

PERFORMANCE CLEANING UNIT FOR CLOVER SEEDS AFFECTING SOME PHYSICAL AND MECHANICAL PROPERTIES

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ABSTRACT

The primary objective of this investigation was to provide database about the physical properties (length , width , mass of 1000 –seeds, volume , percent of sphericity, geometric diameter, arithmetic diameter, transverse surface area, flat surface area, true density and bulk density) and mechanical properties (friction angle, angle of repose, hardness, and terminal velocity) of clover seeds. Also, to study some parameters affecting cleaning unit such as diameter of holes, air speed, sieve tilt angle, sieve oscillation with feed rate of 500 kg/h, and moisture content of 10.5 %. Three different varieties of clover seeds: AL-Mesqawi, AL-Khadrawi and Al-Seadi which are considered as the most important clover seeds in Egypt. The results indicated that :Length, and width, for AL-Mesqawi, AL-Khadrawi and Al-Seadi were 2.40, and 2.10; 2.45 and 2.12 ; 3.00 and 2.10 mm respectively. percent of sphericity and Volume for AL-Mesqawi, AL-Khadrawi and Al-Seadi were 87 , 86 and 70 % ; 4.55 , 4.65 , and 5.36mm³ respectively.

Friction angle with three sheets from stainless steel, metal and wood was 24 , 31 and 36 degree; 24, 31, and 37 degree; 25, 32 and 38 degree for AL-Mesqawi, AL-Khadrawi and Al-Seadi respectively. Terminal velocities for AL-Mesqawi, AL-Khadrawi and Al-Seadi were , 15 , 15 and 16 m/s respectively.

From the study , the principals parametere of sieve unit, the diameters of round sieve hole were , 3.0, 3.0 and 3.5 mm for AL-Mesqawi, AL-Khadrawi and Al-Seadi respectively. The main results of this study can be summarized as follows:

- The cell area depends on the physical properties of seeds clover and its shape depends on the percent of sphericity of seeds. The separation can be achieved on the basis of length using a screen aperture of 4 mm diameter, and percentage of sphericity of approximately 85 % on length for circular hole.
- Terminal velocity to suspend clover seeds (variety AL-Mesqawi, AL-Khadrawi and Al-Seadi) was 16 m / s.
- The results showed that cell shape, sieve tilt angle, sieve oscillation and air speed were the main factors that affect purity and total losses in cleaning.
- The results showed that cell shape, sieve tilt angle, sieve oscillation and air speed were the main factors that affect purity and total losses in cleaning. The purity increased by increasing air speed, sieve tilt angle and sieve oscillation. Total losses increased by increased air speed, sieve tilt angle and oscillation.
- The optimum performance was at air speed of 6 m/s , moisture content of 10.5 % , sieve oscillation of 250 rpm, sieve tilt angle of 3⁵ , round shaped sieve 4 mm diameter, and feed rate of 500 kg/h. purity at these conditions was 99 % and total losses 1 %.

INTRODUCTION

Clover seed considered among the most important plants in Egypt. To increase seed production with good quality, scientists are studying

physical and mechanical properties seed from an engineering standpoint. These properties can be exploited as a guide in designing methods for such seed production as planting, and testing particular cleaning machines.

Mohsenin (1986) reported that the physical properties of any material such as shape, volume, and surface area are important in many problems associated with design or development of specific machine or analyzing the behavior of the product in handling or grading of the material. Islam *et al.*(1980) mentioned that a seed cleaner to clean various seeds and grain employs various methods of separation, according to width, length, thickness and weight of grain. El-Raie (198^v) studied the shape and size of three varieties of corn at the storage moisture content in terms of length, width, thickness, volume, geometric diameter, arithmetic diameter, percent of spherically, area of flat surface and area of the transverse surface of the individual seeds. Arora (1991) concluded that the engineering properties such as size, diameter, volume, bulk density, particle density, porosity, terminal velocity, drag coefficient and resistance coefficient. Physical properties were found to be related to M_c , physical properties were linearly dependent upon M_c . The aerodynamic properties (terminal velocity, drag-coeff. and resistance coeff.) also increased with an increase in M_c . Soliman (1994) studied the effect of moisture content on angle of repose of paddy rice. He concluded that the dynamic angle of repose, is one of the physical properties needed for the design of material handling systems and storage facilities for rice and rice products. Nimkar and Hattopaddhyay (2001) examined some physical properties of green grain as a function of moisture content in the range of 8.39 to 33.40 % (db). The average length, width, thickness and thousand grain mass were 4.21 mm, 3.17 mm, 3.08 mm and 28.19 g at moisture content of 8.39 %(db). The geometric mean diameter increased from 3.45 to 3.77 mm, whereas sphericity decreased from 0.84 to 0.81. Studies on rewetted grains showed that the bulk and true densities decreased from 807 to 708 kg/ m³ and 1363 to 1292 kg/m³, respectively, whereas the corresponding bulk porosity increased from 10.1 to 12.1 m/s¹. The static coefficient of friction varied from 0.344 to 0.625 over different material surfaces, while angle of repose varied from 26.6 to 31°. Within the studied moisture range. Gomea (1992) studied some physical properties of wheat grains during cleaning and separating operation. Harmond *et al.* (1965) reported that, terminal velocity represents the maximum velocity of a seed will attain in free fall through still air. If conditions are reversed so that the seed remains suspended in a rising air stream. The air must be moving at a speed equal to the terminal velocity of the seed. They mentioned that air separations could be employed in seed cleaning to separate inter the material, weed and other contaminants from crop seeds provided these components possess different terminal velocities.

