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A Simple Device for Barnyard Seeds Purification to Use It As Feeder for Small Birds

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ABSTRACT

A portable apparatus for separating the expended husks from bird seed mixtures after the bird has shelled the seeds and left the husks among the seeds has been designed. It includes a hopper, rectangular case divided in two parts (one for receiving seeds and other collecting un-seed materials) and air supply means. The air stream agitates the mixture and floats the husks and fine dust up wardly for collection in the husk receiver while the air exhausts through holes at the opposite side. The experiments included four cleaning air speeds (2.5, 3.0, 3.5 and 4.0 m/s), four baffle angles (35, 40, 45 and 50°), two fiberglass baffles (with or without rubber covered) and two seed samples (before and after feeding). Cleaning efficiency and seed losses were measured. Results showed that, the maximum value of cleaning efficiency (98.7 %) for seed mixture before feeding was achieved at cleaning air speed of 4.0 m/s, baffle angle of 35° and baffle without rubber. The minimum value of seed losses (0.3 %) for seed mixture after feeding was achieved at cleaning air speed of 2.5 m/s, baffle angle of 50° and baffle with rubber. It is recommended to use the cleaning device at cleaning air speed of 4.0 m/s, baffle angle of 35°, baffle without rubber to increase the cleaning efficiency and use it at cleaning air speed of 2.5 m/s, baffle angle of 50°, baffle with rubber to lessen seed losses.

Keywords: separating impurities; cleaning; barnyard seeds; small birds.

INTRODUCTION

Barnyard grass (*Echinochloa crus-galli*) is the most harmful weeds all over the world as reported by Heap, 2014, because of its superior biology and tremendous ecological adaptations. It causes substantial yield losses in rice crop, but we can use it as an effective feeder for small birds like bet birds (parakeets and canaries), pigeons and poultry. Bet bird husker the upper layer of barnyard seeds located in its feeder ban, but due to its short pick it cannot reach the lower part so, fabrication device for barnyard seeds purification from husks is very important. Domesticated small birds pigeons, parakeets, canaries and the like, are particular eaters. Like children, they will eat what they like and prefer the good seeds like Japanese millet. All competitive features and adaptive characteristics which are necessary for survival and competition under arrange of climatic conditions as showed by Marambe and Amarsinghe, 2002. Clay et al., 2005 Studied the effect of weed on rice crop and reported that this weed enables to emerge as a strong competitor in rice crop. It can produce large number of seeds and also have a level of seed dormancy, which ensures its propagation as well as seed bank build up in the soil profile. Barnyard can reduce yields in most crops Manitoba Agriculture; Weeds, Insects, and Diseases, Pest Management 2001. In rice crops, it can seriously impact rice yields when its density reaches 20 plants/m^2 Manidool 1992. Also showed that when a rice crop is fertilized, it competes successfully, being favored more than the rice. In competition, it can reduce rice tillering by 50% along with height, the number of inflorescences, number of seeds per panicle, and weight of the rice seeds. Alfalfa can experience 80% mortality of seedlings if it germinates and emerges within the first 2 weeks of alfalfa's life cycle Maun and Barrett 1986.

It germinates from early spring to throughout the summer. One plant can produce thousands of seeds Holm et al. 1991. Barkworth et al. 2003 this research was determine to confirm effectiveness of use of Japanese millet, reported that it is grown for fodder, grain or birdseed used as a feeder for pigeon and Pet birds. Also, ducks have been observed to eat the seed of it by Kramer and Euliss 1986. It is tested as a forage Mitich 1990. It is also used for poultry feed Draves 2012 and Small 2012. The plant is sometimes used, especially in Egypt, for the reclamation of saline and alkaline areas.

The separation is made by one of the following machines, which generally separate only one type of contaminating seed from the desired clean product. Specific gravity separators will divide seeds according to their weight and size. Indent disk and cylinder separators will remove long seeds from short ones. Pneumatic and aspirator separators will separate seeds that present a different resistance to airflow. Velvet roll separators remove smooth seeds from rough seeds. Spiral, inclined draper, timothy bumper mill, vibrator, and horizontal disk separators divide seeds according to their shape. Electronic separators sense a difference in the electrical properties of seeds. Magnetic separators and the buck- horn machine separate rough or sticky- surfaced seeds from smooth seeds. Color separators divide the light- colored seed from the dark ones.

