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Development of a Portable Pneumatic Grain Broadcasting Unit

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ABSTRACT

The present research was carried out in El-Sharkia Governorate, El-Sowa Village in 2014 season to develop and evaluate a portable pneumatic grain broadcasting unit under Egyptian conditions in clay soil. The study included three fan peripheral speeds of 1.7, 1.97 and 2.18 m/s, three grain path lengths of 50, 100 and 200mm from air outlet under and two states of grains (dry and germinated). These parameters were evaluated with horizontal and vertical fan positions, comparing to manual broadcasting on rice grains (Giza 178). Broadcasting width, coefficient of variance (CV), coefficient of distribution uniformity (CU), consumed energy according to power requirements and total costs were determined under split-split plot design with three replicates for all treatments. The obtained results showed that fan peripheral speed of 2.18 m/s and outlet path length of 100mm with horizontal fan gave the best results for all measurements, which obtained thebroadcasting widths of 10.2 and 8.8 m were obtained under horizontal fan with dry and germinated grains, respectively. The least and highest values of CV, CU, Consumed energy and were 17.33 and 82.67 for dry grains and 19.11 and 80.89 for germinated grains respectively. At the above conditions the consumed energy broadcasting costs values were 0.56 and 0.87 kWh/fed, and 10.60 and 13.85 LE/fed for dry and germinated grains, respectively comparing to 20 LE/fed with the traditional method. Finally, the study recommends developing the broadcasting unit to overcome the problems of fragmented, small holdings, which need suitable small machinery with the possibility of trying them in broadcasting other précised seeds. It is also, recommended to study the number and angles of vanes and simultaneously studying different fan diameters and then the material of its manufacturing.

Keywords: broadcasting, distribution, peripheral speed, air velocity

INTRODUCTION

The cultivated area of rice is about 0.55×10^6 hectare (1.363 million feddans) that produced about 4.79×10^3Mgpaddy rice. Because of fragmented areas, most farmers use the manual method to broadcast grains in their fields, which give undistribution uniformity. Mechanical rice planting is very important in saving hand labor, improving production, allowing further mechanization and decreasing production costs. Helmy et al. (2000) concluded that the grain yield of rice crop variety Giza 181, by using the mechanical drilling in dry condition, gave the lowest cost (87.5 L.E./Mg) and highest net profit (412.5 L.E./Mg). Kamel et al. (2002) indicated that there are significant differences in the amount skewing, coefficient of variation and minimum and maximum points in the overlapped pattern of resulting from choice of methods. Using blades with curved C- shaped, the coefficient of variation was varied from about 51.05 to 38.04 % for spinner speed of 540 rpm and -10 blade angle degrees without wind protection. Using spiral curved shaped blades; the coefficient of variation was varied from 42.70 to 32.93 % at the same conditions. Kishta and Eliwa (2005) developed and evaluated a portable grain and fertilizers spreader. They found that the highest uniformity coefficient of distribution, field efficiency and lowest cost of 95.80 %, 61.60 % and 1.57 LE/fed respectively is noticed at better speed of 500 rpm when using the electrical device in the wheat field. Increasing total required time 1.2 h/fed by manual device (fertilizer) caused to continuous decreasing in effective field capacity. Morad*et al.* (2005) reported that the optimum distribution pattern and high degree of fertilizer uniformity can be achieved under the following conditions: Linear speed of about 10.5 m/s, (500 rpm), blade angle of +15 deg forward, (0.26 rad), dip angle of 0 deg (0 rad), gate opening of 16.63 cm^2 and machine forward speed of about 6 km/h. Abo El-Naga(2006) found that the best uniformity of grain distribution obtainedby using developed distributor unit at diameter of pipe 5.08 cm and air stream velocities of 12.5 and 17.75 m/s. Best uniformity of grain distribution obtainedby using developed distributor at pipe diameter of 3.81 cm and air stream velocities of 12.5 and 17.75 m/s. Increasing of air stream velocity increased grain discharge for all varieties of small grains at steady gate out area 4.28 cm^2.Khoshtaghaza and Mehdizadeh (2006) showed that by increasing mass of the kernel from 0.02 to 0.05 g and moisture content from 7 to 20 % (w.b.), its terminal velocity increased linearly from 7.04 to 7.74 m/s and 6.81 to 8.63 m/s, respectively. Alireza and Sheikhdavoodi (2012) stated that the uniformity and accuracy of seed broadcasting on field surface is significant parameter of broadcaster performance and improper and inaccurate broadcasting causes abnormal and nonhomogeneous soil fertility which is against to the purposes of sustainable agriculture. Also, broadcasters are used for planting seeds like wheat, barley etc., so it’s appropriate performance effect on crop production.

