DEVELOPMENT OF A SUITABLE PLANTER FOR HYBRID RICE CROP

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ABSTRACT

Laboratory experiment was carried out at Rice Mechanization Center (Agric. Eng. Res. Institute, Ministry of Agric.) in Kafr El-Sheikh to determined some of physical and engineering properties for Egyptian hybrid rice No.1 that help in develope of a suitable precision vacuum planter for sowing dry, soaking and incubated hybrid rice seeds.

The rice seed (dry, soaked and incubated) properties were seed moisture content (Mc), mean dimensions {Length (L), Width (W) and Thickness (Th)}, shape index (Si), seed density (ρ), weight of 1000 seeds (Wi), sphericity (Sp), arithmetic mean diameter (Da), geometric mean diameter (Dg), repose angle (Ra), dynamic coefficient of friction (Fd) and terminal velocity (Tv).

From laboratory experiments, it has been manufacturing a precision vacuum planter unit suitable for planting hybrid rice seeds in two rows with 150 mm and 150 mm spaced in the row.

INTRODUCTION

Rice considered one of the most important cereal crop in Egypt. The cultivated area of rice crop was about 1.427 million feddans in year 2012, that produced about 5.66 million ton paddy rice (Bulletin of the Ministry of Agriculture, Agricultural Economy in, 2012). The main objectives of the National Rice Research Institute program is to develop a new varieties of high-yield. Egyptian hybrid rice No.1 is one of this varieties, which it's productivity reached about 5.5 to 6.5 tons / fed and sowing rate about 7.5 to 10 kg seeds/fed. with a 1-2 plans in the hill and transplanting distances 15 x 15 cm or 20 x 20 cm. Ibrahim et al. (2008) studied some physical properties of rice seeds before and after soaking procedures, they found that the values of shape index (SI), actual seeds density (ρ) and mass of 1000 seeds were obtained about 2.81, 99.96 g/cm^3 and 33.03 g for dry rice seeds (Giza 178) at 12.6 % seed moisture content, and about 2, 48.13 g/c m^3 and 78.47 g for hasting emergence rice seeds at 35.2 % seed moisture content, respectively. While the mass of 1000 seeds of egyptian hybrid rice No.1 were 22,89 g according to Abo-Yousef *et. al* (2011).

Mechanical rice planting is very important in saving hand labor, improving production, allowing further mechanization and decreasing production costs. Khan and El-Sahrigi (1990) showed that Egypt still need to develop simple row seeders for direct seeding for paddy under wet and dry field conditions. Younis *et al.* (1991) concluded that the mechanical drilling rice stayed only 124 days (less than the transplanted rice, which stayed about 134 days). Energy requirement for mechanical drilling was about (3.773

MJ/ton), which is less than that required for manual and mechanical transplanting methods. Mechanical drilling recorded the minimum total cost (65 LE/ton) and the maximum net profit (135 LE/ton). So they consider the mechanical drilling method is the appropriate method for rice production in Egypt. Abo-Habaga (1994) reported that the bandwidth sowing method may be considered as the most suitable direct seeding methods for rice. It increased the efficiency of seed distribution regularity about 20.8% and crop yield about 14.39% in comparison with the hand sowing method.

Due to the lack of studies about the physical and engineering properties for Egyptian hybrid rice No.1, therefore, the present study was performed to determined some of physical and engineering properties for Egyptian hybrid rice No.1 to help in the development of a suitable precision vacuum planter for sowing dry , soaking and incubated rice seeds.

MATERIALS AND METHODS

The experiment was carried out on the Rice Mechanization Center (Agric. Eng. Res. Institute, Ministry of Agric.) at Kafr El-Sheikh to developed the Soffgia precision vacuum planter for sowing dry , soaked and incubated rice seeds.

Soffgia precision vacuum planter

Precision vacuum planter model (Soffgia) Number G299 (fig. 1) used in planting the large grain (such as corn, soybeans, cotton, etc.) where the minimum distance between two rows 40 cm and a maximum distance of 70 cm, and it didn't used to planting the small grains (such as wheat, rice, etc.). The technical specifications of the Soffgia Precision vacuum planter are summarized in table (1) .

Fig. 1: Soffgia precision vacuum planter

Table 1: The technical specifications of Soffgia precision vacuum planter

Specifications	Characteristic
Model	Soffgia
Country of production	Italy
Planter type	Pneumatic
Pneumatic type	Vacuum
No. of planting units	4
Distance between two row	40-70 cm
Type of furrow opener	Runner
Type of closing device	Rubber wheel

Seed moisture content

The rice seed moisture content was determined using Grain Moisture Tester Model Kett KM No. 148-C Japan accuracy of 0.5%. Three croup samples were taken to determine the seed moisture content for hybrid rice No1. at dry, soaking and incubated.