The objective of this work was to study some physical and mechanical properties of some varieties of clover cultivated in Egypt. These properties may be utilized effectively in the design and development of precision planting, handling, cleaning, machines.

The aim of this study is represented as the following points.

- Study the physical and mechanical properties of three Egyptian varieties of clover seeds (AL-Mesqawi, AL-Khadrawi and Al- Seadi,),this properties provides data base, consequently it can be used as a guide in seed production.
- To obtain the engineering parameters of the suitable separation device from physical and mechanical properties of the threshed materials.
- Determine the terminal velocity values to suspended clover seeds and their impurities.

MATERIALS AND METHODS

This work was carried out in 2009 season, in order to determine some physical and mechanical properties of seeds of three clover varieties commonly cultivated in Egypt. These varieties are: AL-Mesqawi, AL-Khadrawi and Al-Seadi, and also to study some parameters affecting cleaning unit such as diameter of holes, air speed, sieve tilt angle, and sieve oscillation. The physical and mechanical properties studied may help in choose altering or design of a suitable machine for cultivating, handling, cleaning of clover seeds.

Machine specifications and description:

In investigation, the cleaner of seed used for clover winnowing, was constructed and tested. The machine followed the design of Khan *et al.*, 197^o. The portable seed cleaner was developed to fill the need for a faster and more efficient method of seed cleaning. The machine is easy to operate and convenient to service and maintain. The cleaning machine consists of a frame, a seed hopper, an oscillating dual-screen assembly, a centrifugal blower and an electric motor as shown in fig. 1 . General specifications of machine are : overall length 1428 mm, overall width 570 mm, overall height 1210mm, power of 0.3 hp, labor requirement 1 man, easy operation; minimum adjustments, reduced repairs and maintenance problems. Multi crop capability, includes two screens with interchangeable top screen. Simple design, includes integral shaft for horizontal oscillating screen drive and fan. Construction includes 1 mm sheet metal and 30 x 30 x 3 mm. angle iron.

Frame: Made of angle steel sections 30 x 30 x 3 mm.

Hopper: Made of steel sheet metal of 1 mm thickness and angle iron steel section 30 x 30 x 3 mm.

Sieves: Made of steel sheet metal of 1.5 mm thickness. They consist of upper and lower sieves and hang on four links (2 fixed rods in the front and 2 adjustable in the rear to alter the sieve tilt angle) . The upper sieve has two sheets; one solid under the hopper gate and the other perforated 3 mm hole diameter for separating chaff and straw from seed. The lower sieve is mounted 150 mm below and parallel to the upper screen. The lower screen has 1 mm diameter holes to remove fine impurities and dust. The proper mesh-size of the sieves was determined from physical properties of seed.

Blower; The blower is made of metal sheet of 1 mm thickness . The blower fan assembly consists of six bladed radial fan, driver from electric motor with

V-shape pelt bully. The fan discharges air blast through the sieve perforations.

Measuring instrumentation:

Digital dial caliper; with accuracy of 0.05 mm was used dimensions (length, width and thickness) of clover seeds were determined considering the three axes x, y and z.

Electrical balance: An electronic balance was used for weighing samples before and after cleaning. Its scale ranged from 0 to 5 kg max., with accuracy of 0.2 g.

Electrical oven: with forced hot air circulation of maximum temperature of 300 c⁰.

Rigidity force: A digital force gauge with accuracy of 0.2 % was used for measuring the rigidity force. It has a maximum reading of 2200 g, so, construction was used for amplifying force reading.

