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DEVELOPMENT OF A SIMPLE DEVICE FOR SEPARATING SMALL SEEDS SUITABLE FOR SMALL AREAS

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ABSTRACT

This study was conducted in order to develop a simple local device for separating small seeds and aimed to utilize the use of centrifugal force in separating seeds for minimizing the costs and losses of separating small seeds. The studied factors were three disc positions of (P1=20, P2=15 and P3=10 rubber spikes fixed on its upper surface), three cylinder positions (a= without any spike, b= 7spikes in one row and c= 14 spikes in two rows fixed on its inner surface), four disc speeds of (S1= 3.9, S2= 5.7, S3= 8.2 and S4= 10.4 m/s), three levels of seed moisture content (M1=19.8, M2= 15.2and M3= 10.3 %) and four levels of separating clearances (C1=1.0, C2=1.5, C3= 2.0 and C4=2.5 cm). The evaluation was on the following parameters:- seed quality, separating efficiency and capacity. The suitable conditions for using the new prototype device were (position P1)=20 spikes on separating disc ,(position C) = 14 spikes on cylinder, 5.7 m/s disc speed, 1.5 cm of separating clearance and 15.2% of seed moisture content. The previous factors gives 99.31 % of seed quality, 89.19 % of germination ratio, 99.34% of separating efficiency and 5.87 Kg/h of separating seed capacity .

INTRODUCTION

Solving the problem of separating small seeds is the main purpose of this research. So it was important to develop a small and simple device manufactured with local materials in local workshop to be suitable for small areas with the lowest power requirements and costs. There are many small seeds crops such as Onion seeds. Onion is one of the most important vegetable crops with a world production of about 55 million tons (FAO, 2006). It ranks the second position after cotton as an export crop in Egypt (Essa and Gamea 2003) . Never can we ignore the great value of the separating onion seeds operation to produce clean seeds with high quality. So, The objective of this study were to develop a device from local materials for small Egyptian farmers, evaluate the performance of the developed device such as capacity, separating efficiency and seed quality ,also Minimizing the costs and losses of separating small seeds.

El-Shiekha *et al.* (1994) reported that, in their research on the local flail type threshing machine the cylinder concave clearance and opening of the concave were not considered in the local Egyptian and Turkish machine designs on scientific losses on narrowing this clearance to 15 mm, and opening the concave outlet. The threshing capacity increased about 5 times threshing efficiency approaching 100 % seed damage did not exceed 3.5 % . Helmy *et al.* (2000) mentioned that three sunflower grain moisture contents (15.4, 20.9 and 28 %) were tested to evaluate the performance of a modified Bamby 049 BBy thresher against the conventional Bamby 049 BBy and local thresher (Misr CRS) in Turkey. A grain moisture content of 15.4 – 20.9 %

produced optimum results for the modified thresher. Lotfy et al (2002) studied the effect of concave clearance (6, 8 and 10 mm) in combine on losses of Winter Rasp-seed crop . They noticed that, increasing concave clearance high than 8 mm or decreasing it low than 8 mm led to increase the drum losses at constant both forward speed 1.8 km/h and seed moisture content of 15.3% . Decreasing the concave clearance led to decrease the percentage of unthreshed seeds . Moussa and Mohamed (2005) reported that two mechanical harvesting methods for threshing sunflower (mower then thresher) and combine harvester were compared with traditional method (manual then thresher) . The mechanical harvesting methods were done at five different field speeds 2.5, 3.1, 3.6, 4.0 and 4.5 km/h for mower and combine. Three different speeds (450, 500 and 550 rpm) were also effected on grain losses and damage grain for combine and thresher machines at three different moisture contents 8.78, 10.68 and 13.37 % . Increasing thresher drum speed from 450 to 550 rpm increase threshing losses about 0.46 % and damage grain by 1.35 at feed rate of 1 Mg/h. Ahmed et al (2008) reported that a thresher winnower machine was designed, constructed and tested to evaluate its performance in threshing and winnowing caraway crop under the designed operating conditions. The operating variables were, drum speeds of 5.87, 6.67, 8.007, 9.34 m/s, feed rates of 360, 450, 720, 900 kg/h and air velocity of 3.0, 3.5, 4.0 and 4.5 m/s. The evaluation was based on the following parameters: seed losses, chaff rejected, cleanliness, effectiveness, separating efficiency and percentage of cracked grain. The seed losses, chaff rejected cleanliness, effectiveness and separating efficiency were 1.42, 99.98, 99.9, 92.23 and 93.01 % respectively under feed rate of 360 kg/h, air velocity of 3 m/s and drum speed of 9.34 m/s as the optimum condition of designed thresher winnower machine.

MATERIALS AND METHODS

1. Materials :

The main objective of the present work is to develop and evaluate the performance of a machine to separate small seeds . This study was carried out in El-Serw agriculture research station during 2007 and 2008 seasons to separate small seeds such as onion seeds (Giza 8). All treatments were replicated three times. The main objective of this study was to design and develop a device from local materials for separating small seeds to suit small areas, evaluate its performance such as capacity, separating efficiency and seed quality with minimum costs and losses of separating small seeds.

1-1. Physical Properties of Onion Seeds :-

Giza (8) Varity of onion was used in this study. The average of physical properties and characteristics of Giza (8) are summarized as follows in table (1) .

