Misr J. Ag. Eng., 25(3): 655-676 FARM MACHINERY AND POWER

DEVELOPMENT AND EVALUATION A SMALL MACHINE FOR SOAKED RICE DIRECT PLANTING .

***Ibrahim M. M. ; **H. N. Abd El-Mageed ; ***T. H. Abd- Alla**

ABSTRACT

This study was carried out to evaluate the response of soaked and hasting emergence rice for mechanical direct planting.
As known, planting soaked and hasting emergence rice provide rice seedling more ability to compete the field weeds.
rice grains after soaking and hasting emergence have a new mechanical properties make it fewer endurance for impact and friction forces inside planter feeding system, which expose it to mechanical damage . However, the physical and mechanical properties of soaked and hasting emergence rice were estimated at the rice mechanization center Meet El-Dyba Kafr El-Sheikh Governorate Egypt, as a fundamental base to developed a new seeder have technical parameters suitable to direct planting for soaking and hasting emergence rice.
The developed seeder for direct planting soaked and hasting emergence rice was manufactured and laboratory tested at the Agricultural, Engineering Department, Faculty of Agricultural, Mansoura University.
To evaluate the tendency of the developed seeder , the another seed drill (Denmark seed drill Nordesten type) was tested as a control treatment.
The effect of passing rice grains through planting machine feeding system was estimated . Two factors were tested , (feeding shaft rotating speed , and rice grains treatments) , and three measurements were recorded (visible grain damage , invisible grain damage , total grain damage) .

INTRODUCTION

Seeding of agricultural crops was one of earliest farming operation to be mechanized after tillage mechanization. The main objective of most planting machine is to plant seeds irrgualy in rows or on beds. To do this in the desired manner, the seeder must perform a number of functions. Metering of seeds is considered the major and the most critical function of any planting machine. However, this function is performed by the metering mechanism, which have to form a layer of seeds fed from seed box. Then shift it simultaneously a side, and finally push it into feed tubes in a stream line flow.

*Prof. of Agric. Eng. Fac. of Agric. Mansoura Univ.
** Prof. of Agric. Eng. and Dean of Fac. of Agric. Mansoura Univ.
***Assistant Lecturer Agric. Eng. Fac. of Agric. Mansoura Univ.

The engineering characteristic, of the stream line flow involved the uniform seed path, the facility pouring of seed mass, and accurate seed dispensing. These characteristic are affected planting uniformity, seed damage and feeding rates **Awad (1999).**

Rice crop is considered one of the most important foods and export crops in Egypt. In the last ten years, the annual cultivated area increased from 1.08 to 1.56 million feddans, and the grain yield increased from 3.14 to 5.80 million tons. The average grain productivity was 3.42 ton/fed. **(Ghonimey and Rostom, 2002).** On the other side **publications of Ministry of Agriculture in Egypt (2007)** indicated that the rice cultivated area reached to 1. 6 million feddans , and the grain yield reached to 6.74 million tons.

As a matter of fact soaking of seeds before sowing strongly encourage germination and enable to add useful matters such as growth activators and unit-fungus and insecticide to the soaking water or coating material **El-Nakib (1990). Hill et al. (1998)** In their study they indicated that soaked rice seeds in water for 24 to 36 hours and drained for 18 to 24 hours, and planted by airplane directly initiates germination and increasing seed weight by approximately 25 percent so it will sing to the soil surface in the same time the unsoaked seed may float on the water surface and distribute unevenly in the field. Planting presoaked seed speeds germination and seedling emergence by two days, compared to planting dry seed. On the other side they indicated that a prolonged soak / drain period reduces seed viability and may cause complete mortality from overheating or oxygen deprivation. Rao et al. (2007) reported that in Europe , Australia and United states encourage rice direct seeding owing to facility applied mechanization, and the risk of yield due to weeds competition can be decreased as the result of size differential between the rice plant and weeds, and from the other side to the suppressive effect of standing water on weed growth. **Khan and El-Sahrigi (1990)** reported that the direct seeding in rows, does not only save transplanting labor but also facilitate mechanical weeding, plant protecting operations and efforts. They showed that Egypt still need to develop simple row seeders for direct seeding for paddy under wet and dry field conditions.

