can be exported to several Arab countries. It has been widely cultivated especially in Northern Regions of Egypt, such as Kafr El-Sheikh Governorate, and newly reclaimed lands. The total cultivated area of watermelon is about 170000 fed., with an average seed yield of 470 kg/fed. (*Egyptian Ministry of Agriculture and Land Reclamation, 2005*).

In fact seed extraction machinery from watermelon is not available in Egypt. In addition the imported machines, are expensive and complicated design and operations leads to low efficiency, because they does not suit most Egyptian fruit and seed properties, (*Abou El-Magd et al., 2002*). Saving several million of pounds in Egyptian economy requires developing of locally and reliable machinery such as seed extraction equipment to suit in the prevailing Egyptian conditions. *Hassan (2000)* indicated that, a great future is waiting production of watermelon seeds in the developing countries (including Egypt). That is may be due to two reasons: - the first is high nutrition value of different varieties of watermelon seeds. Whereas they have high contents of proteins and fats and proper contents of amino and fatty acids. The second may be attributed to the availability of planted these seeds in different soil and environmental conditions. *Chen, et al., (1996)* indicated that, in order to increase watermelon seed production quantity and quality, the agricultural engineering specialists has realized the need to develop, use, and improved modern watermelon machinery technology. Numerous attempts have been made to transfer appropriate machinery technology for different Egyptian field operations. Those saved the efforts, and time of the farmers, and consequently savings several million of pounds in Egyptian economy. *Abo-Haded, (2003)* reported that, available figures of the Annual Foreign Trade Bulletin (*CAMPAS, 2000*) indicate that, Moreover 50% of the vegetables and fruits exports are forwarded to the Arabic countries. In addition, watermelon seeds represent 4 % of
total Egyptian agricultural exports. Thus watermelon seeds come as an important vegetable crop with a good exportation potentiality. This is especially true since Egypt enjoys a comparative advantage in both its production and exportation. Kholief et al, (2005) reported that, lowest value of seed damage was 1.59% at drum speed of 0.35 m/s and feeding rate of 3.714 ton/h for triangle drum shape. And the increased of drum speed decreases seed losses whereas, the increase the feeding rate increases seed losses.

Sayed-Ahmed (2004) found that, increasing the reservation time from 3 to 7 days tends to increase the visible seed damage by 81%. Generally, increasing the reservation time harvesting tends to increase the visible seed damage for all studied variables. This trends due to the fiber of flesh after three days still not analyzed completely, therefore the seeds was protected from multi impacts and decreased the visible damage. However, after seven days these fibers were analyzed completely and become as liquid, therefore the seeds were affected by multi impacts and increased the visible damage.

Abd El-Hameed, (1994) noticed that, increasing the drum speed increased separating efficiency. The maximum separating efficiency was obtained by using metal spike drum, hole concave type and drum -concave clearance.

Odigboh, (1979) reported that, melons are protein-rich seeds very important in the Nigerian diet. He mentioned that mechanized shelling is necessary to remove the tedium involved in manual shelling of the seeds. Relevant physical properties of melon were determined. He designed a spinning disc sheller, and a prototype which shells by impact and pneumatically cleans the shelled seeds of chaff. He showed that shelling efficiency was about 96 percent, breakage 8.9 percent and cleaning efficiency practically 100 percent at an average capacity of 145 kg/h. He concluded that although the prototype was not intended and therefore too big for household use, it would be possible to scale the machine down to a size suitable as a kitchen appliance. The obtained values of cleaning efficiency decreased 9.08% when feeding rate increased from 60 to 90 kg/min. Cleaning efficiency decreased by 13.59% when the drum speed was increased from 4.71 to 11.79 m/s. (Abou El-Magd et al., 2006)

Reed, (1981) proposed a technique for seed separation of muskmelon. This proposed technique includes the following steps. Fruit is cut in
half and seed is scooped out of the fruit halves and placed in barrel, jar, or plastic bag. Then water is added to the seed-placenta mixture and the seed set a side to ferment for a few days. He added that most processors stir the seed daily to aid separation of the seed from the placenta. After fermentation breaks up the placenta, the mixture is strained and washed with water to float off the placental debris or force it through the wire mesh. Finally the clean seed is then dried in a tray. He concluded that one major drawback is that some seeds from overripe melons begin to germinate during fermentation. El-Behiry et al. (1997) found that, operational costs per hour were estimated according to traditional price for all machines. The costs of threshing Mg of grain depends on the machine productivity, therefore, it was decreased. The traditional method in Egypt is separating watermelon seeds from the fruit involves manual cracking of the fruit with cutting the head or tail portions of the fruits with a knife. All done in order to separate the seeds from the mesocarp and endocarp at the same time, mainly for seed purposes. It requires a lot of time and labor. The aim of present study was to development locally machine and evaluate equipment for seed extraction from watermelon seed.