Table (1) Physical properties of onion seed

Seed length, mm	Seed width, mm	Seed thickness, mm	Mass of 1000 seed g	Friction coefficient	bulk density, kg/m^3	Hardness, N
3.01	2.10	1.59	3.90	0.38	498.0	54.72

1-1. Laboratory measurements :-

A) Size: Three principle axes (L, W and t) were measured by using a micrometer reading to 0.01 mm .

B) Bulk density : Clove volume was determined according to Singh and Goswami (1996).

C) Hardness:- the hardness test was carried out using Penetronetro S T 308

D) Friction coefficient (f) : It was measured by using inclination angle (ϴ˚)

f = tan ϴ where :- f =friction coefficient .

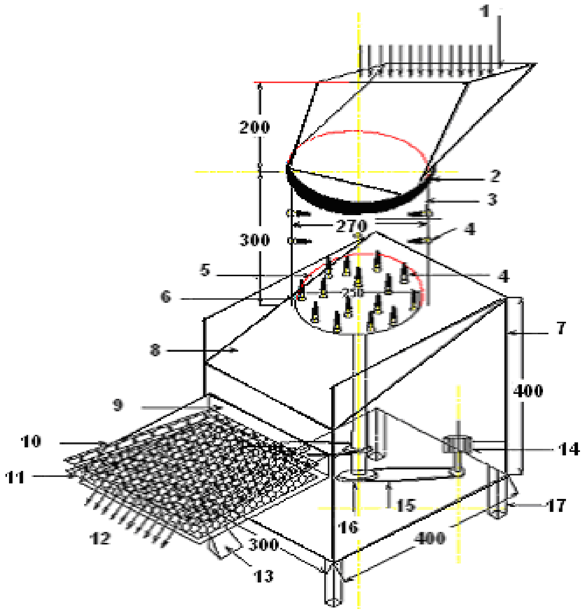
1-2 :- General description of the prototype :-

The used prototype was manufactured in a local workshop using local materials. It is illustrated at fig (1). It consists of a small disc rotating in horizontal plane inside cylindrical concave. On both disc and cylinder rubber teeth were fixed. The device has 65cm in length, 30cm in width and 90cm in height separating unit:-

A) Disc : - Of (25, 24 , 23 and 22cm diameter to obtain a clearances of 1.0 ,1.5, 2.0 and 2.5 cm. On its upper surface rubber spikes. The spikes were fixed with the shown arrangement the spike circles at 5 and 10 cm radius.The spike dimensions were 9cm height, 1cm top diameter and 2.0cm bottom diameter (7.0 ,2.0 cm above and blow the disc). It was operated by an electric motor of 0.25 kW (0. 33hp) with different pulls .

B) The concave housing was cylindrical assembled around the drum (disc form) , made from steel sheet of 2mm thickness with a diameter of 27 cm fixed on its inner surface spike of rubber. The spike dimensions were 6cm height, 1cm top diameter and 2.0cm bottom diameter (4.0 ,2.0 cm inside and outside the cylinder).

No	The objects
1	Feed opening
2	Cylinder cover
3	Cylinder
4	Rubber fingers
5	Separating disc
6	Clearance
7	The machine body
8	Declined surface
9	The sieve carrier
10	The upper sieve
11	The lower sieve
12	Ruches outlet
13	Seed outlet
14	Electric motor
15	V- belt
16	Pulley
17	Machine legs



Dimensions by, mm **Fig (1-B) Sketch view of the machine**

C) Feeding inlet : 20cm length and 15cm width with manual feeding
D) Cleaning unit : consists of three main parts :-
The upper sieve : it has 30cm length and 20cm wide. A wire mesh 0.4 cm holes diameter was used to prevent any bigger elements than the seeds and the lower sieve has (30cm length and 20cm width). A wire mesh of 0.25cm holes diameters was used to prevent any small size than the seeds, the sieves were set at a tilt of 25 degree. The separating materials flow on sieves by acting of gravity forces, sieves angle and oscillation motion

The basic of this device were as follows :-
1-2. Studied Factors:
A) Variable factors :-
1- Disc positions :- There are spikes fixed on its upper surface as follows :-

- position (1) : using 20 spike of rubber named (P1),
- position (2): using 15 spike of rubber named (P2) and
- position (3): using 10 spike of rubber named (P3).

2-Cylinder position :- Three positions of spikes on the inner surface of **cylinder were tested** :-

* position (a) without any spike named (a),
* position (b) one row of spike (7 spike) named (b) and
* position (c) two rows of spike 7+ 7= (14 spike) named (c) .

3- Disc speed :- There were four levels of disc speed were used. They were 450 rpm (3.9 m/sec) named (S1), 610 rpm (5.7 m/sec) named (S2), 830 rpm (8.2m/sec) named (S3) and 980 rpm (10.4 m/sec) named (S4)

4- Separating clearance : three levels of clearance were used, they were, 1.0 1.5, 2.0 and 2.5 cm named C1 , C2 , C 3 and C4, subsequently.
5- Seed moisture content : levels were 19.8, 15.2, and 10.3 %)named M1,M 2 and M3 .
B) Constant factors :-
1- Sieves speed : the sieves speed (oscillation speed of 0.25 m / s).
2- Feed rate (1.0 kg / 1.5 min) 3- Power : An electric motor of 0.25 hp.
Methods :
1. Experimental Procedure :-

The crop of onion harvested manually by picking the onion umbrellas in the morning from plants and left on the field to reach the suitable seed moisture content. Then it was collected the capsules in form of heaps to start the separation process. The heaps was divided to small heaps (1.0 kg weight) to be fed in 1.5 minute to obtain approximately constants feeding rate of (40 kg/hr) in the present study. The digital Tachometer was used for measuring the rotating disk speed. A common stop watch with 0.1 second accuracy was used to record the time spent during the experimental. In all experimental the samples component were weighted to get the percentage of un-threshed seeds, seed damage and moisture content.