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One of the methods of cleaning of various grain mixtures is pneumatic separation Sosulski, 1987. The greater the difference between values of critical velocities of individual components in a mixture, the better and more efficient is the pneumatic separation Emami et al., 2007. The method of segregation of grain mixtures with a stream of air is used not only in specialist pneumatic chaff removal plants but also in more or less complex threshing and grain cleaning machines Grochowicz 1989

Small birds generally pick up and shell the barnyard seeds in what seems like one continuous motion. The expended husk or hull drops back into the seed feeder and after a while the top most portion of the feeder is covered with the spent husks. The bird tends to grope for the good or preferred seeds. However, in a short time of repeatedly coming up with empty shells, it soon gives up. At this point it has eaten all the preferred seeds as it were.

When the cage is cleaned the next morning, the owner invariably takes the seed feeder out of the cage and dumps the whole works into the trash. The seed feeder is refilled with the balanced seed mixture and the whole process is repeated day after day. Not only are the bad nutritional habits of the bird perpetuated but the waste of good seed that has gone into the trash increases day after day. If the owner tries to be thrifty, he will try to separate the husks of Japanese millet. One known method is to hold the seed feeder inside the neck of a paper bag and gently blow on the top surface of the seed feeder. The light husks will fly in all directions. Some get in the eyes of the blower and some will completely miss the bag and spread around where not intended. It is truly a tedious task and an exasperating way of separating the hulls from the good barnyard seeds.

The present study was undertaken to provide a simple, effective, low cost bird seed cleaning device in which the fine particles such as husks of the seeds, fine dirt, empty seeds, and fine dust or very small particulates which either intermix with or adhere to seeds may be rapidly and effectively removed from the seeds so that the latter, when replenished in supply, can be returned to the feeder with a minimum effort.

MATERIALS AND METHODS

Materials

This study was carried out at faculty of agriculture – Mansoura University during summer season 2020 on barnyard seeds (*Echinochloa crus-galli*) to clean it from husks, empty seeds, fine dirt, and fine dust or very small particulates, which either intermix with or adhere to millet seeds.

Specification of seeds

Samples were collected from big rice polisher workshops. It is 3.0 - 4.0 mm long and 2.0 - 2.5 mm diameter, grayish-yellow and has a smooth, shiny surface with 3 pale nerves and numerous longitudinal striations (Figure 1). The seed is an ovoid caryopsis, flat on one side and distinctly humped on the other. It has a large, circular brown hilum and large rounded embryo. The embryo is 66-86% as long as the caryopsis (CFIA 2012). There is approximately 2.93 gram per 1000 seeds.

Figure 1. Image of barnyard seeds

Device mechanism description

Figures 2(A and B) illustrate the device apparatus that was used for barnyard seeds purification process. It consists of a generally enclosed rectangular transparent body or case (350 mm length, 270 mm width and 400 mm height) divided to two parts with a material flow inlet. Figures (3) illustrate two blast-fans or blowers works as an air source creates an air-flow transverse to the path of the particle flow for removing the fine particulates from the main material. It has a top portion includes material flow inlet to which is attached a supply hoper. The feed regulating gate located under the hopper bottom.

Alternately arranged downwardly slopping baffles disposed on opposite sides of the apparatus for receiving and directing the particle flow into rotatable means which simultaneously transform the linear momentum of the particle flow as it cascades down the baffles to angular momentum thereby fanning out the fine particulates into the airstream. Each successive baffle is longitudinally spaced from the previous baffle. Lower edge of each of baffles remotely overlaps top surface of the successive baffle so that the particulate material that is introduced into particle flow channel must follow a circuitous route from material flow inlet to material flow outlet. As soon as particle flow and passes through inlet, it impacts with and gravitationally moves down the uppermost baffle towards lower edge. There is a series of finely air holes in the opposite side of its lower end, to allow the current of air to pass through it. It has a vertically disposed column with a particle flow channel, which an airstream is produced. The switch used for regulating the air-blast is illustrated in figure 4. The two fans were connected to an adapter by suitable wiring. Figures 2(A and B) illustrate a mechanism of the apparatus that was used for purification of barnyard seeds.