MATERIALS AND METHODS

The present study was conducted during the agricultural of 2007. The experimental was carried out in El-Tiowhney Village, Kafer El-Sheikh Governorate. The experiment included development cleaning units, evaluate the machine performance and operation efficiency. The main purpose of this machine was divided into three processes. The first process was for crushing watermelon fruits, while the second process was for separating peel from the mixture of seed and flesh, wherever, the last process was for cleaning the seeds from flesh to obtain highly extracting efficiency. The main parts of watermelon seeds extracting machine was sketched in Fig.1, the technical specifications of this machine are indicated in Table 1. The fabricated equipment has been tested and evaluated considering number of knives on drum 4 knives, different feeding rates (45, 60, 75 and 90 kg/ min) different drum speeds (3.53, 5.30, 7.07 and 8.84 m/s), clearances between the concave and drum 40 mm, different numbers
of cleaning brushes (8, 12 and 16 brushes) and different brushes rotation speeds (1.77, 2.36, 2.95 and 3.53 m/s).

The effect of previous considered parameters on the performance of fabricated equipment were evaluated in terms of total losses, visible seed damage, fuel consumption, energy and cost requirements. The effect of brush number and speed of brush on cleaning efficiency was also studied. The extracting operation of watermelon seeds was run at 5, 6, 7 and 8 days after harvesting. These days were selected because of the germination of seed inside the fruit almost start after ten days from harvesting. So, the experiments were conducted before the germination. Sayed-Ahmed (2004).

The machine consists of three parts {Crushing and separating, Cleaning system and Transmission system} to develop cleaning system we used three numbers of brushes which are 8, 12 and 16 brush. They were fabricated and used in the present investigation Fig 3.

The cleaning brush dimensions are 50 × 4 cm and 2.5 cm thickness. They are fixed to a wooden bar through two flanges welded to the auger shaft of seeds as shown as Fig. 2. A strainer constructed from steel sheet (37) with 3 mm thickness is considered an outer frame of the brushes. This strainer contains circular openings with diameter of 8 mm. It consists of two extracted parts to simplify the repair and maintenance operations of the brushes.

Machine was driven by a transmission system connected to the P.T.O. of tractor, 60 hp by means of pair of pulleys, and a universal joint. The first pulley transmits the motion to the pulley of cutting and extracting drum and the second one transmits the motion to the pulley of cleaning unit.

The extracting machine was designed to be powered by the tractor. It was driven by a transmission system connected to the P.T.O. of tractor, 60 hp by means of pair of pulleys, and a universal joint.
Fig. (1): Main extracting machine for watermelon seeds

<table>
<thead>
<tr>
<th>No.</th>
<th>Part name</th>
<th>Dim. in cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main frame</td>
<td>266</td>
</tr>
<tr>
<td>2</td>
<td>Feeding hopper</td>
<td>52.5</td>
</tr>
<tr>
<td>3</td>
<td>Crushing drum</td>
<td>215.8</td>
</tr>
<tr>
<td>4</td>
<td>Cleaning unit</td>
<td>71</td>
</tr>
<tr>
<td>5</td>
<td>Seeds outlet</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>From tractor PTO</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>Develector unit</td>
<td>52.5</td>
</tr>
<tr>
<td>8</td>
<td>Concave</td>
<td>65</td>
</tr>
<tr>
<td>9</td>
<td>Covering machine</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>Wheels</td>
<td>20</td>
</tr>
<tr>
<td>11</td>
<td>Seeding unit</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Table (1): The technical specifications the machine:

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture</td>
<td>Locally small workshop</td>
</tr>
<tr>
<td>Total length, cm</td>
<td>266</td>
</tr>
<tr>
<td>Width, cm</td>
<td>158</td>
</tr>
<tr>
<td>Height, cm</td>
<td>216</td>
</tr>
<tr>
<td>Mass, kg</td>
<td>500</td>
</tr>
<tr>
<td>Source of power</td>
<td>Tractor P.T.O.</td>
</tr>
<tr>
<td>Length of the crushing cylinder, cm</td>
<td>120</td>
</tr>
<tr>
<td>Diameter of the drum, cm</td>
<td>45</td>
</tr>
<tr>
<td>Total crushing knives on the drum</td>
<td>4 knives (36.6 cm length, 6.0 cm height and 1.0 cm thickness).</td>
</tr>
<tr>
<td>Feeding tray of fruits, cm</td>
<td>55 x 37 x 60</td>
</tr>
<tr>
<td>Output opening diameter for seeds, cm</td>
<td>30</td>
</tr>
<tr>
<td>Outlet opening for peels, cm</td>
<td>20 x 30.8 x 15.2</td>
</tr>
</tbody>
</table>

**Determination of visible seed damage:**

The percentage of visible seed damage was calculated according to Desta and Mishra, (1990) as follows:

\[
\text{Vis.} = \frac{M_b}{M_t} \times 100 \quad \% \quad \text{------------------------ 1}
\]

where:

Vis. = visible seed damage, %;

\(M_b\) = mass of broken seeds in the sample, g, and

\(M_t\) = total mass of seeds in the sample, g.

**Estimation of Seed losses**

The percentages of seed losses were determined using the following relationship:

\[
\text{Seed losses} = \frac{M_1}{M_t + M_2} \times 100 \quad \% \quad \text{------------------------ 2}
\]

where:

\(M_1\) = mass of seed mixed with the expelled peels, g, and

\(M_2\) = mass of clean seeds from output opening, g.

**Estimation of cleaning efficiency**

The cleaned seeds were collected from the seed opening and weighed, \(M_c\). Also, the seeds which expelled with the peels and foreign matters were picked and weighed, \(M_L\). The cleaning efficiency was calculated according to the following equation:
Cleaning efficiency = \( \frac{M_f}{M_i + M_l} \times 100 \) %

Fig. (2): Three numbers of brushes for the cleaning unit
Estimation of machine productivity:
Machine productivity was calculated according to the following equation:

\[ C = \frac{60 \times M}{T_s} \]

where:
- \( C \) = extraction capacity of the machine, Mg/h;
- \( M \) = mass of classified seeds, Mg, and
- \( T_s \) = experiment running time, min.

Estimation of power and energy requirement:
The power required by the tractor was calculated using the measured fuel consumption during threshing operation under different variables of the study.

The following formula was used to estimate the tractor horsepower according to Embaby (1985).

\[ E.P = F_c \times \frac{1}{60 \times 60} \times \rho \times \frac{L.C.V. \times 427 \times \eta_{\text{th}} \times \eta_{m}}{75} \times \frac{1}{1.36} \text{ kW/h} \]

Where:
- \( F_c \) = The fuel consumption, L/h.
- \( \rho \times F \) = The density of fuel, kg/L (for solar = 0.85 kg/L).
- \( L.C.V. \) = The lower calorific value of fuel (kcal/kg).
  - L.C.V. of solar = 10000 (kcal/kg).
- \( \eta_{\text{th}} \) = Thermal efficiency of the engine, consider being about 40% for diesel engine.
- 427 = Thermo-mechanical equivalent, (kg.m/kcal).
- \( \eta_{m} \) = Mechanical efficiency of the engine, (80% for Diesel).

Power required = 3.16 \( F_c \) kW/h.