2. Measuring instruments

The following measuring instruments were used in this study :-

A tape meter, electric oven - Petri dishes , speedometer, stop watch, electrical balance and ordinary balance.

3. Measurements

To determine the optimum conditions for using the new device, the following calibration criteria were studied:

A- Threshing efficiency, % **B-** Threshing capacity, kg/hr **C-** seeds quality %

So, after experiments, samples were taken to the laboratory in El-Serw Agricultural Research station to determine the following equations according to RNAM 1995 :-

1- Total seed input : A = B + E + F ………… (1-1)

A : Weight of total seed input per unit time .

B : Weight of separated seed per unit time collected at the main grain outlet.

E : Weight of separated seed (Escaped seed) per unit time collected at all outlets except from main seed outlet .

F : Weight of unseparated seed collected from all outlets per unit time .

2- Seed damage percentage :

The damaged seed ratio was calculated as a percentage by following :-

A) Visible seed damage (external) : Visible seed damage was determined according to the following equation :- $= \frac{G}{A} \times 100 \ldots\ldots\ldots\ldots(1-2)$

G = weight of damaged grains collected from spout per unit time .

A = Total grains input by weight per time .

B) Invisible seed damage (internal) :

Invisible seed damage was estimated by using germination test according to the following test :-

$$Cracked\ seed\,\% = \frac{N}{T} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1-3)$$

Where :- N = No. of cracked seed (failed to germinate and exceeded the ideal value) . T = Total grain number of seed in sample .

3 - Grain losses percentage :

Collected losses were carried out to determine their masses by an electrical Balance. $percentage\ of\ seed\ losses = \frac{L}{A} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots(1-4)$

L =Weight of seed loosed with the straw and separated using a suitable sieve.

A = Total seed input by weight per unit of time .

4- Separating Capacity :

The separating capacity was calculated by dividing the separated quantity (kg) by the consumed time (sec) in kg / hr .

5 - Percentage of unseparated seeds :

$$\frac{F}{A} x 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1-5)$$

F=Weight of unseparated seed from all outlets per time

A=weight of total seed input per unit of time .

6 - Determination of separating efficiency :

Machine field efficiency was estimated according to the following formula :

Separating efficiency % = 100 – percent of unseparated seeds ....(1 - 6)

7- Cleaning efficiency :

The cleaning efficiency was determined as follows :

$$Cleaning\ efficiency\ \% = 100 - (\frac{R}{B}) \ldots\ldots\ldots\ldots(1-7)$$

Where : R= weight of tarnishes (the strange materials) in grain per unit of time collected at the main grain outlet . B = Weight of separated seed per unit time collected at the main seed outlet .

• { The equations (3(1-7)) are according to RNAM, 1995 }

RESULTS AND DISCUSSION

The prototype machine has been tested and evaluated to fulfill the following points: 1- Separating efficiency 2- capacity.
2- Power requirements . 3- Separation costs .

The results were discussed through two stages,

- The first stage was to study the effect of different numbers of spike position on disc and cylinder, the prototype machine performance and seed properties and selecting the best spike .
- The second stage was to study the efficient of variable factors (seed moisture content, disc speed, separating clearance and new position of spikes on the machine performance and seed properties .

➢ **First stage :-**

This stage was conducted to test and compare three different disc positions (spikes were fixed on upper surface of disc in three positions : P1=20, P2 =15 and P3= 10 spike) with three different cylinder housing positions (spikes were fixed on inner surface of cylinder in three position : a = without any spikes, b= 7 spikes arranged in one circle and c = 14 spikes arranged in two circles). Data in fig (3- A, B and C)show the effect of different spikes positions under (5.7 m/s) disc speed, (19.8%) seed moisture content and (1.5cm) disc-housing clearance on machine performance and seed properties according to the following measurements :

1- Seed quality :

the results from fig (2-A) show that increasing spike numbers on disc from (10 to 20 spikes) and on the cylinder from (zero to 14 spikes) leaded to increase the impact action on separated materials, subsequently increase the percentage of seed damage, therefore it results in decreasing the value of seed quality. The minimum value of seed quality was 98.87% noticed with the larger spikes number on disc (P1=20 spikes)and cylinder at (C= 14 spikes). Also vice-versa the maximum value of seed quality was 99.83% remarked with the lowest number of spikes on disc (P3=10 spikes) and on cylinder (a = without spikes)

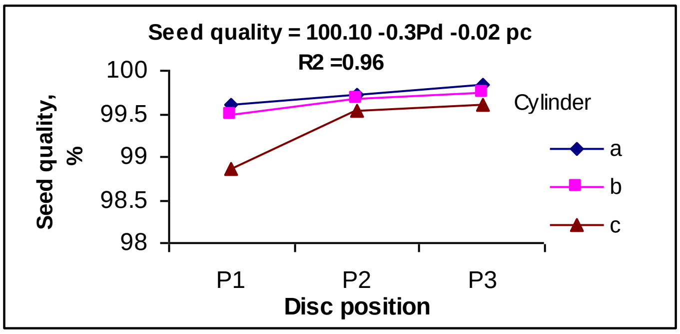


Fig (2-A) Effect of spikes position on disc and cylinder on seed quality

2- Unseparated seed and separating efficiency :

It was found in fig (2-B) that, increasing spikes number leaded to decrease unseparated seeds ,subsequently increase separating efficiency. The minimum percentage of unseparated seed was (1.04%) and maximum separating efficiency was 98.96% noticed with spikes positions of (P1=20 spikes on the disc and c = 14 spike on cylinder). While the higher percentage of unseparated seeds was 2.64% and lowest value of separating efficiency was 97.54% noticed with the lowest spikes positions of (P3=10 spikes on the disc and a = without any spikes on the cylinder).