Aerodynamic properties such as the terminal velocities of agricultural products are important and required for the design of air conveying systems and the separation equipment. Physical properties such as density, shape and size, etc. need to be known for calculating the terminal velocity and drag coefficient for separating the desirable products from unwanted materials. As a result, aerodynamic properties such as terminal velocity and drag coefficient are needed for air conveying and pneumatic separation of materials (Gupta et al., 2007). Gharekhani et al. (2013)mentioned that the terminal velocity ofand white rice increased linearly with an increase in moisture content from 5 to 37% (w.b.). The drag coefficient of white rice decreased linearly while for paddies the two varieties showed a quadratic trend with moisture content increase. Generally, the use of tractor with ordinary attached broadcasting machines could be compact the soil layers due to its heavy weight. Therefore, the object of this research is to develop and evaluate a broadcasting unit to give the best performance at rice grain planting.

MATERIALS AND METHODS

Field experiments were carried out at private farm at El-Sowa Village, El-Sharkia Governorate, to develop and evaluate a portable pneumatic grain-broadcastingunit during 2014 season.

The developed portable unit

Specifications of the developed portable unit presented in Table (1) and illustrated in Fig. (1), which consists of:

Table (1): Specifications of the developed portable unit

Item	Specifications	Item	Specifications
Engine	2 strokes, air cooling, single cylinder, gasoline	Air flow (m³/h)	640
Cylinder Volume (cc)	70	Air velocity (m/sec.)	100
Engine (rpm)	6000	Fuel cons.(L/h)	4.25
Power (kW)	3.68	Fuel tank (L.)	1.8
Mass net (kg)	15.5	Tank capacity (L.)	20

Fig. 1.The developed portable unit

The developed portable unit consists mainly of the grain hopper, broadcasting device and power system.The specifications of each part could be discussed as follows:

Grain hopper

The developed portable unit (Fig. 2) has a quadrilateral steel hopper (1), 0.5 mm thickness with dimensions of 600 mm height and 500 mm upper width with 100 mm bottom width at approximately volume of 0.062 m^3. A 30 mm outlet diameter was adjusted for rice grain flow. At the bottom outlet of the hopper there is an outlet grain gate with area of 5.069 cm^2 (2); controlled by the outlet grain controller (5), and a plastic grain hose (6) of about 30 mm diameter and 500 mm length.

The grain hose was connected to the end of the air duct tube (4) at hole as the outlet path length [the point where air duct and grains are facing before leaving the tube end and hit the spreader fan (8).

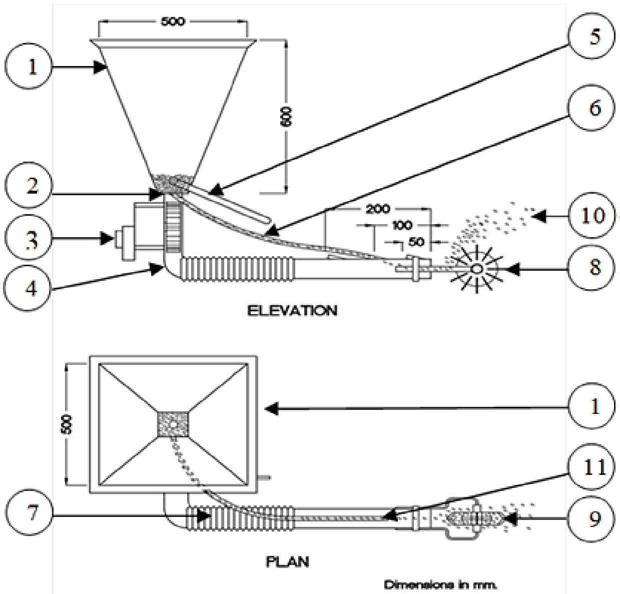


Fig. 2: A schematic diagram of the developed portable unit

1- Hopper;2- Grain gate;3- Engine and pump;4- Air duct tube; 5- Gate control;6- Grain tube;7- Flexible hose; 8- Spreader fan 9- Spreader fan;10- Broadcasting grains; 11- Grain inlet hole

Broadcasting device

The developed unit has a plastic spreader fan (Fig. 3) with 130 and 40 mm maximum diameter and height. The number of vertical hexagonal vanes is 12 vans with 400 × 400 × 1.0 mm height, width and thickness respectively. The vanes angle was adjusted at zero deg. according to (Morad*et al*. 2005). The broadcasting device is rotating depending on the air ducted from the engine pump through the air duct tube (4).