Mass of 1000 seeds

In order to determine the mean mass of 1000 seeds from (dry, soaked and incubated) rice seeds, samples of 1000 seeds were randomly selected. Each sample was weighted using an electronic balance with an accuracy of 0.01 g.

Shape index

A random sample of one hundred grains was taken in the same time of determining the seed moisture content. The shape of each seeds sample was studied in terms of length (L), width (W), and thickness (T) by using a digital caliper with a sensitivity of 0.01 mm. The obtained data were used to calculate the shape index of each sample, according to Ismail (1988).

$$\text{Shape index (SI)} = \frac{L}{\sqrt{W.T}} \quad ……………….. \quad (1)$$

At (SI) > 1.5 the seed is considered oval and (SI) < 1.5 the seed is considered spherical.

Geometric, arithmetic mean diameter and seed surface area

The geometric, arithmetic mean diameter and seed surface area of hybrid rice seeds are determined from the samples taken in the same time of determining the seed moisture content using the following equations according to Mohsenin, (1986):

$$D_g = (LWT)^{1/3} \quad ……………………… \quad (2)$$

$$D_a = \frac{L+W+T}{3} \quad ……………………… \quad (3)$$

$$A_s = 2\,п\,(L.W) \quad …………………….. \quad (4)$$

Where:

    D_g = Geometric mean diameter (mm), A_s = Seed surface area (mm^2),
    D_a = Arithmetic mean diameter (mm),   L = Length of seed (mm),
    W = Width of seed (mm), and   T = Thickness of seed (mm).

Seed density

The seed density was determined using the liquid displacement method (Mohsenin, 1986) by immersing a certain mass of seed in a certain benzene alcohol solution. The increase in the cylinder volume gave the absolute volume of rice seed. Ten samples were taken to determine the seed density. The density of rice seeds was determined by using the following equation:

$$\rho = \frac{M}{V} \quad \text{..............................(5)}$$

Where:

ρ = seed density (g/m^3),

M = mass of seeds (g), and

V = Volume of the seed (m^3).

The degree of sphericity

The degree of sphericity (ϕ) were determined from the samples of linear dimensions of hybrid rice seeds in the same time of determining the seed moisture content using the following equations according to Singh and Sarawat, (2005).

$$\phi = \frac{\left(L\ W\ T\right)^{(1/3)}}{L} \times 100 \quad \text{.....................(6)}$$

coefficient of friction

The dynamic coefficient of friction for hybrid rice grain on the surface of steel sheet iron was measured using an instrument constructed in the workshop of Rice Mechanization Center . The seeds sample was placed over the surface to be tested, which is titled around its side pivot. The friction angle was displayed when 75% of the seeds reached the spout and the tray was stopped friction coefficient for the mentioned sample was obtained as follows:

$\mu = \tan \varphi$…………………….……………(7)

Where:

μ = Friction coefficient, and

φ = Friction angle (deg).

Repose angle

Angle of natural slope (repose angle) of rice seeds was measured by an instrument every measurement was repeated 10 times and mean value was calculated to determine the angle of repose for each treatments.

Terminal velocity of hybrid rice seeds

Terminal velocity of hybrid rice seed was determined theoretically from the mass of hybrid rice seed, air density, projected area of hybrid rice seed and drag coefficient of semi-sphere shaped using the following equation according to Hexing, 1989.

$$V_t = \sqrt{\frac{2\,mg}{\rho_a A_p C_d}} \quad \text{.........................(8)}$$

Where:

V_t = terminal velocity of hybrid rice seed (m/s),

m = mass of particle hybrid rice seed (kg),

ρ_a = air density (1.204 kg/m^3),

724

A_p = projected area of hybrid rice seed (m^2),

C_d = drag coefficient (dimensionless).

Seed indices

Seed metering system uniformity was evaluated in terms of the miss index (S_m),multiple index (S_{mu}) and seed catch efficiency (η_c) were calculated according to (Srivastava 1995).

1-Seeds miss index (S_m)

The seed miss index could be considered as the first indicator for the seed disposing performance. It was estimated for each treatment by counting the number of hole/sells that have no seeds and counting the number of the used holes/sells in each treatment. Then the percentage of miss index can be calculated as follows:

$$Sm\% = \frac{B_n}{M} \times 100 \dots\dots\dots\dots\dots\dots\dots(9)$$

Where:

Sm = the percentage of seed miss index,%,

M = the total number of the used holes/sells.

B_n = the number of holes that have no seeds.

2- Seeds multiple index (S_{mu})

The seed double ratio could be considered as the second indicator for the seed disposing performance. It was estimated for each treatment by counting the number of holes that have more than one seed and counting the number of the total holes in each treatment. Then the percentage of seeds multiples index can be calculated as follows:

$$S_{mu}\% = \frac{A_n}{M} \times 100 \dots\dots\dots\dots\dots\dots\dots(10)$$

Where:

$S_{mu}\%$ = the percentage of seeds multiples index, %

A_n = the number of holes that have more than one seeds.