Anemometer instrument, An anemometer instrument (SATAKE CO., Japan) was used for measuring the air speed, temperature, and pressure. It is ranged from 0 to 50 m/s. The measurement theory depends on the declination of the sensor inside the instrument. The movement of air pushes

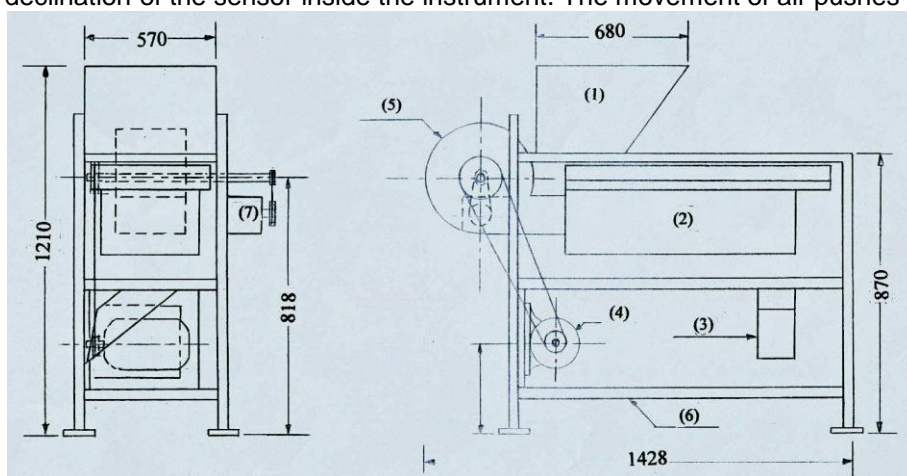


Fig. (1): Sketch view of the cleaner machine. Dim. in mm.

1- Hopper 2 – Screen 3 – Spout 4 – motor
5 – Fan 6 – Main frame 7 – Eccentric

the sensor then voltage indicates the variation of the air speed (source of power is battery).

Digital instrument for measuring coefficient of friction.

It was used to measure the friction angle on stainless steel, metal, and wood sheet surface with dimensions 14 x 30 cm.

Experimental procedure:

Moisture contents:

The moisture contents was determined for clover seeds using the oven methods according to ASAE standard ISBN 0-929355-50.4 Library of congress. (1994).

Seed dimensions:

The sample of seeds about 300 seeds was taken randomly to carrying out the required measurements.

The main dimensions length "L", and width "W" were measured using a digital vernier calper and the mean value was calculated for each sample. The following equations (used by El-Raie *et al* (1996) for some agriculture products) were used to calculated of geometric diameter (D_g)

arithmetic diameter (D_a), volume (V), area of flat surface (A_f), area of transverse surface (A_t) of an individual grain in millimeters, mass of 1000-kernels g, percent of sphericity %, and bulk density kg/m³.

$$V = (\pi/6) (L * W * T) \text{ mm}^3 \text{-----} (1)$$

$$S = 100 * (L * w * T^*)^{1/3} / L \% \text{-----} (2)$$

$$D_g = (L * w * T^*)^{1/3} \text{ mm} \text{-----} (3)$$

$$D_a = (L * w * T^*)^{1/3} \text{ mm} \text{-----} (4)$$

$$A_t = (\pi/4) (T * W^*) \text{ mm}^2 \text{-----} (5)$$

$$A_f = (\pi/4) (L * W^*) \text{ mm}^2 \text{-----} (6)$$

Where:

L = length, mm w = width, mm T = thickness, mm

V = volume, mm³ S = percentage of sphericity, %

D_g= geometric diameter, mm D_a= arithmetic diameter, mm

A_t= transverse surface area, mm² A_f= flat surface area, mm²

Volume:

The volume of individual seed" V_a"was measured as the increase volume in 5 ml sodium nitrate.

Friction and Repose angle of seeds:

Friction 'θ' and Repose " ω "angles were determined. The friction angle was determined between the seeds and a steel surface according to Mohsenin (1986). The repose angle was measured according to the following formula,

$$\omega = \tan^{-2} h/0.5x \text{-----} (7)$$

Where:

h= height of the cone formed by the seeds,

x = diameter of the base of the cone.

Real and Bulk densities:

Individual seeds were taken at randomly to determine the real density and quantities of seeds were taken, randomly to determine the bulk density. Real " P_g " and Bulk " P_b " densities of seeds were calculated according to the formula:

$$P_g = M/V \text{-----} (8)$$

Where:

P_g = real density of an individual seed, g/cm³;

M = mass of an individual seed, g;

V = volume individual seed, cm³.

$$P_b = Mb/Vb \text{-----} (9)$$

Where:

P_b = bulk density of seeds, g/cm³;

Mb = mass of the quantity, g;

Vb = volume of the quantity.