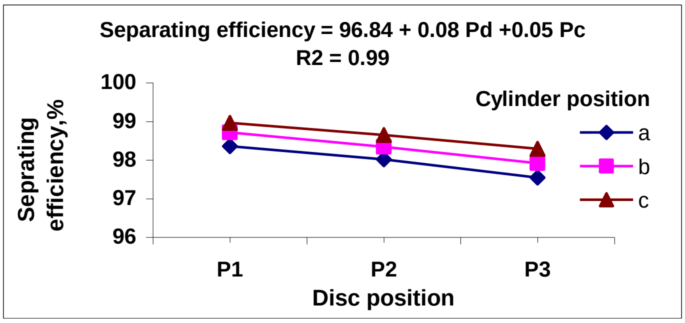


Fig (2-B) Effect of spikes position on disc and cylinder on separating efficiency

3- Separating capacity :

From the results in fig.(2-C), it was remarked that increasing spikes number on disc and cylinder tended to increase separating capacity. The minimum value of separating capacity was (3.46 kg/h) at spikes number of (P3=10 spikes on disc and position a = without spikes on cylinder). While the maximum value of separating capacity was 4.69 kg/h by using larger spikes number (position P1 = 20 spikes on disc and position c = 14 spikes on cylinder). That means, increasing spikes number tended to increase their centrifugal force and impacts, therefore, decreasing the remained time of the separated material in separating chamber which subsequently increase capacity .

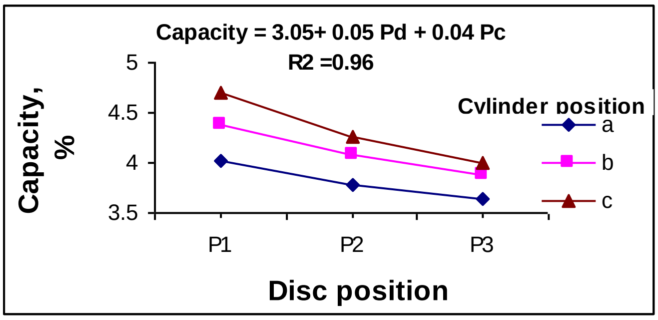


Fig (2-C) Effect of spikes position on disc and cylinder on separating Capacity .
Where :- Pd = disc position Pc = cylinder position

- **The second stage :**

From the first stage it was noticed that, the suitable positions of spike numbers on disc and cylinder were 20 spike numbers on disc and 14 spike on cylinder. The previous positions of disc and cylinder gave the lowest Unseparated seed (1.04), higher separated efficiency (98.96%) and separated capacity (4.69 kg/h). For the previous results we can be used the new position P1= 20 spike on the disc and position c = 14 spike on the cylinder. The second stage was to study the effect of different disc speed, separating clearance and seed moisture content with the new position of disc and cylinder on seed quality, separating clearance and capacity .

- **Seed quality :**

1-The effect of disc speed :- Figure (3-1)shows the effect of different disc speed with different clearances on seed quality. It was noticed that, increasing disc speeds tended to increase both of the visible and invisible damage as a logic result decrease the value of seed quality with all values of separating clearance and seed moisture content. The higher values of seed quality were 99.78, 99.72 and 99.35% remarked with little disc speed 3.9 m/s and larger separating clearance (2.5 cm). While the lower values of seed quality were 98.86, 98.76 and 98.18% noticed with higher rate of disc speed 10.4 m/s and lower separating clearance at different seed moisture content 19.8%, 15.2 and 10.3% respectively. From the previous data it was remarked that, there were very little difference between the higher and lower values of seed quality at seed moisture content of 19.8 and 15.2 %.

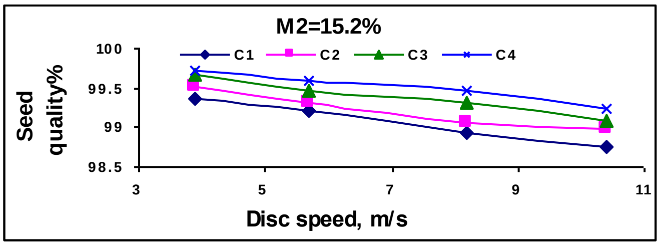


Fig (3-1) Effect of disc speed on seed quality

2- The effect of disc-housing clearance :- figure (3-2) shows that with increasing clearance from 1 cm to 2.5 cm, seed quality increased from (99.43 to 98.86%), (99.61 to 99.17 %) , (99.71 to 99.35%) and (99.78 to 99.41%) at disc speed of S_1, S_2 ,S_3 and S_4 subsequently with seed moisture content of 19.85 while with moisture content of 15.2% these values were (99.36 to 98.76%), (99.51 to 98.99%), (99.66 to 99.09%) and (99.72 to 99.24%) at disc speed of S_1, S_2 ,S_3 and S_4 subsequently. Also these values increased from (98.82 to 98.18%), (99.01 to 98.36%),(99.19 to 98.56%) and (99.35 to 98.73%) at disc speed of S_1, S_2 ,S_3 and S_4 subsequently with moisture content of 10.3% . The minimum value of visible damage (0.22 %) was remarked at clearance of 2.5 cm, seed moisture content of 19.8% and disc speed of 3.9 m/s. The maximum value of seed quality (99.78 %) was remarked with clearance of 2.5 cm , seed moisture content of 19.8% and disc speed of 3.9 m/s .