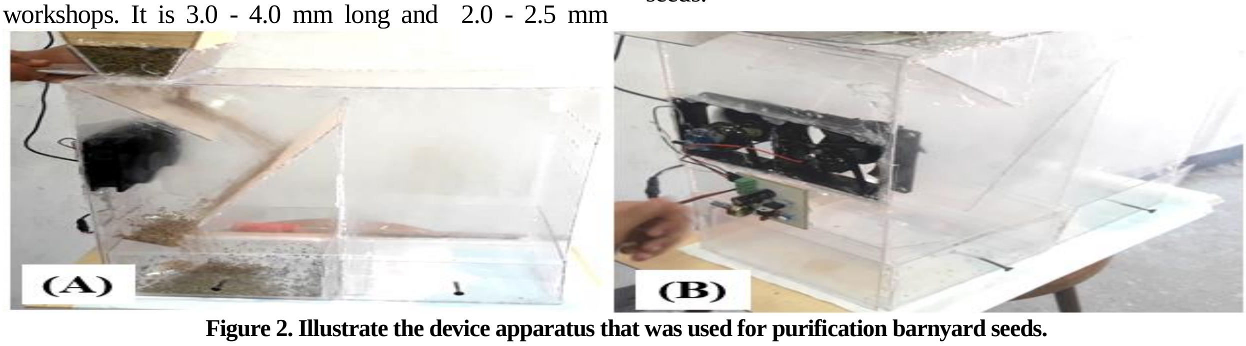


Figure 2. Illustrate the device apparatus that was used for purification barnyard seeds.

Figure 3. Blast-fans works as an air source

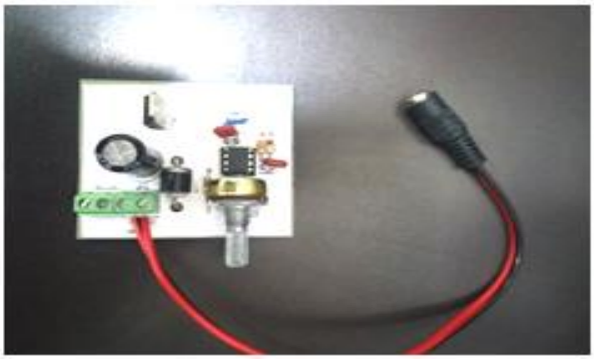
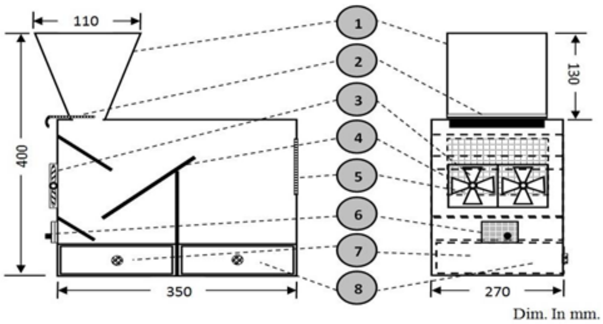


Figure 4. The switch used for regulating the air-blast

Methods

After the mixture including whole seeds, husks, empty seeds, fine dirt, and fine dust was fed into the path of a current of air, which carries off the lighter material and allows the grain to fall upon the first case. The material is subjected to a strong upward draft, which carries a considerable portion of the lighter foreign matters into this air-duct, the construction of which is clearly illustrated in figure 5.



1- Supply hoper.
2- Seed slot gate.
3- Fan.
4- Seed baffle sheet.
5- Finally air holes.
6- Air-blast control switch.
7- Seed receptor bow.
8- Impurities receptor bow.

Figure 5. A schematic diagram of the apparatus that was used for purification barnyard seeds.

The primary experimental procedure

Repose angle (the angle betwe en the inclined side of the feeding cone and its horizontal base due to the free fall of mixture through it) was determined for two mixtures of barnyard seeds (before and after feeding) on a sheet of fiberglass with and without rubber to select the baffles inclination angle range between 35 and 50°.

Study of performance parameters

The performance parameters of the designed device are described as follows:

1) Four cleaning air speeds (S) of 2.5, 3.0, 3.5 and 4.0 m/s named S_1, S_2, S_3 and S_4 respectively, which changed using switch located in the control panel (figure 4).
2) Four baffle angles (A) of 35, 40, 45 and 50° named A_1, A_2, A_3 and A_4 respectively, were studied.
3) Fiberglass baffles materials (T) with or without rubber covered named T_1 and T_2 respectively,.
4) Seed mixtures (N) before and after bird feeding named N_1 and N_2 respectively,.

Measurements

Cleaning efficiency, %

Cleaning efficiency ($\eta_{un.}$, %) is calculated using the following relationship:

$$\eta_{un.} = \frac{H_{\text{sample}} - H_{separated}}{H_{\text{sample}}} \times 100 \quad \rightarrow (1)$$

Where:

H_{Sample} = Weight of husks in the sample, gram.
$H_{Separated}$ = Weight of Separated husks, gram.