So, the energy requirement in (kW.h/fed) was calculated as follows:

\[ \text{Energy requirement} = \frac{\text{The consumed power, kW}}{\text{Actual field capacity, Mg/Th}}\text{ kW.h/Mg} \]

Machine operation Cost:
Estimated according to Hunt, (1983) as follows:
Total cost, LE/h = Fixed cost, LE/h + Variable cost, LE/h

Unit costs (UC): The unit costs, (LE/Mg) was estimated as follows:

\[
\text{Unit cost} = \frac{\text{Total cost, LE/h}}{\text{Equipment capacity, LE/Mg}}, \text{LE/Mg}
\]

**Estimation of criterion cost:** The criterion cost was estimated according to the following equation

\[
\text{Cr} = \text{Uc} + \text{Lc} + \text{Visc}
\]

where:
- \(\text{Cr}\) = the criterion cost, LE/fed;
- \(\text{Uc}\) = unit cost, LE/Mg;
- \(\text{Lc}\) = losses cost, LE/Mg;
- \(\text{Visc}\) = visible damage cost, LE/Mg.

**Net profit:**

The net profit was estimated according to the following equation:

\[
\text{P} = \text{Ry} - \text{Cr}
\]

where:
- \(\text{P}\) = net profit, LE/Fed;
- \(\text{Ry}\) = revenues of yield, LE/Fed.

**RESULTS AND DISCUSSION**

1- **Seed Losses:**

Data presented in Table 2 obvious the effect of four drum speeds, four different levels of feeding rates and four time span after harvesting of watermelon. Increasing of drum speed increased seed losses at all variable levels. On the other hand, increasing of feeding rates increased the seed losses. However, the minimum values of seed losses were 4.17 % at feeding rate of about 45 kg/min. In addition, increasing the drum speed from 3.53 to 8.84 m/s increased seed losses from 3.42 to 5.28%. Data in Table 2 indicate the effect of extracting intervals on the seed losses at different values of feeding rate and drum speed. Similar results were found by Abou El-Magd et al., (2006). The obtained values of seed losses were
5.73, 5.45, 5.17 and 5.30 % at extracting intervals of 5, 6, 7 and 8 days after harvesting operation, respectively. The extracting operation of watermelon seeds after seven days from harvesting achieved the lowest values of seed losses compared with other extracting dates after harvesting 5, 6 and 8 days.

2- Visible Seed Damage:

Table 2 shows the effect of drum speed and feeding rate on the visible seed damage. It can be seen that, increasing feeding rate from 45 to 90 kg/min., decreased visible seed damage from 0.598 to 0.497 %. That is may be due to decreasing on the impact forces between watermelon seeds. However, the increase of feeding rates tends to decrease the seed damage under the various operating parameters. Also, the increasing drum speed from 3.53 to 8.84 m/s, increased visible seed damage from 0.369 to 0.497%. Similar results were found by Kholief et al, (2005) The obtained values of visible seed damage were 0.391, 0.426, 0.460 and 0.499 % at extracting intervals for watermelon seeds of 5, 6, 7 and 8 days after the harvesting time, respectively. Due to lifting the watermelon fruits under sunshine many days after harvesting, the fibers of fruits flesh was analyzed vapidly, therefore, the internal bands between flesh and seed or between the flesh and peel becomes weaken. However, after seven days these fibers were analyzed completely and become as liquid, therefore the seeds were affected by multi impacts and increased the visible damage.

3- Machine productivity:

Productivity is affected by many parameters such as feeding rate and drum speed. The data presented in the Table 2 show that increasing feeding rate from 45 to 90 kg/min, increased productivity from 145.90 to 238.12 kgw/h. after four days span from harvesting similar results were found by Kholief et al, (2005). It could be observed that increasing feeding rate tends to increase seed losses at all parameter levels. The data indicated that average values of productivity slightly decreased when the drum speed ranged from 3.53 to 8.84 m/s. The average values of machine productivity were 212.96, 214.20, 215.33 and 215.66 kgw/h at times of 5, 6, 7 and 8 days after harvesting operations, respectively. However, increasing extracting time after harvesting days tends to increase the machine productivity for all the different variables.
Table (2): Effects of feeding rate, drum speed and time span after harvesting, on seed losses %, average visible seed damage %, and seed productivity, kg/w/h