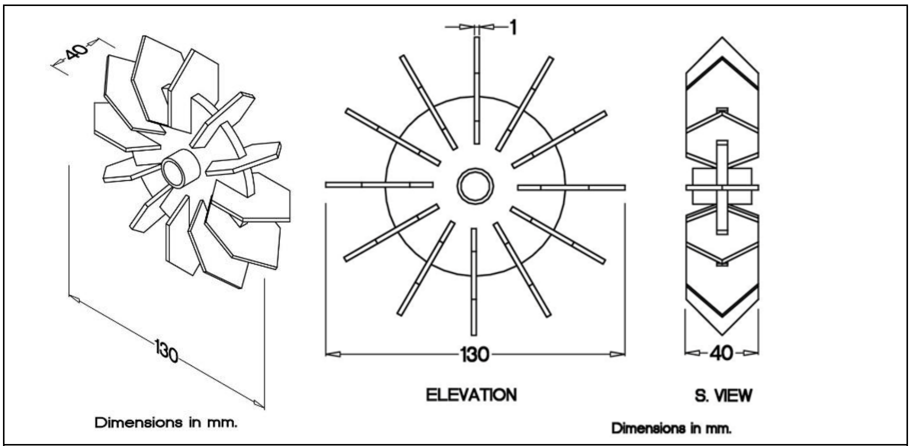


Fig. 3: Plastic spreader fan

Power system

As in Fig. 2, the engine (3) of about 3. 68 kW transmits the power to an inertial aluminum pump which blasts air that broadcasting grains through blowing air.

The experimental tests done in Soil Dept., Faculty of Agric., Zagazig University at clay soil texture. Soil specifications are presentedin Table (2).

Table (2): Soil properties: -

Soil composition%				
Clay, %	Silt, %	Sand, % Coarse	Sand, % Fine	Soil texture
48	20	5.2	26.8	Clay

Therice grains, variety Giza 178were obtained from Al-Serw Agric. Res. Station, Agric. Res.Center, Egypt. The grains werecleaned manually to remove all foreign matters, broken and immature grains. Then some characteristics of rice grain as tabulated in Table (3). Moisture content was 12.2% (wet basis) which determined using a pre-calibrated moisture meter (Wile 35).

To determine the repose angle of grainsthe following equation (Jha ,1999) was used:

$$\theta = tan^{-1}\left(\frac{2H}{D}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, θ is the angle of repose in degrees, and H and D are the height and diameter of the heap in mm, respectively.

The developed portable unitwas evaluated for broadcast 60 kg/fed of both dry and germinatedgrains.

Table (3): Some characteristics ofgrains

Grains state	Bulk density, (g/cm^3)	Moisture content, (%)	Angle of repose, (deg.)	Coefficient of friction with plastic	Diameter range, (mm)
Dry	0.545	12.2	44±0.28	0.54±0.41	2-4±0.34
Germinated	0.684	19.5	52±0.28	0.61±0.41	2.2-4.3±0.24

The variables of study included;

- Three spreader fan rotational speeds of 250, 290 and 320 rpm represents fan peripheral speeds of 1.7 m/s, 1.97 and 2.18 m/s, respectively according to three air velocities of 50, 75 and 90 m/s, respectively.
- Three grain path lengths of 50, 100 and 200 mm from air outletwere pinpointed by making three circular holes on the air duct tube before the end of the grain outlet path (Fig. 2 in ELEV view). Two of the three holes must be closed while using the third one in each treatment to prevent air leakage.
- Two grain states; dry and germinated in dry and muddy soil, respectively.
- Three broadcasting systems of horizontal and vertical spreader fan position and manual.

Instrumentation

- **Speedometer:** Speedometer laser technique was used for measuring the broadcasting fan.
- **Graduated flask:** One liter graduated flask with accuracy of 0.01 cm^3 was used to measure grains bulk density.
- **Moisture content caliper:** A Wile 35 Moisture meter was used for measuring grains moisture content (wet basis) before broadcasting grains.
- **Electronic balance:** An electronic balance was used for weighing grains while filling grain hopper before broadcasting grains with accuracy of 0.5 g.
- **Wooden frame:** A square wooden frame of 1.0 m^2 with 50 mm height was constructed. The frame bottom was covered by a plastic sheet for gathering the broadcasted grains during laboratory tests.

Experimental procedure:

The experimental procedure includes three divisions as:

1-Laboratory experiments: They were done by extendinga square plastic sheet of 15 x 15 m on the ground which was used as a field ground. Then the developed broadcasting unit was used for all treatments which were carried out depending on steady-hand operator (without moving from left to right and without twisting) to pinpoint the broadcasting centerline and measure the broadcasting width, and number and weight of grain per m^2.