Terminal velocity:

The terminal velocity of seeds were measured using the terminal velocity apparatus, according to Awady and El-Sayed (1994). The air flowed upwards in the tube from the bottom to top and the air velocity at which the major fraction of sample remained suspended was recorded by using an anemometer . Ten replicates were undertaken for each sample.

Test procedures for the experimental aeromechanical winnowing unit.

The experiments were carried out to study the effect of the following factors on the cleaning efficiency and losses.

Factor relating to the suspending velocity:

The terminal velocity was measured to determine the suspending velocities for clover seeds and their impurities.

Factor relating to the constructed cleaning machine:

The following factors were tested to show their effect on separation effectiveness:

- 1- Sieve tilt-angle : Three different sieve tilt-angles were under test: zero, 3, 6 degree.
- 2 –Air speed: Three different air speeds were under test: 4, 6 and 8 m/s.at fan speed 650, 700 and 750 r.p.m.
- 3- Sieve oscillation: Three different sieve oscillations were under test : 150, 250, 350 and 500 r.p.m.
- 4 – Shape of screen holes: Round shape of screen holes was used (4mm diameter).
- 5 – Moisture content: 10.5 % moisture content was used.
- 6 – Feed rate: 500 kg/h feed rate was used.

-Purity:

Purity; seeds ratio after removing the impurities (mass basis).

Purity % = (mass of clean sample /sample of mass before cleaning)x100(10) -Total losses;

Total losses = (Seed lost behind the machine / Seed output) x 100----- (11)

RESULTS AND DISCUSSION

1-The main dimensions:

Table (1) shows the mean dimensions of clover seeds length “ L”, width “ W” and thickness of the tested seeds of the three clover varieties, and the coefficient of variation for the measurements. represent frequency distribution for L, W, and T. The distribution of the measured quantities for each variety shows a trend to the normal distribution. The frequency of each variety lies within a narrow range, which is favorable for screen pores. The data listed in table (1) are useful in the determination of the dimensions of the holes of the screens and the dimension of the working elements of the cleaning machines suitable for use in Egypt. A cleaning sieve of a hole diameter of 4 mm is suitable to be used to clean the seeds from dust and foreign materials, the set of sieves ranged from 4-6 mm could be suitable to graduate the seeds to different sizes.

Also, volume, geometric diameter , arithmetic diameter, percentage of sphericity, bulk density, true density, transverse surface area, flat surface area, mass of 1000 seeds and moisture content % for clover seeds are shown in table (1).

Clover angle of friction:

Friction angle for the investigation clover on the metal surface was measured is values are in table2. It was 31, 31 and 32° (variety clover).

Clover angle of repose:

Repose angle of seeds clover was determined is values are in table 2. It was 34, 34 and 35 degree(variety clover).

Terminal velocity of seeds clover and impurities:

Terminal velocity of both seeds clover and their impurities were determined by using the floating apparatus and listed in table 2. The maximum terminal velocity for impurities is 5.5 m/s. and the maximum terminal velocity for seeds clover (variety AL-Meqawei - AL-Khadrawi- AL-Seadi) was 15 m/s , 15 m/s and 16 m/s . So that the recommendation of these case is using air velocity of 6 m/s for separating seeds clover

Table (1) : some properties of clover seeds

variety	AL-Khadrawi		AL-Khadrawi		AL-Seadi	
	mean	C.V %	mean	C.V %	mean	C.V %
Seed parameter						
Length (L),mm	2.40	6.5	2.45	6.7	3.30	7.5
Width (W),mm	2.10	5.3	2.12	4.3	2.10	5.6
Moisture content(Mc) %	9.50		10.0		10.1	
Mass of 1000 seeds (M),g	10.20	7.8	11.20	7.3	11.25	8.8
Volume (V), mm ³	4.55	10.	4.65	10.	5.36	10.
Percent of sphericity (S),%	85	12	86	11	63	15
Geometric diameter(D _g), mm	2.19	4.2	2.23	4.5	2.44	4.4
Arithmetic diameter(D _a), mm	2.2	7.3	2.23	5.3	2.5	3.3
Transverse surface area (A _t),mm ²	3.90	8.3	3.52	8.3	3.46	9.3
Flat surface area(A _f),mm ²	3.95	12	4.07	11	5.44	12
Balk density (Bd), Kg/m ³	0.4		0.45		0.49	

2 – Mechanical properties of clover (variety AL-Meqawei - AL-Khadrawi-AL-Seadi)

Friction angle, coefficient of friction, angle of repose, and terminal velocity are shown in table (2).