<table>
<thead>
<tr>
<th>Variables</th>
<th>seed losses%</th>
<th>Visible seed damage%</th>
<th>Productivity, kg/w/h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feeding rate, (kg/min)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>4.17</td>
<td>0.598</td>
<td>145.90</td>
</tr>
<tr>
<td>60</td>
<td>4.42</td>
<td>0.540</td>
<td>173.88</td>
</tr>
<tr>
<td>75</td>
<td>5.08</td>
<td>0.488</td>
<td>207.18</td>
</tr>
<tr>
<td>90</td>
<td>5.43</td>
<td>0.427</td>
<td>238.12</td>
</tr>
<tr>
<td><strong>Drum speed, (m/s)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.53</td>
<td>3.42</td>
<td>0.369</td>
<td>218.01</td>
</tr>
<tr>
<td>5.30</td>
<td>3.93</td>
<td>0.405</td>
<td>216.80</td>
</tr>
<tr>
<td>7.07</td>
<td>4.39</td>
<td>0.454</td>
<td>215.24</td>
</tr>
<tr>
<td>8.84</td>
<td>5.28</td>
<td>0.497</td>
<td>214.22</td>
</tr>
<tr>
<td><strong>Time span after harvesting, (day)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5.73</td>
<td>0.391</td>
<td>212.96</td>
</tr>
<tr>
<td>6</td>
<td>5.45</td>
<td>0.426</td>
<td>214.20</td>
</tr>
<tr>
<td>7</td>
<td>5.17</td>
<td>0.460</td>
<td>215.33</td>
</tr>
<tr>
<td>8</td>
<td>5.30</td>
<td>0.499</td>
<td>215.62</td>
</tr>
</tbody>
</table>

4. Required power:

From the data present in Table 3 and Fig 3 it could be cleared that at all conditions, the drum speed of 3.53 m/s gave the lowest values of power required, and the highest values were recorded at drum speed of 8.87 m/s. Similar results were found by Baiomy et al. (1999). Increasing the feeding rate from 45 to 90 kg/min increased the power required from 9.21 to 13.55 kW. It is evident that, the maximum values of power required were obtained at 90 kg/min., compared with the other feeding rates for all the factors under study. Gummert et al. (1992).
Table (3): Effect of feeding rate and drum speed on power required.

<table>
<thead>
<tr>
<th>Feeding rate, kg/min</th>
<th>Drum speed, m/s</th>
<th>Required power, kW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.53</td>
<td>5.3</td>
</tr>
<tr>
<td>45</td>
<td>8.06</td>
<td>8.8</td>
</tr>
<tr>
<td>60</td>
<td>9.17</td>
<td>9.95</td>
</tr>
<tr>
<td>75</td>
<td>10.41</td>
<td>11.33</td>
</tr>
<tr>
<td>90</td>
<td>11.88</td>
<td>12.99</td>
</tr>
<tr>
<td>Mean</td>
<td>9.88</td>
<td>10.76</td>
</tr>
</tbody>
</table>

Fig. (3): Effect of feeding rate and drum speed on power required.

5. Cleaning Efficiency:
The effect of feeding rate, drum speed, brush speed, number of brushes and time of extracting after harvesting on the cleaning efficiency of watermelon seeds after extracting operation are indicated in Table 4. The effect of drum speeds and the feeding rate of watermelon on cleaning efficiency are shown in Fig 4.
Increasing drum speed tends to increase seed cleaning efficiency. The obtained values of cleaning efficiency decreased from 90.29 to 84.69 % when feeding rate increased from 45 to 90 kg/min at brush speed 3.53 m/s. Cleaning efficiency was decreased from 87.93 to 83.87 % with increasing drum speeds from 3.53 to 8.84 m/s at brush speed 2.95 m/s. The data presented in Table 6 indicated that, the maximum value of cleaning efficiency which is of about 94.61 % was achieved with the feeding rate of about 45 kg/min at drum speed of about 3.53 m/s, 16 brushes and 3.53 m/s brush speed. While, the minimum value of cleaning efficiency of 74.13 % was obtained with the feeding rate of about 90 kg/min, at drum speed of about 8.84 m/s, 8 brushes and 1.77 m/s brush speed. Similar results were found by Abou El-Magd et al., (2006). Generally, for all the drum speeds, brush numbers and brush speeds in addition to time of extracting, the highest values of cleaning efficiency was achieved at feeding rate of about 45 kg/min.