2- Field-experimental tests: They were done in field to determine the human walking speed (ground speed) in mud soil which found about 2.4± 0.45km/h (0.76 m/n), field capacity and field efficiency, number of grain in m^2. Therefore, the broadcasting time and the timed consumed as re-filling the hopper with grains three times/fed with dry grains and four times with germinated grains were determined. Also some weather measurements were estimated as wind speed of 2.1 km/h (0.69 m/s) and the air temperature varied from 22 to 28 ^oC.

Experimental design

In split-split plot design, an experimental area of about 2.0 feddans were divided into two main plots represent the grain status (dry and germinated grains) and each of them was divided into three sup plots according to the used broadcasting system (horizontal or vertical spreader fan position and manual broadcasting). Two of sub plots were divided into three sub-sub plots according to spreader fan peripheral speeds.

The experimental treatments were carried out after the soil tillage and irrigation then puddling (leveling in water) and were replicated three times. The outlet grain gate was adjusted for the two broadcasting systems at 60 kg/fed.

Measurements

A - Broadcasting width

The broadcasting width were measured as indicated of distribution uniformity widthwhich includes the coefficient of variation and coefficient of uniformity.

- **Coefficient of Variation (CV) can be determined** according to Coates (1992), the standard deviation (δ) and coefficient of variation (CV) are determined as follows:

$$\delta = \sqrt{\frac{\sum (x_i - x_a)^2}{n-1}} \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where:

x_i= The individual reading.

x_a= Mean reading = $\sum \frac{x_i}{n}$

n = Number of readings.

$$C.V. = \frac{\delta}{x_a} x100 \ldots\ldots\ldots\ldots\ldots(3)$$

- **Coefficient of distribution uniformity (CU)**

The coefficient of distribution uniformity is calculated by the following equation, (Dragos, 1975):

$$C.U. = 1 - CV \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

B- Energy requirements

The following formula was used to estimate power consumption (Hunt, 1983):

$$P = \frac{FC\ x\ \rho.f\ x\ LCV\ x\ 427\ x\ \eta_{th}\ x\ \eta_{mec}}{3600\ x\ 75\ x\ 1.36} kW \ldots\ldots\ldots(5)$$

Where:

FC= fuel consumption, L/h,

ρ.f= density of fuel, kg / L (for diesel = 0.85),

L.C.V= calorific value of fuel (10000 kcal / kg),

427= thermo-mechanical equivalent, J / kcal,

η_{th}= thermal efficiency of engine (≈ 35% for diesel engines) and

η_{mec}= mechanical efficiency of engine (≈80%).

The specific energy calculated by using the following equation

$$Specific\ energy\ (kW.h/fed) = \frac{Power\ requirement\ (kW)}{Effective\ field\ capacity\ (fed/h)} ..(6)$$

D- Broadcasting cost.

The economic machinery costs (fixed and variable) as well as repair and maintenance is derived from theories described by Nilsson (1972), Have (1991) and Hunt (1995), and expresses the total yearly fixed and variable costs as a function of machine capacity:

$$C = \left[\psi\ x\ \rho\ x\ \theta + \frac{A\ x\ U}{\theta\ x\ FE} x(r\ x\ \rho\ x\theta + L + \delta\ x\ \theta)\right] / \Pr \ldots\ldots\ldots(7)$$

Where; C: is the total yearly costs (LE),

Ψ: is a factor expressing depreciation and interest as a fraction of the purchase price, (1/year)

ρ: is the purchase price per unit capacity (LE.h/ton),

θ: is the machine capacity (ton/h),

A: is the treated seasonal area (fed/year),

U: is the expected crop yield (ton/fed),

FE: is the field efficiency expressing the ratio between gross and theoretical capacity,

r: is a factor expressing repair and maintenance costs as a fraction of purchase price,

δ: is the fuel costs proportional to the capacity (LE/L), and

Pr: is process productivity (ton).

- **Statistical analysis:**The obtained data were tabulatedand analyzed statistically by using a computer program of Microsoft excel window 2007 for estimating the regression analysis and the probability at level5%.

RESULTS AND DISCUSSION

A- Effect of spreader fan peripheral speed on broadcasting width

From Fig.4, it was indicated that increasing fan peripheral speed resulted in increasing broadcasting width. For dry grains, results in Fig. 4 (A) shows that the most amount of grainsis distributed in small width at lower fan peripheral speed of 1.7 m/s compared with the high speeds of 1.97 and 2.18 m/s which increases the broadcasting width around the centerline of the portable unit carrier especially under 200mm outlet path length.

The broadcasting width using fan peripheral speed of 2.18 m/s and outlet path length of 200 mmwere 10.2 and 6.4 m respectively for horizontal and vertical fan. While themanual broadcasting width was 4.4 m. It is clear that fan peripheral speed of 2.18 m/s and outlet path length of 200 mm showed the highest broadcasting width. Fan peripheral speed of 1.7 m/s with outlet path length of 50mm showed the least values of broadcasting width whilefan peripheral speed of 1.97 m/s and outlet path length of 100 mm showed medium values and the two factors gave similar trends.