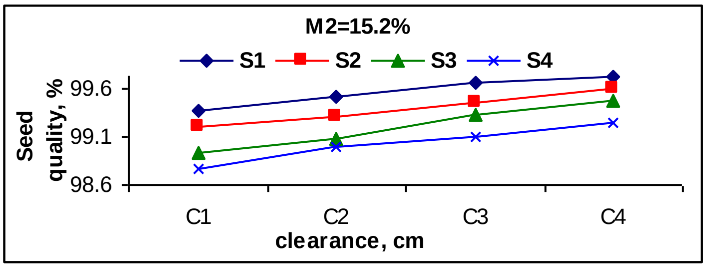


Fig (3-2) Effect of disc-housing clearance on seed quality

3- The effect of seed moisture content :- Figures (3-3) shows that, decreasing seed moisture content from 19.8% to 10.3 % tended to increase both the visible and invisible damage as a logic result decrease the value of seed quality with all values of clearances and disc speeds. Also it was noticed that the higher value of seed quality was 99.78% remarked with seed moisture content of 19.8% , clearance of 2.5 cm and lowest disc speed (3.9 m/s). While the lower value of seed quality was 98.18% noticed with the lowest seed moisture content of 10.3% ,lower separating clearance of 1 cm and higher rate of disc speed (10.4 m/s). From the previous data it was remarked that, there were very little difference between the higher and lower values of seed quality at seed moisture content of 19.8 and 15.2 % .

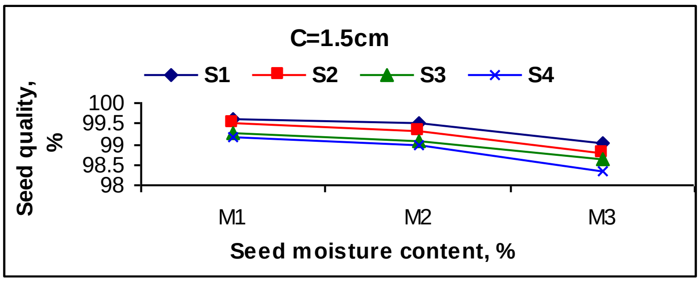


Fig (3-3) Effect of seed moisture content on seed quality

4 - Regression equation analysis :

The regression coefficient is ($R^2 = 0.93$) .

Seed quality = 98.143 + 0.07 M + 0.312 C - 0.082 S ………………………(3)

Where :- M = Moisture content , % , C = Separating clearance, cm and S = Disc speed , m/s

Separating efficiency :

1-The effect of disc speed :- Figure (4-1) shows the positive effect of disc speed on separating efficiency. By increasing disc speed from 3.9 to10.4 m/s the values of separating efficiency were increased as follows : -From (98.76 to 99.34), (98.43 to 99.04), (97.64 to 98.33) and (96.76 to 97.59) at seed moisture content of 19.8 %. . While separating efficiency increased from (99.39 to 99.68), (99.11 to 99.59), (98.73 to 99.42) and (98.25 to 98.99) under seed moisture content of 15.2 .Also separating efficiency increased from (99.52 to 99.81), (99.26 to 99.76), (98.93 to 99.53) and (98.64 to 99.38 %) with seed moisture content of 10.3% under different clearances from (1.0 to 2.5 cm) . This is due to the separated material exposed to less centrifugal force with small disc speeds than it with higher disc speed .So the un-separated seeds with higher speed were little than it with small speeds subsequently increase separating efficiency was accordant with increase of disc speed.

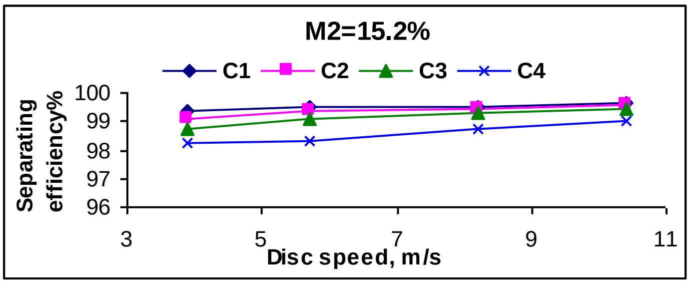


Fig (4-1) Effect of disc speed on separating efficiency

2- Effect of disc-housing clearance :- Figure (4-2) shows that with increasing clearance from 1 to 2.5 cm, separating efficiency decreased from (98.76to 96.76%), (98.96 to 96.94%), (99.09 to 97.29%) and (99.34 to 97.59%) m/s at seed moisture content 19.8%, while at seed moisture content of 15.2% these values decreased from (99.39 to 98.25%), (99.48 to 98.34%), (99.53 to 98.75%) and (99.68 to 98.99%). Also these values decreased from (99.52 to 98.64%), (99.68 to 98.82%), (99.74 to 99.11%) and (99.81 to 99.38%) at seed moisture content 10.3% under different levels of disc speeds from 3.9 to 10.4. So from the previous values the minimum value of un-separated seeds and higher value of separating efficiency were 0.19%and 99.81% (noticed at clearance of 1 cm, seed moisture content of 10.3 % and disc speed of 10.4 m/s). Also the higher value of unseparated seeds and lower value of separating efficiency were 3.24 and 96.76% were noticed at clearance of 2.5 cm, seed moisture content of 19.8% and disc speed of 3.9 m/s .