Table (2): Mechanical properties of clover

Mechanical properties	Variety clover		
	AL-Meqawei	AL-Khadrawi	AL-Seadi
Friction angle for metal surface, degree (θ)	31	31	32
Angle of repose, degree(ω)	34	34	35
Terminal velocity of seeds clover(V _{t1}), m/s	15	15	16
Terminal velocity of impurities, m/s(V _{t2})	5.5	5.5	5.5

3 – The results of cleaning machine:

Selecting technical parameters of portable seeds clover cleaner:

By studying the physical and mechanical properties of clover, it is easy to determine the type and the dimensions of the screen holes and the working elements of seed cleaning and separating machine. The frequency curve for length, width, and thickness for clover crop used in investigation and the results in table 1. It is clear that the separation can be achieved on the basis of length, using a screen aperture of 4 mm. diameter, where about 99 % of seeds clover is recovered associated with 0.01 % of total losses.

On the basis of terminal velocity characteristic, using an air velocity of 6.00 m/s. impurities are rejected without any seeds clover losses.

Effect of air speed on purity and total losses.

By increasing air speed, the purity increased at different sieve tilt-angles, and sieve oscillations (screen speed) at moisture content of 10.5 %, shape of screen holes round and feed rate of 500 Kg/h as shown in fig.3. For instance, at sieve tilt-angle of 3 degree, and sieve oscillation 350 r.p.m, purity increased from 97 to 99 % at air speed increasing from 4 to 6m/s. (fan speed from 650 to 750 r.p.m). Increased purity is due to increase in air quantity capable to suck more seeds clover and impurities.

The total losses decreased by increasing air speed at different sieve tilt-angles, and sieve oscillations at moisture content of 10.5 %, shape of screen holes round and feed rate of 500 kg/h as shown in fig.4. For instance, at sieve tilt-angle of 3 degree, and sieve oscillation 350 r.p.m, total losses decreased from 0.31 to 0.01 % at air speed increasing from 4 to 6 m/s. (fan speed from 650 to 750 r.p.m). Decreased losses are due to increase of air quantity pushing more seeds.

Above mentioned results suggested that the highest purity and least losses were at air speed 6 m/s. (fan speed 700 rpm).

Effect of sieve tilt-angle on purity and total losses.

The purity was found to increase as sieve tilt-angle increased at different air speeds, and sieve oscillations at moisture content of 10.5 %, shape of screen holes round and feed rate of 500 kg/h., as shown in fig. 2. For instance, at air speed of 6 m/s, and sieve oscillation 350 r.p.m., purity increased from 95 to 99 % at sieve tilt-angle increased from zero to 3 degree. Increase of purity is due to increased movement of threshed material fast on the sieve giving less chance for straw and impurities to pass through the grain spout by increasing sieve tilt angle.