M = the total number of the used holes/sells.

3- The seed catch efficiency (η_c)

The seed catching efficiency was estimated from the actual number of seeds which stuck to the holes of the seed plate to the total number of holes in the seed plate (theoretically). The actual number of seeds which stuck to the holes of the seed plate was donated by (ANC). However, the (TNS) is expressed of the theoretical number of seeds. The actual number of seeds that stuck to the seed plate was determined by collecting them in a plastic bag and counted them for each run under seven levels of blower speeds, for each seed plate and rice seed treatments. Then, the seed catching efficiency could be estimated as follows:

$$\eta_c = \frac{ANC}{TNS} \times 100 \dots\dots\dots\dots\dots(11)$$

Where:

η_c = the catching efficiency (%),

TNS = the theoretical number of seed, and

ANC = the actual number of seed.

725

Negative pressure and blower speed

The negative pressure was measured by using vacuum gauge (Fig. 2) Model WIKA, overload limit -1 m bar and staging (0-100 m bar) a sensitivity of (-0.01 m bar), under seven levels of blower speeds for each seed plate and rice seed treatments. The blower speeds was measured using a tachometer (Fig. 2 b) Model STICHT a sensitivity of 0.01 rpm.
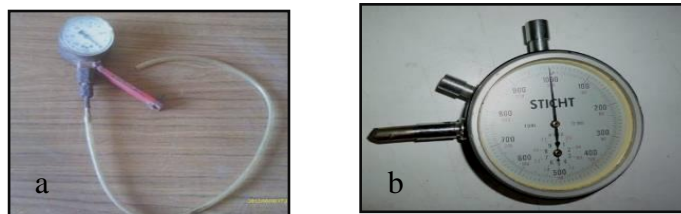

Fig. 2: Vacuum gauge and a tachometer

RESULTS AND DISCUSSION

Seed moisture content

Fig. (3) showed that the mean value of moisture content for dry seed was 14.9% with standard deviation about 0.62. While the mean value of moisture content for soaked seed was 27.12% with standard deviation about 0.52. Whereas the mean value of moisture content for incubated seed was 29.47% with standard deviation about 0.26.
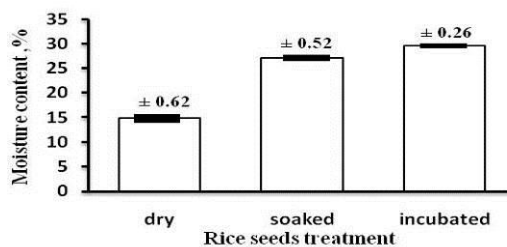
**Fig. 3: Rice seed moisture content at different treatments**

Seed dimensions

Results in fig. (4) showed that the average dimensions of dry rice seeds (length 7.75±0.31, width 2.66±0.2 and thickness 1.71±0.06 mm), soaked rice seeds (length 8.18±0.26, width 2.99±0.15 and thickness 2.13±0.1 mm) and incubated rice seeds (length 8.26±0.28, width 3.25±0.19 and thickness 2.16±0.07 mm). From previous results, it was clear that the shorter dimensions of the seeds were at dry seeds, the value was (1.71± 0.06 mm) and so it was designed the hole diameter for seed plate less than 1.64mm. Therefore the suitable hole diameter was 1.5mm.

Shape index:

The results in fig (5) showed that the mean value of shape index for dry seed was 3.75 with standard deviation about 0.06. While the mean value of shape index for soaked seed was 3.31with standard deviation about 0.08.

Whereas the mean value of shape index for incubated seed was 3.10 with standard deviation about 0.06. From above results, it can be recorded that increase the period of soaking seeds decrease the average shape index within the time period used in the study. From previous results, it was clear that all values of shape index higher than 1.5, this intend that all rice treatment take oval shape. This contributed us to fabricate precision vacuum planter seed holes as a cylindrical shape and to disqualify spherical from.
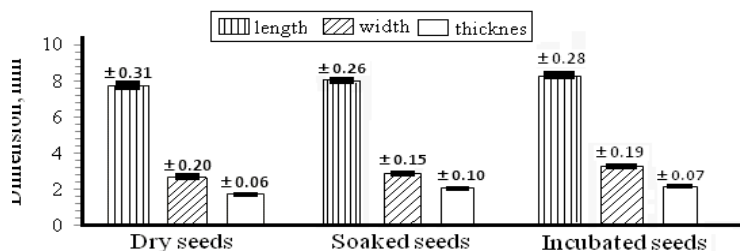
Rice seed treatments

Fig. 4: Dimensions of rice seed at different treatments
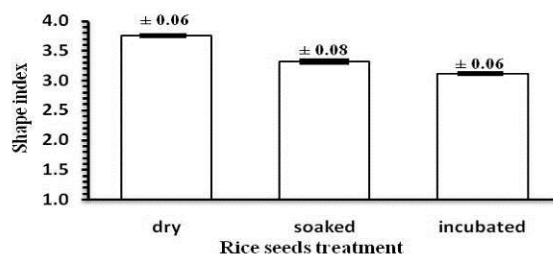
Fig. 5: Shape index of rice seed at different treatments