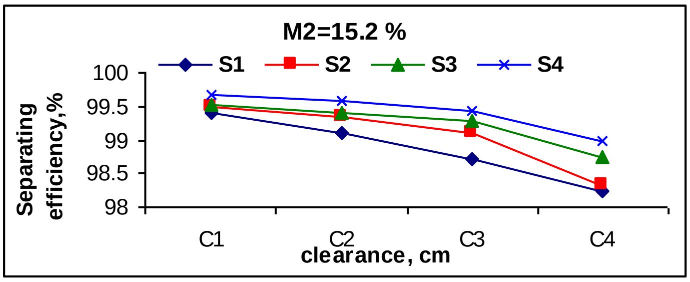


Fig (4-2) Effect of clearance on separating efficiency

3- Effect of seed moisture content :- Figure (4-3) shows that, decreasing of seed moisture content from 19.8 to 10.3 % leaded to reduce the percentage of un-separated seeds, subsequently increasing separating efficiency. This is may due to the increase of seed moisture content which make it difficult to separate seeds with more losses. The maximum percentage of separating efficiency (99.81%) was noticed at the lower seed moisture content (10.3%), disc speed 0f (10.4 m/s) and clearance of (1 cm). Also, the minimum value of un-separated seeds (0.19 %)was remarked at seed moisture content of 10.3% , disc speed of 10.4 m/s and clearance of 1 cm .

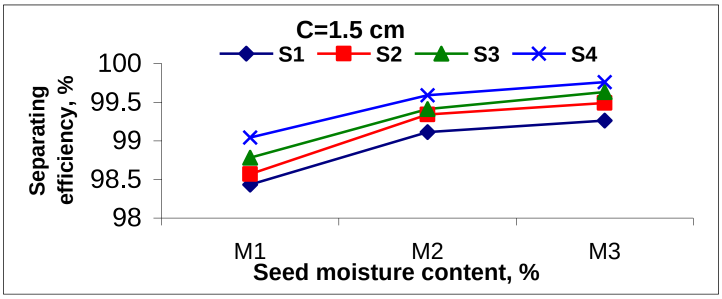


Fig (4-3) Effect of seed moisture content on separating efficiency

4-Regression equation analysis:-

The regression coefficient is (R² = 0.69) .

Separating efficiency = 98.659 - 0.395 M - 0.0148 C + 1.264 S ………….(4)

- **Separating capacity :-**

1-The effect of disc speed :- Fig (5-1) shows that, with increasing disc speed from 3.9 m/s to 10.4m/s, separating capacity increased from (4.28 to 5.81 kg/h), (4.69 to 6.39 kg/h), (5.14to 6.99 kg/h) and (5.67 to 7.49 kg/h) with disc speed of 3.9, 5.7, 8.2 and 10.4 m/s respectively at seed moisture content of 19.8 %, while at seed moisture content of 15.2 % these values were (4.66 to 6.27 kg/h), (5.29 to 6.86 kg/h), (5.73 to 7.37 kg/h) and (6.11 to 7.81 kg/h) with disc speed of 3.9, 5.7, 8.2 and 10.4 m/s respectively. Also these values increased from (5.28 to 6.66), (5.76 to 7.11) , (6.26 to 7.47 kg/h) and (6.62 to 7.88 kg/h) with disc speed of 3.9, 5.7, 8.2 and 10.4 m/s respectively at seed moisture content 10.3% under different clearances from 1 to 2.5 cm. The highest value of the separating capacity (7.88 kg/h) was noticed at disc speed of 10.4 m/s with clearance of 2.5 cm and seed moisture content of 10.3% .

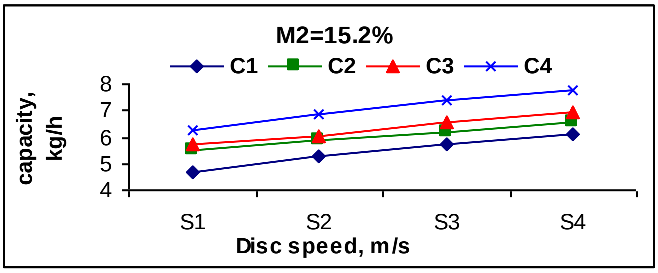


Fig (5-1) Effect of disc-housing clearance on separating capacity

2- Effect of disc-housing clearance :- Fig (5-2) shows that, With increasing separating clearance from 1 cm to 2.5 cm, separating capacity increased from (4.28 to 5.67 kg/h), (4.84 to 6.25), (5.42 to 6.84) and (5.81 to 7.49) at seed moisture content 19.8 %, while at seed moisture content of 15.2 % these values were (4.66 to 6.11), (5.51 to 6.60), (5.74 to 6.91) and (6.27 to 7.81). Also these values increased from (5.28 to 6.62), (6.09 to 7.18) , (6.26 to 7.34) and (6.66 to 7.88) at seed moisture content 10.3% under different disc speeds from 3.9 to 10.4 m/s. The higher value of the separating capacity (7.88 kg/h) was noticed at clearance of 2.5cm, seed moisture content of 10.3 % and disc speed of 10.4 m/s.