For germinated grains, similar trends were shown in Fig. 4 (B). Under the same previous conditions of fan peripheral speed and outlet path length values of broadcasting widths were 8.8, 5.5 and 3.7 m for horizontal fan, vertical fan and manual broadcasting, respectively. These results using fan peripheral speed of 2.18 m/s and 200 mm outlet path length. In the same way fan peripheral speed of 1.7 m/s and outlet path length 50 mm showed the least values of broadcasting width and medium values were obtained under fan peripheral speed of 1.97 m/s with two other outlet path length of 50 and 100 mm. This result may be attributed to the increase in centrifugal force occurred by high fan peripheral speed which caused increasing fan speed.

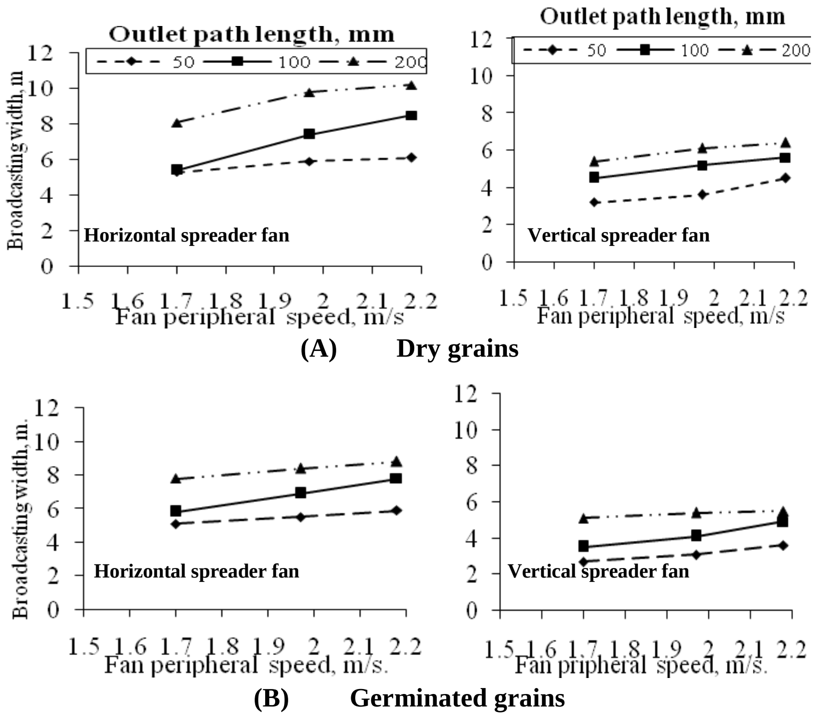


Fig.4: Effect of fan peripheral speed and outlet path on broadcasting width for (A): dry grains and (B) germinated grains

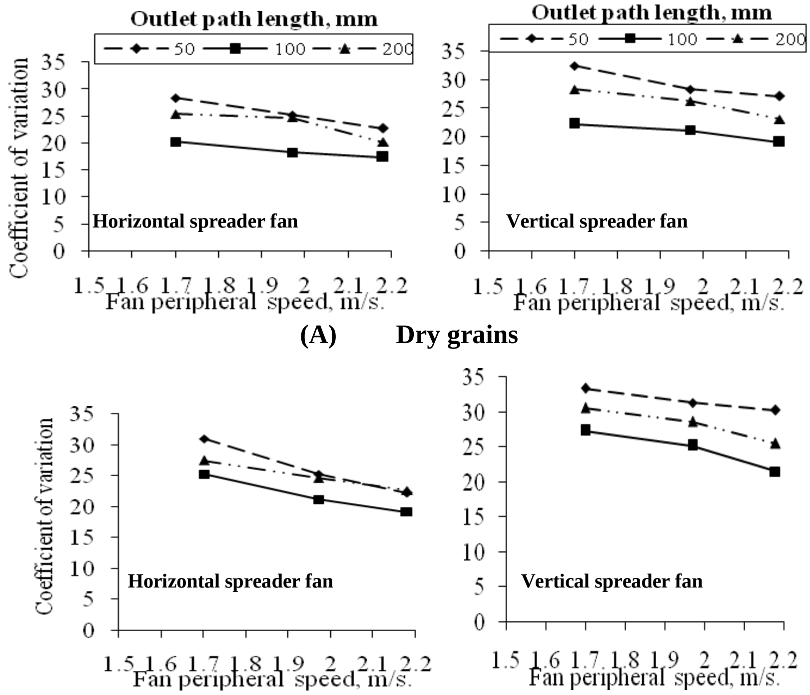
Effect of fan peripheral speed and outlet path length on CV and CU.