Mass of 1000 seeds:

Fig. (6) showed that the mean value of mass of 1000 rice seeds for dry seed was 22.20 g with standard deviation about 0.71. While the mean value of mass of 1000 rice seeds for soaked seed was 28.54 g with standard deviation about 0.31. Whereas the mean value of mass of 1000 rice seeds for incubated seed was 29.52 with standard deviation about 0.28. From above results, it can be recorded that increase the period of soaking seeds increase the average mass of 1000 rice seed within the time period used in the study.
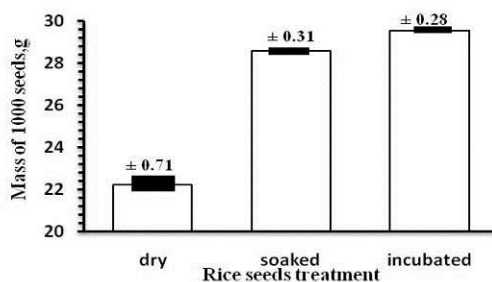
Fig. 6: Mass of 1000 rice seed at different treatments

Seed density:

The results in fig. (7) showed that the mean value of seed density for dry seed was 5.99 g/cm^3 with standard deviation about 0.11. While the mean value of seed density for soaked seed was 7.33 g/cm^3 with standard deviation about 0.27. Whereas the mean value of seed density for incubated seed was 8.26 g/cm^3 with standard deviation about 0.21. From above results, it can be recorded that increase the period of soaking seeds increase the average seed density of rice seed within the time period used in the study.
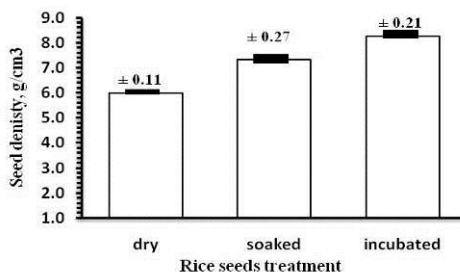

Fig. 7: Seed density of rice seed at different treatments

Geometric and Arithmetic mean diameter

The results in fig (8) showed that the mean value of geometric mean diameter for dry seed was 3.25 mm with standard deviation about 0.21. While the mean value of geometric mean diameter for soaked seed was 3.73 mm with standard deviation about 0.26. Whereas the mean value of geometric mean diameter for incubated seed was 3.85 with standard deviation about 0.27. From above results, it can be recorded that increase the period of soaking seeds increase the average geometric mean diameter of rice seed within the time period used in the study. Also, the results indicated that the mean value of arithmetic mean diameter for dry seed was 4.06 mm with standard deviation about 0.25. While the mean value of arithmetic mean diameter for soaked seed was 4.39 mm with standard deviation about 0.25. Whereas the mean value of arithmetic mean diameter for incubated seed was 4.54 mm with standard deviation about 0.25. From above results, it can be recorded that increase the period of soaking seeds increase the average arithmetic mean diameter of rice seed within the time period used in the study.

728

Spheriity

The results in fig. (9) showed that the mean value of spherical for dry seed was 0.42 % with standard deviation about 0.008. While the mean value of spherical for soaked seed was 0.46 % with standard deviation about 0.011. Whereas the mean value of spherical for incubated seed was 0.47 % with standard deviation about 0.008. From above results, it can be recorded that increase the period of soaking seeds increase the average spherical of rice seed within the time period used in the study.
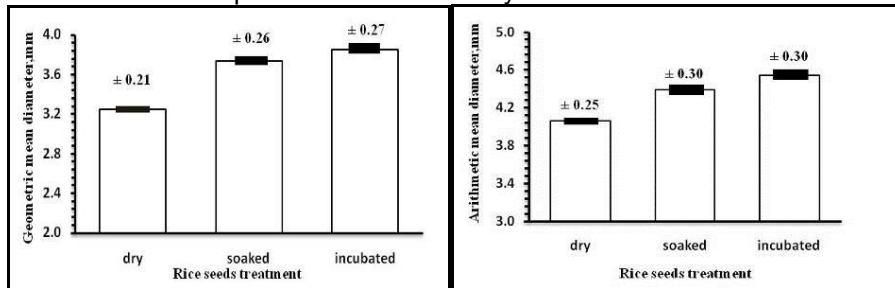

Fig. 8: Arithmetic and geometric mean diameter of rice seeds at different treatments
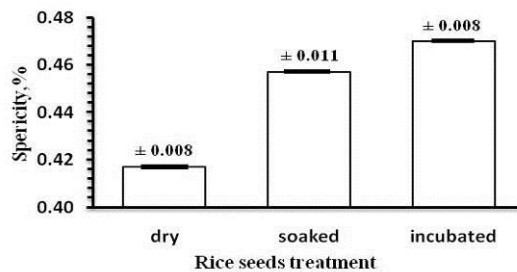