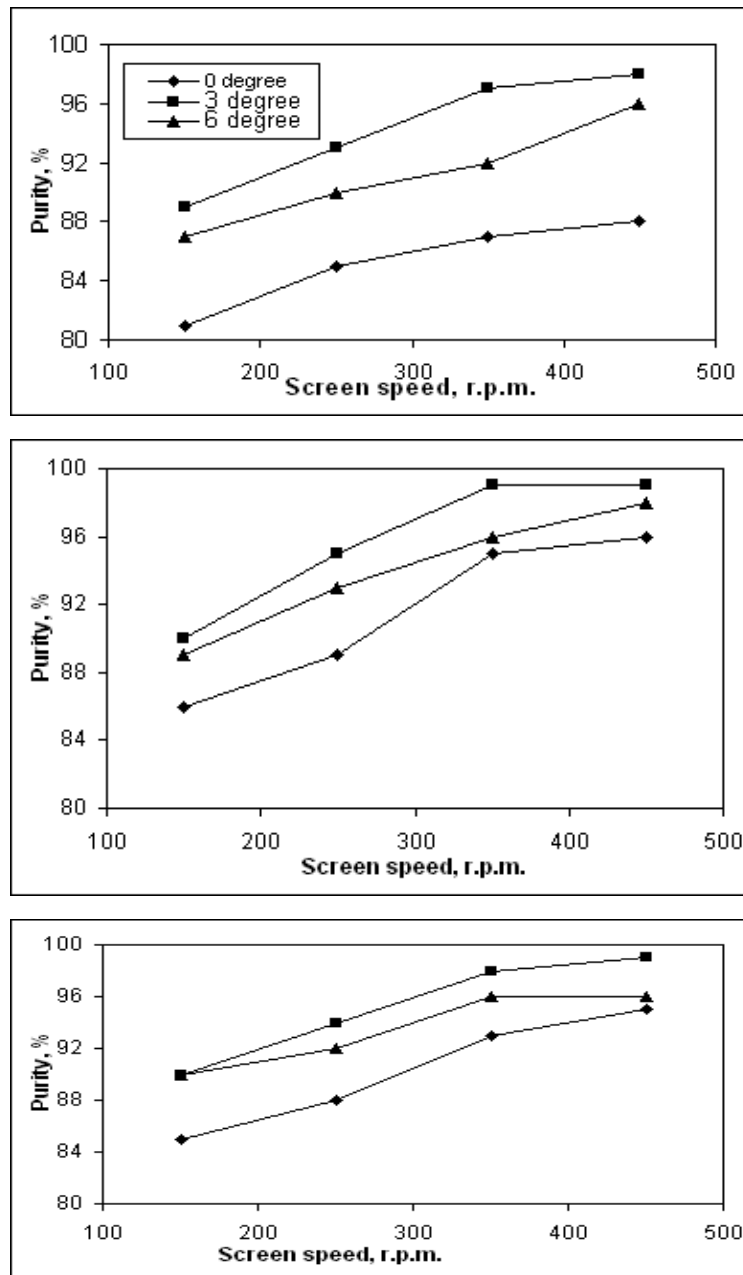


Fig. (2): Effect of screen speed on purity at different sieve tilt angles, and air speeds and round screen hole 4 mm.