Fig. 5 shows the effect of fan peripheral speed and outlet path length on CV for both dry and germinatedgrainsat different positions of fan comparing to manual broadcasting. For dry grains from Fig 5 (A), it is clear that increasing fan peripheral speed resulted in decreasing CV values under all treatments and consequently increasing the CU. Also, it is obvious that using fan showed a decrement in CV values comparing with the controltreatment. Using horizontal fan gave the least values for CV in all treatments. CV values at fan peripheral speed of 1.7, 1.97 and 2.18 m/s with 100 mm outlet path lengthwere 20.22, 18.25 and17.33, and 22.21, 21.15 and19.10 for horizontal and vertical fan positions respectively, comparing to 47.50 for control treatment (manual broadcasting).The highest values of CU are 79.78, 81.75 and 82.67, and 77.79, 78.85 and 80.90 for horizontal and vertical fan positions respectively, obtained at the same previous conditions. These results may due to the increase in centrifugal force occurred at high peripheral speed. So, the coefficient of variation could be decreased by increase fan peripheral speed.

The best distribution pattern is coincided the lowest values of CV. The fan peripheral speed of 2.18 gave the lowest value of CV of 22.71, 17.33 and20.19, and 27.11, 19.01 and 23.11 under different outlet path length of 50, 100 and 200 mm for horizontal and vertical position, respectively. Results show that, the suitable peripheral speed for dry grains is 2.18 m/s. The two other outlet path length showed similar results and trends.

With germinated grains Fig. 5 (B), the same trend for CV values were shown for all treatments comparing to the control treatments under the same conditions with dry grains. CV values at fan peripheral speed of 1.7, 1.97 and 2.18 m/s with 100 mm outlet path lengthwere 25.23, 21.12 and 19.11, and 27.23, 25.15 and 21.45 for horizontal and vertical fan positions respectively, comparing to 49.71 for control treatment (manual broadcasting). The highest values of CU are 74.77, 78.88 and 80.89 and 72.77, 74.85, 78.55 obtained at the same previous conditions. These results may be attributed to the increase in centrifugal force occurred at high peripheral speed.

Although the outlet path length of 50 mm showed the best broadcasting, but the number of grains per $m^2$was less than the recommended values. Therefore, outlet path length of 100 mm showed the best values of number of grains per m^2. The regression analysis showed that outlet path length is an important factor which affects the coefficient of variations of broadcasting (R^2 = 0.957). It was found that, with the probability of 5% which meant outlet path length value affects coefficient of variations of broadcasting. These results may be because more fan peripheral speed results in more grains distribution and in the same way the outlet path length of 50 and 200 m led to sudden impact for grains with scattering fan with 50 mm and more friction with 200 mm which showed the obtained results.



(A) Dry grains

(B) Germinated grains

Fig.5: Effect of fan peripheral speed and outlet path on coefficient of variation for: (A) dry grains and (B) germinated grains

Effect of fan peripheral speed on specific energy:

Fig.6 shows that used dry grains, increasing fan peripheral speed from 1.7 to 2.18 m/s decreased specific energy from 0.9 to 0.46 with horizontal fan positions and from 1.12 to 0.57 kWh/fed, for vertical fan positions. However, using germinated grains, increasing fan peripheral speed from 1.7 to 2.18 m/s decreased specific energy from 1.1 to 0.56 with horizontal fan positions and from 1.12 to 0.77 kWh/fed, for vertical fan positions respectively. The decrease of specific energy consumed as the fan peripheral speed increased was attributed to change portable unit fuel consuming to the high velocity.

Fig.6 shows that increasing fan peripheral speed from 1.7 to 2.18 m/s decreased specific energy from 1.12 to 0.45 kWh/fed, for dry and germinated grains, respectively. The decrease of specific energy consumed as the fan peripheral speed increased was attributed to change portable unit fuel consuming to the high velocity. The specific energy values at the suitable portable unitfan peripheral speed of 2.18 m/s were 0.56 and 0.87 kWh/fed, for dry and germinated grains, respectively. These values of energy consumed are considered economically so cheap comparing with the manual broadcastingspecially in mud as there is no other equipment could broadcast grains in mud and therefore, in Egypt,grain broadcasting is widely manually operated.