![Fig. (4): Effect of brush speed, feeding rate and drum speed on cleaning efficiency.](image)

The values of cleaning efficiency as affected by the different brush speeds during extracting the watermelon seeds under different feeding rates, drum speeds and brushes number are show in Fig 5 and Table 5. The increment rate in cleaning efficiency by increasing brush speed from 1.77 to 2.36 m/s was more than by increasing brush speed
from 2.95 to 3.53 m/s. The decreasing of cleaning efficiency may be due to the insufficient time to clean the extracting seeds with increasing the feeding rate and drum speed.

Table (5): Effect of brush speed and number of brush on cleaning efficiency.

<table>
<thead>
<tr>
<th>No. of brush</th>
<th>Cleaning efficiency, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brush speed, m/s</td>
</tr>
<tr>
<td></td>
<td>1.77  2.36  2.95  3.53  Mean</td>
</tr>
<tr>
<td>8</td>
<td>79.96  82.12  84.16  86.09  83.08</td>
</tr>
<tr>
<td>12</td>
<td>81.91  84.05  86.07  87.93  84.99</td>
</tr>
<tr>
<td>16</td>
<td>83.76  86.02  87.64  89.75  86.79</td>
</tr>
<tr>
<td>Mean</td>
<td>81.87  84.06  85.95  87.95  84.95</td>
</tr>
</tbody>
</table>

Fig. (5): Effect of brush speed and number of brush on cleaning efficiency.

6- Cost evaluation:

Data of Fig 6 and Table 6 indicate that, the profit of
watermelon seed has been affected by feeding rate and drum speed. It is evident that, the maximum values of profit were achieved at feeding rate of 45 kg/min followed by 60 and 75 kg/min, respectively. While, the least profit is associated with 90 kg/min., feeding rate for all different ranges of drum speed. Finally, from the above discussion it could be concluded that the maximum profit is accomplished the feeding rate of 45 kg/min, drum speed of 3.53 m/s. Vise versa the minimum is accomplished 90 kg/min, and drum speed of 8.87 m/s.

**Table (6): Effect of feeding rate and drum speed on net profit.**

<table>
<thead>
<tr>
<th>Feeding rate, kg/min</th>
<th>Net Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drum speed, m/s</td>
</tr>
<tr>
<td>45</td>
<td>3049.7</td>
</tr>
<tr>
<td>60</td>
<td>3016.5</td>
</tr>
<tr>
<td>75</td>
<td>2992.3</td>
</tr>
<tr>
<td>90</td>
<td>2985.3</td>
</tr>
<tr>
<td>Mean</td>
<td>3010.9</td>
</tr>
</tbody>
</table>
CONCLUSION

From the obtained results the following conclusions are derived
- Increasing feeding rate decreased the visible seed damage, cleaning efficiency and net profit in addition to increased seed losses, machine productivity and power required.
- Machine productivity of about 238.12 kg/h and visible seed damage of about 0.427% in addition to the value of seed losses 5.43% were accomplished at feeding rate of about 90 kg/min. The maximum cleaning efficiency was obtained with brush speed of 3.53 m/s and number of brush of 16.
- Feeding rate of about 45 kg/min and drum speed of about 3.53 m/s had been attained the minimum values of seed losses.
- It can be reported that, the cleaning efficiency reached to 90.69 % at brush speed of 3.53 m/s and feeding rate of about 90 kg/min.

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seed melons Misr J. Ag. Eng., 22 (2): 555-571.


تطوير وحدة التنظيف لآلة فصل بذور بطيخ اللب
د. عادل الدسوقي منصور
قسم الموارد الطبيعية والهندسة الزراعية – كلية الزراعة ببئنور – جامعة الاسكندرية

تعتبر عملية حصاد وفصل بذور لب البطيخ آلية من أهم العمليات الزراعية التي تستحوذ على اهتمام المزارع المصري لما يجده من عناية كبيرة في الحصول على البذور بطريقة نحيدة. وبلغ إجمالي المساحة المزرعة ببطيخ اللب في جمهورية مصر العربية حوالي 17000 فدان، حيث بلغ إجمالي الإنتاج السنوي حوالي 79900 طن بمتوسط إنتاج 470 كجم/فدان، وزارة الزراعة كتاب الإحصائية الزراعية 2005م. ويتم إنتاج 8 جينيات لكل كيلو جرام بذر. ويدافع هذا البحث إلى تطوير وحدة التنظيف لآلة فصل بذور بطيخ اللب.