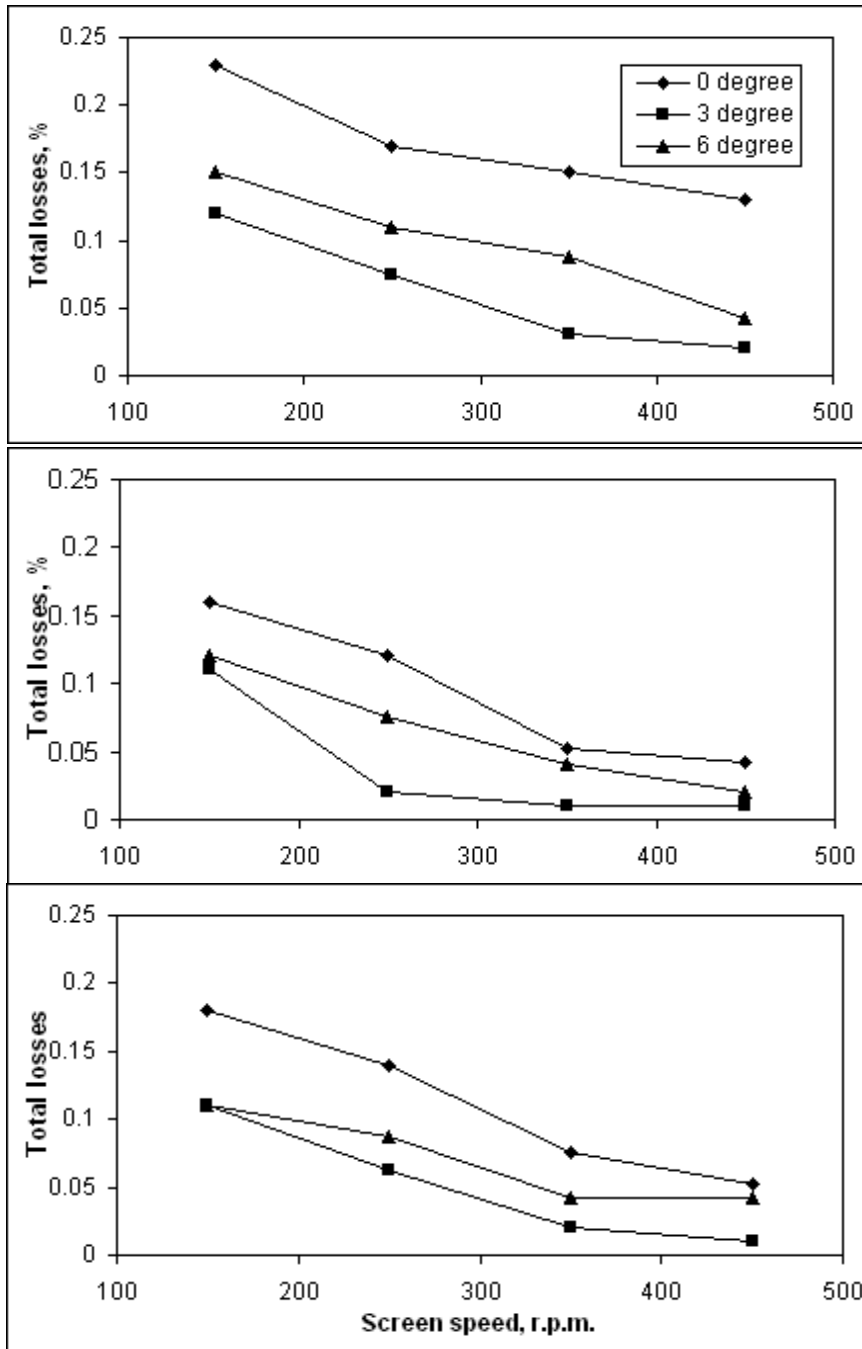


Fig. (3): Effect of screen speed on total losses at different sieve tilt angles, and air speeds and round screen hole 4 mm.

By increasing sieve tilt angle, the total losses decreased at different air speeds, and sieve oscillations at moisture content of 10.5 %, shape of screen holes round and feed rate of 500 kg/h. as shown in fig. 3 for instance, at air speed of 6 m/s and sieve oscillation 350 r.p.m., total losses decreased from 0.15 to 0.01 % at sieve tilt angle increased from zero to 3 degree. Loss refers to increasing jerking movement of threshed material at high sieve tilt angle causing losses behind sieve.

Above mentioned results suggested that highest purity and least losses were at sieve tilt angle 3 degree.

Effect of sieve oscillation on purity and total losses.

When sieve oscillation increased, the purity increased at different air speeds, and sieve tilt angle, at moisture content of 10.5 % shape of screen holes round and feed rate of 500 kg/h. as shown in fig 3 . For instance, at air speed of 6 m/s and sieve tilt angle 3 degree, purity increased from 90 to 99 % at sieve oscillation increased from 150 to 350 r.p.m.

By increasing sieve oscillation, the total losses decreased, at different air speeds, and sieve tilt angles, at moisture content of 10.5 %, shape of screen holes round and feed rate of of 500 kg/h. as shown in fig.4. for instance at air speed of 6 m/s and sieve tilt angle 3 degree, total losses decreased from 0.11 to 0.01 as sieve oscillation increased from 150 to 350 r.p.m.

The above mentioned results suggested that the highest purity and least losses were at sieve oscillation 350 r.p.m.

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أداء وحدة تنظيف لبذور البرسيم وتأثير بعض الخواص الطبيعية والميكانيكية

رأفت على أحمد وربى

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تعتبر محاصيل العلف من المحاصيل الاقتصادية الهامة والتي تنافس الكثير من المحاصيل الحقلية والتي تمثل دخلا يوميا للمزارع المصري ، ونبات البرسيم من أهم محاصيل العلف في مصر لما له من قيمة غذائية عالية وكذلك لإنتاجيته العالية وتبلغ مساحة البرسيم ربع المساحة المزروعة سنويا في فصل الشتاء من المساحة الكلية في مصر(كتاب الإحصاء الزراعية – وزارة الزراعة ٢٠٠٥). ولذلك تهدف هذه الدراسة إلى توفير بعض المعلومات عن الخواص الطبيعية والميكانيكية ودراسة العلاقة بين الخواص الطبيعية والميكانيكية لبذور البرسيم والعوامل الهندسية المؤثرة على أداء وحدة التنظيف لما لها من أهمية كبيرة في ميكنة زراعة وحصاد وتداول هذا المحصول وزيادة إنتاجه.

وتمت الدراسة على ثلاثة أصناف من بذور نبات البرسيم الأكثر انتشارا (المسقوى، الخضراوى ، الصعيدى).

وكانت عوامل الدراسة كالتالي:

- ١ - دراسة الخواص الطبيعية للبذرة وشملت (الطول ، العرض ، السمك ، وزن الإلف حبة ، الحجم ، نسبة التكور ، القطر الهندسي ، القطر الرياضي ، مساحة السطح ، الكثافة الظاهرية والكثافة الحقيقية، وذلك عند محتوى رطوبة ١٠.٥ % للبذرة).
 - ٢ - دراسة الخواص الميكانيكية وشملت (زاوية الاحتكاك ، زاوية التكوين ، الصلابة ، سرعة التعليق لرفع الحبة والشوائب).
- وكذلك تمت دراسة بعض المتغيرات المرتبطة بوحدة التنظيف مثل أقطار فتحات الغربال وأخذت ٤ مم حسب أكبر طول للبذرة، وزاوية ميل للغربال ٠ ، ٣ و ٦ درجات وسرعة جهاز فصل الهواء ٤ ، ٦ ، ٨