Fig. 9: Spheriity of rice seeds at different treatments

Repose angle:

The results in fig (10) showed that the mean value of repose angle for dry seed was 33.90^{o} with standard deviation about 1.13. While the mean value of repose angle for soaked seed was 35.10^{o} with standard deviation about 0.91. Whereas the mean value of repose angle for incubated seed was 38.60^{o} with standard deviation about 0.65. From above results, it can be recorded that increase the period of soaking seeds increase the average repose angle of rice seed within the time period used in the study. From previous results, it was clear that the highest mean value of repose angle for the seeds were at incubated seeds, the value was (38.60 ± 0.65^{o}) and so it was designed the seed hopper in developed precision vacuum planter unit with slope higher than 38.60^{o}.
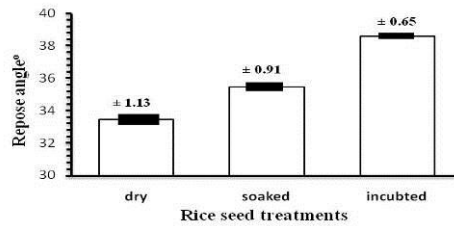
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Fig. 10: Repose angle of rice seed at different treatments

Coefficient of friction:

The results in fig (11) showed that the mean value of dynamic coefficient of friction for dry seed was 0.73 with standard deviation about 0.011. While the mean value of dynamic coefficient of friction for soaked seed was 0.75 with standard deviation about 0.008. Whereas the mean value of dynamic coefficient of friction for incubated seed was 0.77 with standard deviation about 0.013. From above results, it can be recorded that increase the period of soaking seeds increase the average dynamic coefficient of friction of rice seed within the time period used in the study.
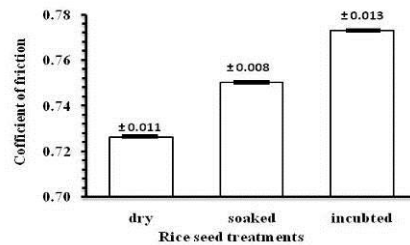

Fig. 11: Coefficient of friction of rice seed at different treatments

Terminal velocity

The results in fig (12) showed that the mean value of terminal velocity for dry seed was 6.68 m/s with standard deviation about 0.67. While the mean value of terminal velocity for soaked seed was 7.20 m/s with standard deviation about 0.50. Whereas the mean value of terminal velocity for incubated seed was 7.95 with standard deviation about 0.02. From above results, it can be recorded that increase the period of soaking seeds increase the average terminal velocity of rice seed within the time period used in the study.
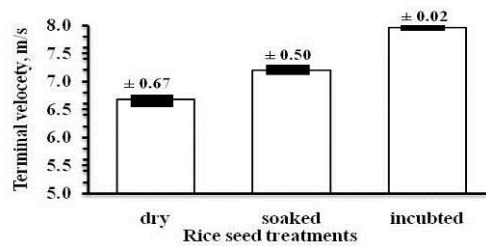

Fig. 12: Terminal velocity of rice seed at different treatments

730

Seeds miss index (%)

The results in fig.(13) showed that the effect of blower speeds on miss index for different type of seed plate at dry seeds, the highest value of miss index were 52.38, 54.76 and 57.14 % at 2500 rpm for all seed plates, while the lowest value were zero at 3800 rpm for seed plate 1 and at 4300 rpm for seed plate 2 and 3, respectively. Also, The results showed that the effect of blower speeds on miss index for different type of seed plates at soaked seeds, the highest value of miss index were 57.14, 59.52 and 60.32 % at 2500 rpm for all seed plates, while the lowest value were zero at 3800 rpm for seed plate1, 2 and at 5000 rpm for seed plate 3, respectively. Also, The results indicated that the effect of blower speeds on miss index for different type of seed plates at incubated seeds, the highest value of miss index were 61.10, 64.29 and 65.08% at 2500 rpm for all seed, while the lowest value were zero at 3800 rpm for seed plate 1 and 2 and at 4300 rpm for seed plate 3, respectively. From above results, it can be recorded that the most suitable blower speed were 3800 rpm at seed plate 1 for all rice seed treatments (dry, soaked and incubated) and a suitable blower speed at seed plate 2 for soaked and incubated seeds, while the blower speed of 4300 rpm was the most suitable speed of the seed plate 3 for dry and incubated seeds.
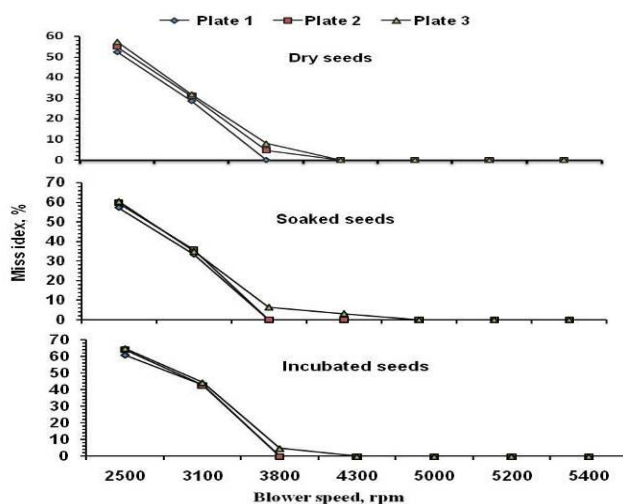