من خلال تحقيق الأهداف التالية: اختبار وتقني أداء الآلة بعد التطور - تحديد أسباب ظروف تشغيل الآلة تحت ظروف تشغيل مختلفة - تقني القيتالي للكالعدة.

تتركب الآلة من الأجزاء التالية ( وحدة القطع الفصل - وحدة التنظيف - وحدة نقل القطر):
- نافورة نقل البذور إلى الفرش وتنتهي البريمة بحيرة خروج البذور.
- فرش بلاستكية مزروعة في قسم من الخشب ذو أبعاد 50 × 4 × 2.5 سم تملع على تنظيف البذور من اللب.
- يغلف جزء الفرش بمصفاة ذات ثقوب دائرية بقطر 8 مم.
- تطور وحدة التنظيف لزيادة كفاءة التنظيف بترشيع عدد فرش التنظيف لتصبح ع 8 و 12 و 16 فرشاً تنظيفية. واعتماد الإشارات حتى يد و فرش فائض في نتيجة صف، ثم تكبير حصة المصنعة ملحيا تحت تأثير المغذيات التالية:

- معدلات تشغيل فيتامين أ (45 - 60 - 75 - 90 كيلوجرام بذرة).
- السرعة الجسمية للذراع و تم استخدام أربع سرعات للذراع الجريفي هي (7.07 - 7.95 – 8.84 - 9.65) م/ثانية.
- ثلاث مرات للفصل من وقت حصاد ثمار البطيخ (5 - 6 - 7 - 8 أيام).
- السرعة الجسمية للذراع و تم استخدام أربع سرعات للفرش التنظيف هي (1.77 - 2.36 – 2.95 – 3.53) م/ث.
- عدد فرش التنظيف و تم استخدام نوعين من عدد الفرش هي (8 - 12 - 16 فرشاً).
- تم إجراء تقييمات النتائج لتقييم أداء الآلة تحت الدراسة كما يلي:
أداء آلة الفصل: أ) تلف البذور. 
ب) فوائد البذور. 
ج) إنتاجية الآلة. 
(1) كفاءة التشغيل. 
(2) القدرة المستغلة. 
(3) التكلفة الكلية لعملية فصل بذور البطيخ.

ويمكن تلخيص النتائج فيما يلي:
- أدت زيادة معدل التلف من 45 إلى 90 كجم ثمار/ دقيقة إلى انخفاض التلف الظاهري للبذور من 0.598 إلى 0.427 % بينما أدت إلى زيادة كل من معدل فقد البذور من 4.17 إلى 5.43 %، وإنتاجية الآلة من 145.90 كجم/ ساعة.
- أوضحت الدراسة أن تشغيل الآلة على سرعة عالية (8.84 م/ ث) أدت إلى زيادة كل من التلف الظاهري للبذور، ومعدل فقد البذور، بينما أدت إلى انخفاض كل من إنتاجية الآلة، وكفاءة التنظيف وصافي العائد.
- أشارت النتائج بأن الفاقد في البذور زاد عندما زادت سرعة الدرفل. حيث أعطت سرعة الدرفل 3.53 م/ ثانى أقل نسبة فاقد فاذ في البذور مقارنة بسرعات الدرفل الأخرى.
- أعلى كفاءة للتنظيف البذور كانت عند 94.61 % تصلح على سعة درفل 3.53 م/ ث وضعف 06.91 كجم/ دقيقة وسرعة 3.53 م/ ث.
- سجلت أقل قيم نسبة فاقد البذور عند فصل بذور البطيخ بعد سبعية أيام من عملية الحصاد مقارنة بفترات الفصل الأخرى { 5 و 6 و 8 أيام } من وقت الحصاد مع كل المتغيرات الأخرى.
- سجلت أعلى عدد وقودة 3049.7 جنيه/ فدان عند معدل تلفق 45 كجم/ دقيقة وسرعة درفل 3.53 م/ ثانية.

وتوصي الدراسة باستخدام معدل تلفق 45 كجم/ دقيقة وسرعة 3.53 م/ ثانية وعدد فرش 16 فرشة وسرعة الفرش 3.53 م/ ث ويتم إجراء عملية الفصل بعد 7 أيام من الحصاد.