م/ث. وأخذت السرعة الترددية للفصل ١٥٠ ، ٢٥٠ ، ٣٥٠ و ٤٥٠ دورة / د ومعدل تغذية ٥٠٠ كج / س عند محتوى رطوبي ١٠.٥ % للبذرة.
وكان متوسط القيم لبعض الخواص كالتالي:
الخواص الطبيعية : كان متوسط كل من الطول والعرض لبذور البرسيم (المسقاوى ، الخضراوى، الصعيدي) كالتالي ٢.٤ ، ٢.١٠ ، ٢.٤٥ ، ٢.١٢ ، ٣.٣٠ ، ٢.١٠ ، مم على التوالي. كالتالي وكان كتلة الألف حبة للأصناف (المسقاوى، الخضراوى، الصعيدي) ١٠.٢٠ ، ١١.٢٠ ، ١١.٢٥ جم على التوالي. وكان حجم البذور للأصناف (المسقاوى، الخضراوى، الصعيدي) كانت كالتالي ٤.٥٥ ، ٤.٦٥ ، ٤.٣٦ مم^٣ على التوالي. ونسبة التكور للأصناف (المسقاوى، الخضراوى، الصعيدي) كالتالي ٨٧ ، ٨٦ ، ٧٠ % على التوالي. وكان القطر الهندسي للأصناف (المسقاوى، الخضراوى، الصعيدي) كالتالي ٢.١٩ ، ٢.٢٣ ، ٢.٤٤ مم على التوالي. وكان القطر الرياضي للأصناف (المسقاوى، الخضراوى، الصعيدي) كالتالي ٢.٢ ، ٢.٢٣ ، ٢.٥٠ مم على التوالي. وكانت مساحة السطح المسطح للأصناف (المسقاوى، الخضراوى، الصعيدي) كالتالي ٣.٩٥ ، ٤.٠٧ ، ٥.٤٤ مم^٢ على التوالي. وكانت مساحة السطح المنقول للأصناف (المسقاوى، الخضراوى، الصعيدي) كالتالي، ٣.٩٠ ، ٣.٥٢ ، ٣.٤٦ مم^٢ على التوالي. وكانت الكثافة الحجمية للأصناف (المسقاوى، الخضراوى، الصعيدي) كالتالي ٠.٤ ، ٠.٤٥ ، ٠.٤٩ على التوالي.
الخواص الميكانيكية : وجد أن زاوية الاحتكاك للأصناف (المسقاوى، الخضراوى، الصعيدي) عند استخدام الأسطح الحديد والصاج والخشب كالتالي (٢٤ ، ٣١ ، ٣٦) ، (٢٤ ، ٣١ ، ٣٧) ، (٢٥ ، ٣٢ ، ٣٨) على التوالي. وكانت زاوية التكوين للأصناف (المسقاوى، الخضراوى، الصعيدي) عند استخدام سطح الصاج كالتالي (٣٤) ، (٣٤) ، (٣٥) على التوالي. ووجد أن سرعة التعليق للأصناف (المسقاوى، الخضراوى، الصعيدي) كانت كالتالي ١٥ ، ١٥ ، ١٦ م/ث على التوالي. وكانت للشوائب ٥ م / ث ووجد أن صلابة البذور للأصناف (المسقاوى، الخضراوى، الصعيدي) كانت كالتالي ١٦٥ ، ١٦٥ ، ١٧٣ نيوتن على الترتيب. وتم التوصل إلى علاقة تربط بين الأبعاد الأساسية والحجم ومساحة السطح حيث يمكن التنبؤ بحجم البذرة ومساحتها. ومن دراسة المتغيرات الأساسية لأجهزة التنظيف تم وضع مواصفات ثقب الغرابيل المناسبة وهي كالتالي عند الفصل حسب أكبر بعد للبذرة (الطول) : قطر الغريبال الدائرية واخذت ٤ مم. وزاوية ميل للغرابيل مع ألواح حديد ٣٠ . ٦° ، وسرعة الفصل اللازمة لإزالة الشوائب ٦ م / ث .
وللحصول على اعلي نسبة نظافة وقل شوائب لبذور البرسيم عموما وفي ظل ظروف البحث يكون عند استخدام قطر الغريبال ٤ مم ، وزاوية ميل للغريبال ٣° ، وسرعة هواء ٦ م / ث ، وسرعة ترددية ٣٥٠ دورة / د ، مع معدل تغذية ٥٠٠ كج / س ونسبة رطوبة للحبة ١٠.٥ % وفي هذه الظروف تعطي نسبة نظافة ٩٩ % وحبوب مفقودة بنسبة ١ %.

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