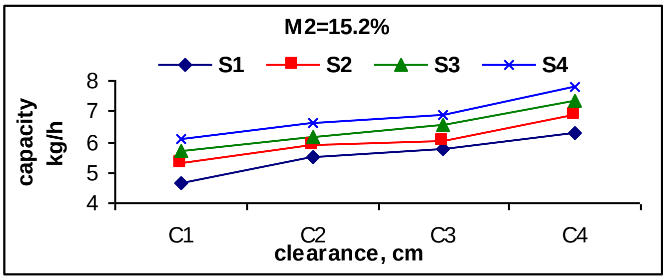


Fig (5-2) Effect of disc-housing clearance on separating capacity

3- Effect of seed moisture content:-

Fig (5-3) shows the negative relationship between seed moisture content and separating capacity. It was noticed that increasing of seed moisture content leaded to decrease separating capacity. This is because of increasing elasticity of materials at high seed moisture content which causes decreasing the impact effect of the spikes on separating materials. The higher percentage of separating capacity (7.88 kg/h) was noticed at seed moisture content (M3= 10.3%) ,disc speed (10.4 m/s) and clearance of 2.5 cm.

4-Regression equation analysis :- The regression coefficient is (R^2 = 0.95).
Separating capacity = 2.124+ 1.363 M + 0.107 C + 1.166 S ……..……….(5)
Separating cost : It was found that, the cost of separating onion seeds from area 175 m2 about 30.6 L.E . Equal about of 34.0 % from manual costs.

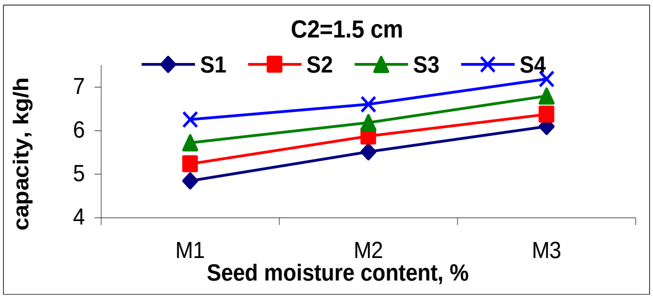


Fig (5-3) Effect of disc-housing clearance on separating capacity

REFERENCES

Ahmed S.F; A. E. Gmaa and H.H.Yousef (2008). Criteria of performance evaluation of a threshing and winnowing machine manufactured for medcininal and aromatic crops.J. Adv. Agric. Res. (Fac. Ag. Saba Basha). 13 (1), 121-147

El-Sheikha, M. A.; S. M. Sharaf and M. A. Mohammed (1994). Modification of the local threshing machine through standing some its important working parameters. Misr J. Ag. Eng. 11(2): 512-521.

Essa, A. H. and G. R. Gamea (2003). Physical and mechanical properties of bulb onions. Misr J. Ag. Eng. 20(3) :661 – 676 .

FAO (2006). Production annual report. Food and Agriculture Organization, Rome.

Helmy-MA., Yousef-IS; and Badawy-MA. (2000). Performance evaluation of some sunflower thresher. Ag. Mech. Dept., Fac. Of Ag., Kafr El-Sheikh, Tanta Univ., Tanta Univ., Tanta, Egypt. Egyptian-Journal-Of-Agricultural-Society-of-Agricultural-Engineers. No. (4), 33-41

Lotfy, A., A.A. Essa and G.R. Gamea (2002). A comparative study between two different methods for harvesting and threshing of winter rap-seed crop. Misr. J. Agric. Eng., 19(4): 867-880 .

Moussa, A. I. and M. I. Mohamed (2005). A study of different harvesting methods for sunflower. J. Agric. Sci. Mansoura Univ., 30(6): 3271-3283.

Rnam. (1995). Test code and procedures for Agriculture Machinery. Technical series 12, Regional Network for Agricultural Machinery (RNAM) of the United Nations. Philippines. Pp : 227 – 246 .

Singh, K. K. and T. K. Goswami (1996). Physical properties of gumim seeds. J. Agric. Eng. Res., 64(2): 93-98 .

تطوير جهاز لفصل بذور المحاصيل الصغيرة يناسب المساحات الصغيرة

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معظم محاصيل الخضر والنباتات الطبية والعطرية من محاصيل البذور الصغيرة ، وقد تم اختيار محصول البصل كأحد محاصيل البذور الصغيرة والذي له أهمية غذائية واقتصادية عالية ، فهو يحتل المركز الثاني كمحصول تصديري بعد القطن (عيسى و جامع 2003) و بلغت المساحة المنزرعة في مصر حوالي (102.2الف فدان) وسجلت إنتاجية الفدان الواحد حوالي 150-200 كجم بذور (الفاو 2006) .