Fig. 13: Effect of blower speeds on miss index for different type of seed plate at different rice seed treatments

The seeds multiple index (%)

The results in fig. (14) showed that the increase of blower speeds leads to increase of multiple index value. Results in fig. (14) showed that slow speeds 2500 and 3100 rpm did not record any case of multiple index value for different type of seed plate at dry seeds. Increase the blower speed from 3100 to 3800 rpm recorded increase of multiple index value from 0 to 3.17% for seed plate 3, while the multiple index value increase into 9.52% for seed plate 1 and 2. Also, the results showed that slow speeds 2500 and 3100 rpm did not recorded any case of multiple index value for different type of

seed plate at soaked seeds. Increase the blower speed from 3100 to 3800 rpm recorded increase of multiple index value from 0 to 4.76% and 7.14% for seed plates 1 and 2 respectively, while plate 3 did not recorded any change of the multiple index value at this blower speed. Also, the results indicated that slow speeds 2500 and 3100 rpm did not recorded any case of multiple index value for different type of seed plate at incubated seeds. Increase the blower speed from 3100 to 3800 rpm recorded increase of multiple index value from 0 to 4.76% for seed plates 1 and 2 , while plate 3 did not recorded any change of the multiple index value at this blower speed. From above results, it can be recorded that the most suitable blower speed were 3100 rpm at all seed plates for all rice seed treatments (dry, soaked and incubated), while the blower speed of 3800 rpm was the most suitable speed of the seed plate 3 for soaked and incubated seeds.
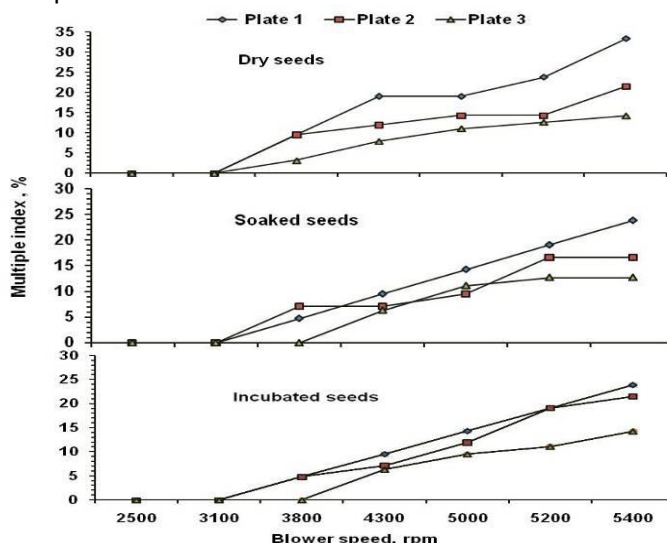

Fig. 14: Effect of blower speeds on multiple index for different type of seed plate at different rice seed treatments.

The seed catch efficiency (%)

The results in fig. (15) showed that the effect of blower speeds on seed catch efficiency for different type of seed plate at dry seeds. Suitable blower speed, which is achieved the nearest value to the desired number of seeds for sowing was 3800 rpm for seed plates 1and 2, which achieved an increase of the number of seeds about 9.52 and 4.76% for seed number required for sowing. While the suitable blower speed for seed plate 3 was 4300 rpm, which recorded an increase about 7.94 % for seed number required for sowing. Also, results in fig. (15) showed that the effect of blower speeds on seed catch efficiency for different type of seed plate at soaked seeds. Suitable blower speed, which is achieved the nearest value to the desired number of seeds for sowing was 3800 rpm for seed plates 1and 2, which achieved an increase of the number of seeds about 4.76 and 2.38% for