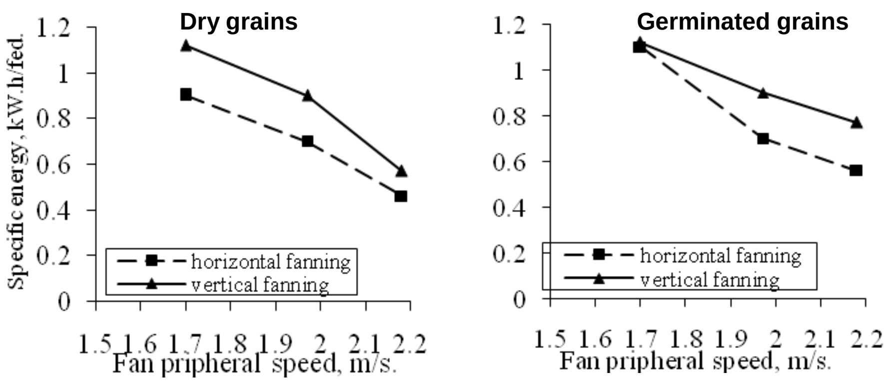


Fig.6: Effect of fan peripheral speed and outlet path length on specific energy under 100 mm outlet path length with dry and germinated grains

Effect of different parameters on broadcasting cost:

Although the outlet path length of 200 mm(Fig.7)showed the highest broadcasting width, the outlet path length of 100 mm showed the least values of CV concerning the effect of ground speed on broadcasting cost (LE/fed).Data indicated that at the mentioned ground speeds of 0.67 m/s with fan peripheral speed of 2.18 m/s and outlet path length of 200 mm the average broadcasting costs were 10.60 and 13.85 LE/fed for dry and germinated grains, respectively comparing to 20 LE/fed for manual broadcasting according to the operator rental costs per hour.

These mentioned results were estimated according to time consumed and timed consumed while re-filling the hopper with grains. It is noticed that increasing fan peripheral speed resulted in decreasing broadcasting cost. This was attributed to the increase in portable unit field capacity and they were considered to be acceptable compared with manual broadcasting.

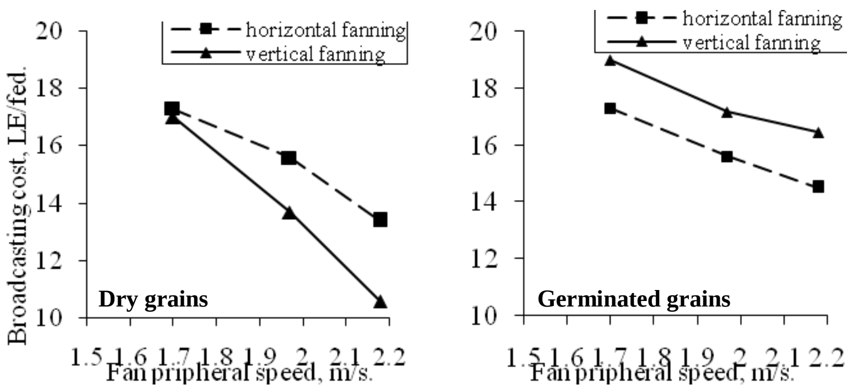


Fig.7: Effect of fan peripheral speed and outlet pathlength on broadcasting cost under 200 mm outlet path length with dry and germinated grains

CONCLUSION

It was found that the developed portable unit is suitable forgrains broadcasting effectively with dry or germinated grains and it is so easy to be manufactured and adjusted to be used for different agricultural operations. The desirable results found that, fan peripheral speed of 2.18 m/s and outlet path length of 100 mm with horizontal fan gave the best results for all measurements, which obtained the broadcasting widths of 10.2 and 8.8 m were obtained under horizontal fan with dry and germinated grains, respectively. The least and highest values of CV, CU, Consumed energy and were 17.33 and 82.67 for dry grains and 19.11 and 80.89 for germinated grains respectively. At the above conditions the consumed energy broadcasting costs values were 0.56 and 0.87 kWh/fed, and 10.60 and 13.85 LE/fed for dry and germinated grains, respectively comparing to 20 LE/fed with the traditional method. Finally, the study recommends developing the broadcasting unit to overcome the problems of fragmented, small holdings, which need suitable small machinery with the possibility of trying them in broadcasting other précised seeds. It is also, recommended to study the number and angles of vanes and simultaneously studying different fan diameters and then the material of its manufacturing.