Seed losses, %

Seed losses (L, %) is calculated using the following relationship:

$$L = \frac{W_{\text{sample}} - W_{separated}}{W_{\text{sample}}} \times 100 \quad \rightarrow (2)$$

Where:

H_{Sample} = Weight of seeds in the sample, gram.
$H_{Separated}$ = Weight of Separated seeds, gram.

Statistical analysis

The data are presented in figures and are analyzed statistically by using a computer program (**SAS., 2012**). All graphs were drawn using the Microsoft excel 2016.

RESULTS AND DISCUSSION

The primary results

The primary results indicated that the mean repose angle (angle of internal friction) was 37 and 33° for samples before feeding with and without rubber, respectively. The repose angle was 49.5 and 45.5° for samples after feeding with and without rubber, respectively.

Table 1 showed the component of every mixture before and after feeding. The results indicated that the percentage of seed decreased to about 35 % due to birds consumption and consequently the percentage of husks increase to about 96 %, while there wasn't any change in the amount of fine clay.

Table 1. The component of every mixture before and after feeding.

Case of every 1000 gram of seed mixture sample	Mixture component		
	Husk, gram	Seed, gram	Fine clay, gram
Before feeding	10	840	150
After feeding	300	550	150

Factors affecting cleaning efficiency, %

Figure (6) shows the effect of cleaning air speeds, baffle angles, type of baffles surface and seeds mixture on cleaning efficiency, %. The mean cleaning efficiency increases from 83.225± 0.615 % at cleaning air speed of 2.5 m/s to 94.931± 0.614 % at cleaning air speed of 4 m/s. The highest mean percentage of cleaning efficiency was 90.175± 1.357 % at 35º of baffle angle. The mean cleaning efficiency increases from 86.721± 0.886 % with rubber cover to 90.490± 0.805% without rubber cover. There is an increment in cleaning efficiency from 88.343± 1.023 % for mixture after feeding to 88.868± 0.781 % for mixture before feeding. It was noticed that cleaning efficiency,% increased with cleaning air speeds, baffle angles, type of baffles surface and seed mixtures, according to the descending order (S1 < S2 < S3 < S4); (A4 < A3 < A2 < A1); (T1 < T2) and (N2 < N1), respectively.

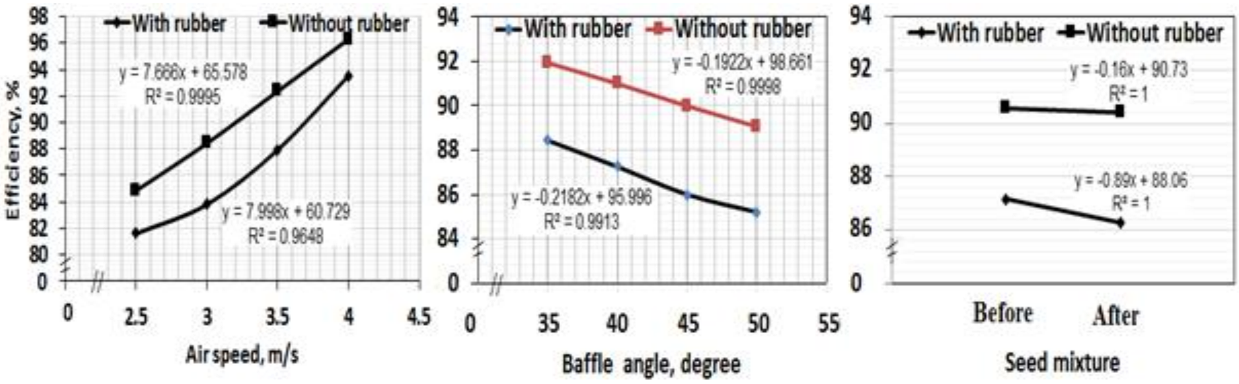


Figure 6. Effect of cleaning air speeds, baffle angles, and seed mixtures on cleaning efficiency,% at the two types of baffle surface.

Results in Table (2) clearly demonstrated that, cleaning air speeds, baffle angles and types of baffles surface have highly significant effect on cleaning efficiency. Concerning case of seed mixtures, it had not significant effect on cleaning efficiency, due to the high effect of the two blast-fans, which carries off any lighter material represent in the two samples of seed mixture.