seed number required for sowing. While the suitable blower speed for seed plate 3 was 4300 rpm, which recorded an increase about 6.34 % for seed number required for sowing. Also, results in fig. (15) indicated that the effect of blower speeds on seed catch efficiency for different type of seed plates at incubated seeds. Suitable blower speed, which is achieved the nearest value to the desired number of seeds sowing was 3800 rpm for seed plates 1and 2, that achieved an increase of the number of seeds about 4.76 and 0.00% for seed number required for sowing. While the suitable blower speed for seed plate 3 was 4300 rpm, which recorded an increase about 6.35 % for seed number required for sowing. From above results, it can be recorded that the most suitable blower speed was 4300 rpm for seed plate 3, while the blower speed of 3800 rpm was the most suitable speed for seed plates 1 and 2 for all rice seed treatments.
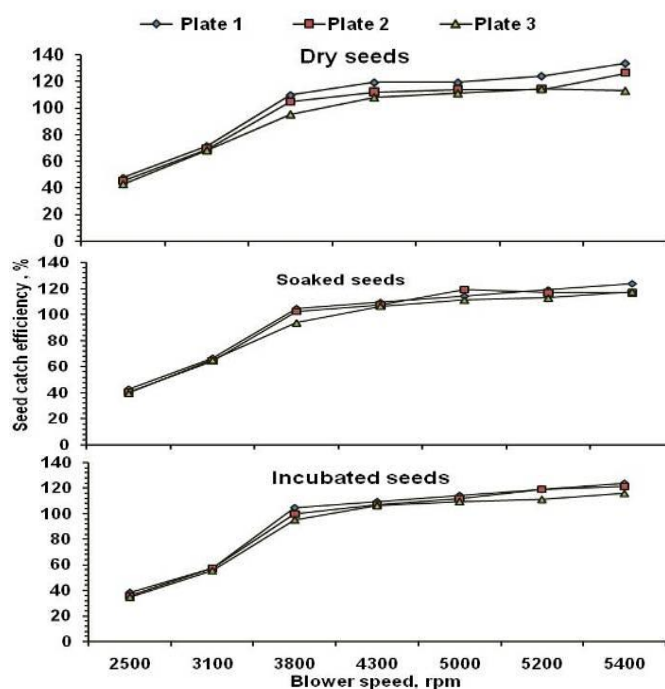

Fig. 15: Effect of blower speeds on seed catch efficiency for different type of seed plate at different rice seed treatments.

Negative pressure and blower speeds

Data in table (2) showed that the negative pressure at different level of blower speeds. The results showed that the highest value of seed catch efficiency were at negative pressure - 40 m bar, which obtained at blower speed 3800 rpm. when using seed plates 1and 2 at all rice seed treatments, whereas the highest value of seed catch efficiency when used seed plate 3 which obtained at blower speed 4300 rpm for all rice seed treatments.

Table 2: Negative pressure at different level of blower speeds.

| Blower speed, rpm	Blower speed, m/s	Negative pressure, -m bar	Negative pressure, K pa
2500	6.26	20	2
3100	7.75	30	3
3800	9.49	40	4
4300	10.74	45	4.5
5000	12.49	50	5
5200	13.00	55	5.5
5400	13.50	62.5	6.25

Previous results lead to determine developed factors for soffgia precision vacuum planter to become suitable for small seeds sowing. The planter has been developed and manufactured from local raw materials at private workshop and can description as follows:

Developed precision vacuum planter unit

The precision vacuum planter unit under this study was developed for planting two rows with 150 mm apart instead of one row with other planters in the market and sowing dry, soaked and incubated hybrid rice seeds. A precision vacuum planter development unit was designed, fabricated and assembled to meet the stated requirements under this study (Fig.16 and 17).The experimental developed precision vacuum planter unit was fabricated using local materials.

Fig. 16: Developed precision vacuum planter unit
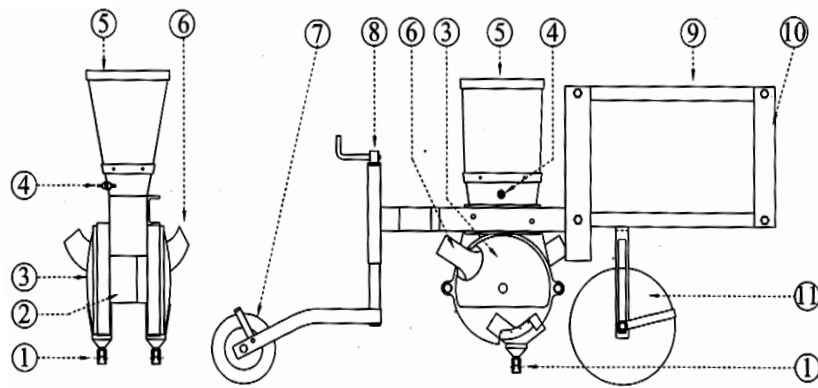
1- Seed counter.   2- Gearbox for two rows.
3- Chamber of seed suction.   4- Level seed control.
5- Seed box   6- Suction air pipe. 7- Rear wheel.
8- Crank to adjusting planting depth.   9- Frame.
10- Hitch point.   11- Furrow opener.