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تطوير آلة محمولة لنثر الحبوب بضغط الهواء

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تعتبر عملية بذار الحبوب من العمليات الزراعية المهمة بعد تهيئة مرقد مناسب للبذرة بعمليتي الحراثة والتنعيم وتتم بطريقتين الأولى يدويا وهي طريقة قديمة والثانية تتم بواسطة معدات البذار الميكانيكي وهي طريقة متطورة. وتقوم آلة نثر الحبوب بزراعة المحاصيل الكثيفة مثل الأرز والقمح والشعير والبرسيم بعرض تشغيل حوالى 6 – 12.5 م حسب حجم الآلة. ومع تفتت الحيازة وصغر الماحات المنزرعة لجأ المزارعون لمثل هذا النوع للتخفيف على العامل ولقليل زمن الزراعة مقارنة بالزراعة اليدوية. كما أن لآلات النثر التقليدية تعتمد على وجود قرص تلقيم وريش عرضية تقوم بنثر الحبوب بالطرد المركزي مما يكسبها طاقة حركة فى المستوى الأفقي ولكن تكثر عيوب هذه الطرق حيث التوزيع الغير منتظم للحبوب نسبياً مقارنة ببعض الآلات الأخرى كما أن قرص التلقيم غير موجب الإزاحة فلا يرتبط فيها معدل التلقيم بسرعة تقدم الآلة مما يتطلب مهارات خاصة لتنسيق سرعة العمل مع سرعة تقدم الآلة ، كذلك تتأثر كفاءة التوزيع بالرياح مع صعوبة ضبط عرض النثر. وللتغلب على هذه المشاكل أجريت هذه الدراسة حيث تم تطوير وحدة نثر محمولة على ظهر العامل تعمل على نثر الحبوب بضغط الهواء - فى تربة طينية بعد إجراء عمليات الحرث والتسوية والتلويط فى وجود الماء - اعتماداً على وجود مروحة بلاستيك مزودة بعوارض رأسية مثبتة فى نهاية ماسورة خروج هواء مدفوع حيث يعمل الهواء المدفوع على إدارة المروحة ذات العوارض بسرعات مختلفة وقد تم تصنيع وتركيب خزان حبوب على شكل رباعى الاوجه (اعتماداً على الخصائص الطبيعية لحبوب الأرز) مزود ببوابة خروج الحبوب يمكن التحكم فيها وتتصل نهايته من أسفل بنهاية ماسورة خروج الهواء المدفوع فتخرج الحبوب المدفوعة بالهواء مصطدمة بالقرص ذو العوارض فتتناثر الحبوب بشكل منتظم ، حيث يمكن التحكم فى عرض النثر وكمية الحبوب عن طريق التحكم فى سرعة الهواء المدفوع بواسطة ذراع توصيل فى يد العامل. كما تم العمل على تثبيت ماسورة الخروج لعدم التحرك الجانبى. تمت التجربة فى مزرعة خاصة ذات تربة طينية فى محافظة الشرقية فى موسم 2014م على زراعة حبوب الأرز صنف جيزة 178 حيث شملت متغيرات الدراسة زراعة60 كجم/فدانحبوب الأرز فى حالتين مختلفتين (بذرة جافة فى أرض جافة – بذرة مستنبتة فى أرض رطبة) وكذلك تم دراسة تأثير وضع مروحة النثر (أفقى – رأسي) وبعد مخرج الحبوب (50 – 100 – 200 مم) عن نهاية ماسورة خروج الهواء المدفوع بسرعات 1.7 ، 1.97 ، 2.18 م/ث والتى تدير مروحة النثر ذات العوارضوتأثير ذلك على نمط التوزيع (عرض النثر) ومقاييس التشتت مثل معامل الانتظامية ، معامل الاختلاف ، وكذلك التأثير على الطاقة المستهلكة والتكاليف الكلية. وأظهرت النتائج أن سرعة الهواء 2.18 م/ث وطول مسار مخرج الحبوب 100 مم مع وضع مروحة النثر فى الوضع الأفقي أعطت أفضل النتائج لجميع القياسات حيث أعطت أعلى عرض نثر 10.2 و 8.8 متر للحبوب الجافة والمستنبتة على التوالى.وكانت أقل قيم لمعامل الاختلاف وأعلى إنتظاميةوأفضل القيم للطاقة المستهلكة والتكاليف كانت17.33، 82.67، 0.56 كيلووات ساعة/فدان، 10.60 جنيه/ فدانعلى التوالى للحبوب الجافة فى حين كانت القيم المقابلة 19.11، 80.89، 13.85 كيلووات ساعة/ فدان فى حين كانت تكاليف النثر 20 جنيه/فدان للنظام التقليدي. وتوصى الدراسة بتصنيع آلة النثر المطورة للتغلب على المشكلات التى تواجهنا من تفتت الحيازات وصغرها مما يستوجب توفير آلات ومعدات صغيرة الحجم تناسب المساحات الصغيرة مع إمكانية تجربتها لتناسب زراعة عديد من الحبوب الأخرى وتوصى الدراسة أيضاً بدراسة عدد وزوايا ميل العوارض على مروحة النثر وبعدها عن مخرج الحبوب وكذلك دراسة أقطار مختلفة لمروحة النثر و دراسة نوع المادة المصنوع منها مروحة النثر.