Factors affecting seed losses, %

Figure (7) shows the effect of cleaning air speeds, baffle angles, type of baffles surface and seed mixtures on seed losses, %. The mean seed losses decreases from 2.412± 0.161 % at cleaning air speed of 4 m/s to 0.931± 0.114 % at cleaning air speed of 2.5 m/s. The lowest mean percentage of seed losses was 1.906± 0.206 % with 35º of baffle angle. The mean seed losses decreases from 2.221±0.124 % without rubber cover to 1.206± 0.104 % with rubber cover. There is decrement in seed losses from 1.962± 0.144 for mixture before feeding to1.465±0.134 % for mixture after feeding. It was noticed that seed losses,% decreased with cleaning air speeds, baffle angles, type of baffles surface and seed mixtures, according to the descending order (S4 < S3 < S2 < S1); (A4 < A3 < A2 < A1); (T2 < T1) and (T1 < N2), respectively.

Table 2. Means along with their standard error for cleaning efficiency affected by studied factors.

Factors		Efficiency,%
Air speed	S_1	83.225± 0.615[d]
	S_2	86.112± 0.690[c]
	S_3	90.156± 0.685[b]
	S_4	94.931± 0.614[a]
	P-value	0.0001
Baffle angles	A_1	90.175± 1.357[a]
	A_2	89.118± 1.301[b]
	A_3	87.993± 1.240[c]
	A_4	87.137± 1.203[c]
	P-value	0.0001
Type of baffles surface	T_1	86.721± 0.886[b]
	T_2	90.490± 0.805[a]
	P-value	0.0001
Seed mixture sample	N_1	88.868± 0.781
	N_2	88.343± 1.023
	P-value	0.1118

[a-b] means with no common superscript within each column are differed significantly (p<0.05).

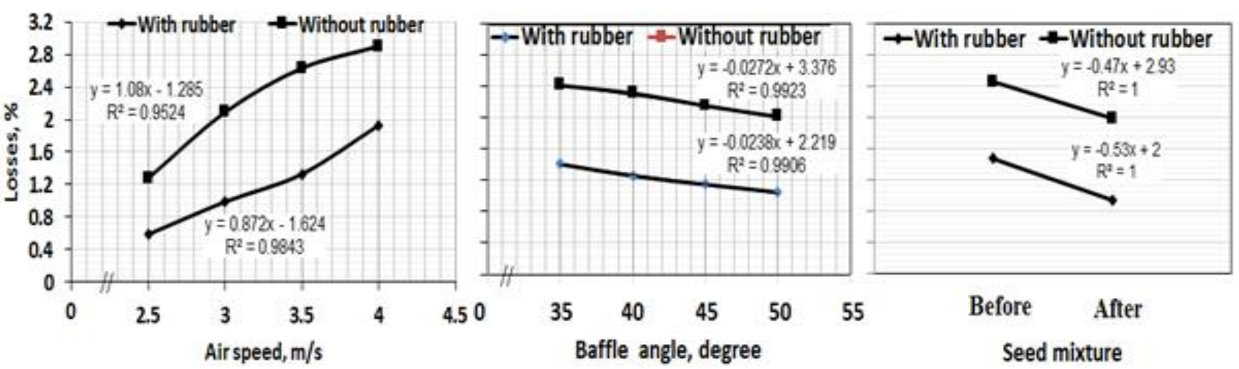


Figure 7. Effect of cleaning air speeds, baffle angles and seed mixtures on seed losses,% at the two types of baffle surface.

Results in Table (3) clearly demonstrated that, cleaning air speeds, baffle angles, types of baffle surface and case of seeds mixture have highly significant effect on seed losses.

Table 3. Means along with their standard error for seed losses,% affected by studied factors.

Factors		Seed losses,%
Air speed	S_1	0.931 ± 0.114^{d}
	S_2	1.537 ± 0.156^{c}
	S_3	1.975 ± 0.183^{b}
	S_4	2.412 ± 0.161^{a}
	P-value	0.0001
Baffle angle	A_1	1.906 ± 0.206^{a}
	A_2	1.781 ± 0.208^{b}
	A_3	1.643 ± 0.208^{c}
	A_4	1.525 ± 0.205^{c}
	P-value	0.0001
Type of baffle surface	T_1	1.206 ± 0.104^{b}
	T_2	2.221 ± 0.124^{a}
	P-value	0.0001
Seed mixture sample	N_1	1.962 ± 0.144^{a}
	N_2	1.465 ± 0.134^{b}
	P-value	0.0001

[a-b] means with no common superscript within each column are differed significantly (p<0.05).