الهدف من الدراسة :

تطوير آلة بسيطة لفصل بذور المحاصيل صغيرة الحجم مصنوعة من خامات محلية منخفضة التكاليف وسهلة الصنع في الورش المحلية وأيضا تستهلك أقل قدرة ممكنة لتناسب المساحات الصغيرة و صغار المزارعين. الآلة بأبسط صورها عبارة عن قرص دائري مركب عليه أصابع مطاطية ويدور في المستوى الأفقي ويحيط به غلاف اسطواني ويوجد فتحة علوية لدخول المادة المراد فصلها وأيضا يوجد فتحة خروج ووحدة للقدرة وغربال للتنظيف . وقد تم إجراء البحث في محطة البحوث الزراعية بالسرو- دمياط في الموسم الزراعي 2007-2008.

عوامل الدراسة :

أوضاع قرص الفصل :- تم اختيار ثلاث أوضاع لقرص الفصل :

1-الوضع (p_1)**:** تشغيل 20 صابع. **2-** الوضع (p_2) تشغيل 15 صابع.

3- الوضع (p_3) تشغيل 10 أصابع.

أوضاع الاسطوانة الخارجية :- أيضا تم اختيار ثلاث أوضاع للاسطوانة :

1-(a) بدون أي أصابع. **2-** (b) استخدام صف واحد به 7 أصابع .

3- (c) استخدام صفين بكل صف 7 أصابع أي 14 صابع .

3- **سرعة قرص الفصل :** تم اختيار أربع مستويات للسرعة وهي :-

S1 =450 لفة / دقيقة (3.9 م /ث) S2 = 610 لفة / دقيقة (5.7 م/ث)

S3 = 830 لفة / دقيقة (8.2 م/ث) S4 = 980 لفة / دقيقة (10.4 م/ث)

4- **خلوص الفصل** (بين قرص الفصل والاسطوانة الخارجية) : تم اختيار أربع مسافات: للخلوص (1 ، 1.5 ، 2 ، 2.5 مم) .

5- **المحتوى الرطوبي للبذور :-** تم دراسة ثلاث مستويات للرطوبة في حدود :- (19.8 ، 15.2 ، 10.3 %) .

القياسات :-

1- جودة البذور . 2-كفاءة الفصل . 3- سعة الفصل. 4- التكاليف الكلية **النتائج :-**

- **المرحلة الأولى/ تأثير أوضاع الأصابع على كل من قرص الفصل والاسطوانة :-**

لقد تم رصد أقل نسبة للكسر الظاهري وأعلى قيمة لجودة البذور المفصولة عند الوضع (P3 = 10أصابع) على القرص ، والوضع (a) أي بدون أصابع على الاسطوانة . كانت أقل نسبة للحبوب الغير مفصولة وأعلى قيمة لكفاءة وسعة الفصل عند الوضع (P1 = 20صابع) على القرص ، والوضع (c = 14 صابع في صفين) على الاسطوانة

- **المرحلة الثانية :**

تأثير سرعة قرص الفصل : كانت أقل نسبة للكسر الظاهري وأعلى قيمة لجودة البذور المفصولة عند أقل سرعة لقرص الفصل 3.9 م/ث لجميع مسافات الخلوص ومستويات الرطوبة .بينما كانت أقل نسبة للحبوب الغير مفصولة وأعلى قيمة لكفاءة وسعة الفصل عند أعلى سرعة 10.4 م/ث لجميع مسافات الخلوص ومستويات الرطوبة .

تأثير مسافات الخلوص : لوحظ أن أقل نسبة للكسر الظاهري وأعلى قيمة لجودة البذور المفصولة عند أكبر خلوص 2.5 سم لجميع مستويات السرعة والرطوبة .بينما كانت أقل نسبة للحبوب الغير مفصولة وأعلى قيمة

لكفاءة الفصل عند أقل خلوص 1 سم لجميع مستويات السرعة والرطوبة .بينما وجد أن أعلى سعة فصل كانت عند أكبر خلوص 2.5 سم لجميع مستويات السرعة والرطوبة .

تأثير المحتوى الرطوبي للبذور : كانت أقل نسبة للكسر الظاهري وأعلى قيمة لجودة البذور المفصولة عند أكبر نسبة للرطوبة 19.8% لجميع مستويات السرعة ومقاسات الخلوص .بينما كانت أقل نسبة للحبوب الغير مفصولة وأعلى قيمة لكفاءة وسعة الفصل عند أقل نسبة رطوبة 10.3% لجميع مستويات السرعة ومقاسات الخلوص .

حساب التكاليف :- من حساب التكاليف وجد أن تكاليف فصل بذور البصل آليا لمساحة قدرها 175م^2 هي30.6 جنيه والتي تعادل 34 % من تكاليف الفصل اليدوي لنفس المساحة. حيث أن مساحة فدان لإنتاج بذور البصل تعطي في المتوسط حوالي 120 كجم /فدان فتكون تكاليف فصل بذور البصل آليا تعادل 195.6 جنية /فدان حيث كانت تكاليف فصل الكيلوجرام من بذور البصل حوالي 1.63 جنية / كجم

أنسب ظروف لتشغيل الآلة :

من النتائج السابقة تبين أن أفضل ظروف لتشغيل الآلة كانت عن الأوضاع التالية :

الوضع (P1 = 20صابع) على القرص ، والوضع (c = 14 صابع في صفين) على الاسطوانة .

السرعة 5.7 م/ث لقرص الفصل .خلوص 1.5 سم بين قرص الفصل والاسطوانة .نسبة رطوبة 15.2 % للبذور .