Fig. 17: Schematic diagram of developed precision vacuum planter

The developed precision vacuum planter consists of the following components:

1- Seed box and seed chamber

The seed box was fabricated from steel sheet iron with 3 mm thickness. The seed box consists of two parts. The upper part in the form of a cube dimensions 20x20x18 cm and the bottom part in the form pyramid-shaped minus, its base upper 20x20 cm and the base bottom 18x16 cm and the height of 4.8 cm. Seed box was designed to use several types of rice seeds with different repose angles ranged from 33.44° to 38.60° for dry and incubated rice seed, respectively. The seed chamber was developed to give two row feed in the planting unit, the distance between them about 150 mm.

2- Seed metering system

Seed metering mechanism under this study was developed for planting two rows with 150 mm apart. The seed metering mechanism consisted of the following parts:

a-Vertical seed plate: Three different types of seed plate designed of stainless steel material, thickness of 3 mm and a diameter of 220 mm. Each plate has some of holes (26, 52 and 78 holes) with 1.5 mm diameter.

b- Plate of vacuum flow: The plate of vacuum flow was fabricated from sort of plastics called (Teflon) with outer diameter 240 mm, it designed with a cavity diameter and thickness of new seed plate (220 and 3 mm) inside plate of vacuum flow to best control of suction air and as well as to reduce the friction between the seed plate and plate of vacuum.

735

c- Transmission system: Transmission system has two functions for driving metric device from land wheel and for changing the auger shaft rotating speed to obtain different application seed rates, kg/feddan.

3-Furrow opener

A single disc-type opener with two outlets was used. The distance between two openers 150 mm, The dimensions of furrow opener are 3 mm thickness and 250 mm diameter.

4-Covering seeds system

Two press wheels were used to cover the seeds in two rows. A pair of closing press wheels closes the furrow for proper seed-soil contact. Adjustable a turn buckle joint applied different force levels to the closing press wheel to achieve the desired compaction level. The dimensions of a press wheel cover are 120 mm thickness and 200 mm diameter and the distance between two wheel 50 mm.

5- Level seed control and Seed counter

The level seed control and seed counter are electronic circuit to indicate the level of seeds in the seed box and number of sown seeds, they designed in the workshop of rice mechanization center (Agric. Eng. Res. Institute, Ministry of Agric.) in Kafr El-Sheikh government.

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" تطوير آلة زراعة فى جور مناسبة لمحصول الأرز "

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يعتبر محصـول الأرز من أهم محاصيل الحبوب بجمهوريـة مصـر العربيـة، حيث بلغت المساحة المزروعة منه حوالى 1,427 مليون فدان بإجمالي إنتاجية ما يقرب من 5,66 مليون طن بمتوسط 4,27 طن/فدان.(نشرة وزارة الزراعة 2012). لهذا تولى الدولة اهتماما كبيرا لزيادة إنتاج هذا المحصول عن طريق الزراعة المباشرة حيث أن الزراعة بالشتل اليدوي تعتبر من أشق العمليات على العامل الزراعي مع ارتفاع أجره حاليا بالإضافة إلى أن زراعة الأرز باستخدام الشتل الآلي مرتفعـة التكلفـة ولا تغطـى إلا مسـاحة صـغيرة جـدا لا تتعـدى 2000 فدان مـن إجمـالي المسـاحة المنزرعة ولا يعطى الكثافة الزراعيـة الموصـى بها لمعظم أصناف الأرز (نشرة وزارة الزراعة 2012). لذا فإن الهدف الرئيسي من هذه الدراسـة هو تطـوير وتصـنيع وحدة زراعة دقيقة مناسبة لزراعة بذور الأرز الهجين بصورة جافة أو مبتلة أو مكمورة، تعمل بشفط الهواء باستخدام خامات محلية الصنع وتقوم بزراعة خطين للوحدة الواحدة بفاصل 15سم بين الصفين ومسافة بينية مقدارها 15 سم داخل الصف.

أجريت تجارب معملية بغرض دراسة مجموعة من الخواص الطبيعيـة والهندسية لبذور الأرز الهجين منها المحتوى الرطوبي للبذور (جافة – مبتلـة – مكمورة)، أبعاد البذور (طـول – عرض – سمك)، متوسط وزن 1000 بذرة، متوسط كثافة البذور، متوسط القطر الهندسي للبذور، متوسط القطـر الحسـابي للبـذور، معامـل شـكل البـذور، درجـة كرويـة البـذور، معامـل الاحتكـاك الديناميكي، زاوية الراحة للبذور بالإضافة للسرعة النهائية للبذور.

تم الاستفادة من النتائج المتحصل عليها في تطوير وتصنيع وحدة زراعة في صفوف محليا تقوم بزراعة البذور على أبعاد 15 سم بين الصفوف وعلى مسافات بينية 15 سم داخل الصف. مـع تزويد الوحدة بدوائر الكترونية مطورة لبيان مستوى البذور في صندوق البذور وتحديد عدد البذور المتساقطة من وحدة الزراعة.

737