CONCLUSION

The results could be summarized at the following main points:

- The maximum value of cleaning efficiency (98.7 %) was achieved at cleaning air speed of 4.0 m/s, baffle angle of 35°, baffle without rubber and with seed mixture before feeding.
- The minimum value of seed losses (0.3 %) was achieved at cleaning air speed of 2.5 m/s, baffle angle of 50°, baffle with rubber and with seed mixture after feeding.
- It is recommended to use the cleaning device at cleaning air speed of 4.0 m/s, baffle angle of 35°, baffle without rubber to increase the cleaning efficiency and use it at cleaning air speed of 2.5 m/s, baffle angle of 50°, baffle with rubber to lessen seed losses

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جهاز بسيط لتنقية حبوب الدنيبة لإستخدامها كغذاء للطيور الصغيرة

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تسبب حشيشة الدنيبة فاقد كبير في محصول الارز لما تتمتع به من خصائص بيئية وبيولوجية قوية تساعدها على التأقلم فتنمو بمعدل كبير و كميات كثيرة فى حقول الأرز. لذا كان من الضرورى البحث في الإستخدام النافع لحبوب الدنيبة كغذاء للطيور الصغيرة مثل طيور الزينة والحمام والدواجن. تحتوى حبوب الدنيبة على الأتربة و الشوائب قبل تقديمها كغذاء للطيور و بعد تقديمها للطيور تحتوى على قشور حيث تقشر طيور الزينة الطبقة السطحية (القشرة السطحية لحبوب الدنيبة) و تتغذى على المحتوى الداخلى للحبوب. فأجريت هذه الدراسة بغرض تصنيع جهاز بسيط لتنظيف حبوب الدنيبة من هذه القشور و الشوائب لإعادة استخدامها في تغذية الطيور الصغيرة. يتكون جهاز التنظيف من قادوس تغذية وجسم مستطيل الشكل مقسم الي جزئيين أحدهما لاستقبال الحبوب النظيفة والاخر لتجميع الاتربة والقشور وكذلك يتكون الجهاز من مصدر لدفع الهواء والذي يعمل على اثارة الخليط ودفع القشور والاتربة (الأخف وزنا) الي وعاء التجميع فى حين تسقط الحبوب (الأثقل وزنا) فى وعاء سفلى أثناء دفع الهواء بينما يستمر تيار الهواء في الخروج من خلال ثقوب صغيرة في الجهة المقابلة من الجهاز. تشمل الدراسة على أربع سرعات لهواء التنظيف وهي 2,5، 3، 3,5، 4 م/ث وأربع زوايا للعارض الذى تسقط عليها حبوب الدنيبة وهي 35، 40، 45، 50° وكذلك نوعين من العوارض أحدهم مغطي بالمطاط والاخر غير مغطي وكذلك نوعين من عينة حبوب الدنيبة أحدهم لم يسبق تقديمه للطيور والاخر مجمع من امام الطيور بعد التغذية عليه لفترة زمنية. وتم قياس كلا من كفاءة التنظيف ونسبة الفقد في الحبوب واتضح ان اعلي نسبة لكفاءة التنظيف هي 98,7% عند سرعة هواء مقدارها 4 م/ث وزاوية توجيه للعارض قيمتها 35° ومع عارض غير مغطى بالمطاط وعند استخدام عينه الحبوب لم تقدم للطيور. كذلك كانت اقل قيمه لفقد الحبوب 0,3% عند سرعة هواء مقدارها 2,5 م/ث وزاوية توجيه للعارض قيمتها 50° ومع العارض المغطى بالمطاط وعند استخدام عينه الحبوب بعد تقديمها للطيور. لذا توصي الدراسة باستخدام جهاز التنظيف لتنقية حبوب الدنيبة لتعظيم الاستفادة منها فى تغذية الطيور و تقليل الفاقد كالآتى: عند سرعة هواء مقدارها 4 م/ث وزاوية توجيه للعوارض قيمتها 35° ومع عارض غير مغطى بالمطاط وعند استخدام عينه من الحبوب لم تقدم للطيور للحصول علي اعلي كفاءة تنظيف عند سرعة هواء مقدارها 2,5 م/ث وزاوية توجيه للعارض قيمتها 50° ومع عارض مغطى بالمطاط وعند استخدام عينة الحبوب بعد تقديمها للطيور للحصول علي اقل فقد في الحبوب.