Abo El-Ees (1985) showed that, the method of seed drilling is very effective as well due to its effects on uniformity of depth and spacing. It is well known that mechanical seed drilling leads to more uniform spacing and sowing depth resulting in higher yield. However, the statistical analysis for the mechanical seed drilling gave a significantly higher yield than the traditional hand method of sowing. **Nour (1990)** studied the parameters affecting rice losses during harvesting. In order to suggest the suitable method of planting rice under Egyptian conditions and to maximize profit. He concluded that planting rice with seed drill is accompanied by the lowest percentage of loss because of the uniform distribution of plants in both vertical and horizontal directions. Then follow by mechanical transplanting and manual planting methods respectively. **Baloch et al. (2007)** in their research on the feasibility of rice new planting techniques (direct seeding on flat, transplanting on ridges and parachute planting). The research was carried out at Dera Ismail Khan region in Pakistan during 2002 and 2003, the results of this study indication was noted for transplanting on flat during both years, but direct seeding on ridges could not excel during both cropping seasons.

Stout (1966) reported that the direct seeding is considered as good as transplanting in Korea and requires ten times less labor. He also added that an experiment in Pakistan in which broadcast plots yielded more than transplanted

From the above mentioned it can be definition the aim of this study is to develop new seeder, the developed unit more suitable for planting soaked seeds.

MATERIALS AND METHODS

This study was carried out to investigate the performance and operating parameters of a developed planting machine for sowing soaked seeds, the experiments of this research could divided into two separate groups.

This groups were conducted in the laboratory under control conditions .

The first group : It was conducted to measuring the physical and mechanical properties of the tested seeds , due to determine the basic data and introduce the most suitable engineering parameters necessary for design and developing a seed drill suitable for planting soaked seeds .

<u>The second group</u> : It was carried out to determine the influence of passing seed samples through feeding system of the developed seeder, and traditional seed drill (Nordsten lift-o-matic model), as a control treatment , and investigate the seed viablity before and after its passing .

The First Experimental Group(Physical And Mechanical Properties Of rice grain) :-

This experimental group was carried out at the Rice mechanization center Meet El-Dyba Kafr El-Sheikh Governorate Egypt .

Physical and mechanical properties of rice grains were estimated before and after soaking according to the following procedures.

1- Coefficient of friction (F) :-

Coefficient of friction for each seeds samples under study was measured under the condition of two friction surfaces (rubber and steel).Coefficient of friction was calculated by instrument as shown in figure (1).

$$\mathbf{F = Tan\ \theta}$$

<u>Where</u> :-

Friction angle (θ) : Inclined angle of friction surface which caused start seeds slides on friction surface.

2- Grains repose angle (Ra):-

Angle of natural slope (repose angle) of rice grains was measured by an instrument shown in figure (2), every measurement was repeated 10 times and mean value was calculated to determine the angle of repose for each treatment.

3- Shape index :-

A random sample of one hundred grains was taken from each sample before and after soaked or coated processes. The shape of each grains sample was studies in terms of length (L), width (W), and thickness (Th). By using the vernier caliper with accuracy of 0.01 mm. The obtained data were used to calculate the shape index of each sample, according to Ismail (1988).

$$\text{Shape index (SI)} = \frac{L}{\sqrt{W.Th}}$$

At shape index > 1.5 the grain is considered oval and ≤ 1.5 the grain is considered spherical.

4- Weight of 1000 grains (W) :-

In order to determine the mean weight of 1000 grains, samples of 1000 grains were randomly selected. Each sample was weighted using an electronic balance with an accuracy of 0.01g .

5- : Actual grains volume (V) and real density (D) :-

The actual grains volume was measured by using half-liter capacity graduated beaker. The graduated beaker was filled with water to a defined level, then (10 grams) of seeds were completely immersed in the beaker. The actual seeds volume was calculated (cm^3/g) based on the difference between the two measured volumes of water for each 10 grams of grains. Real density of seeds, was calculated using the following equation:

$$D = \frac{M}{V} \text{ g /cm}^3$$

<u>**where**</u>:-

D = The real density of seeds g/cm^3.

M = Mass of seeds (10g).

V = Actual volume of seeds cm^3.

6- Grain crashing force (CF):-

Grain crashing force (in Newton) was determined for each grains sample by using the instrument which shown in figure (3). Every measurement was repeated 10 times , and mean values was calculated .

Fig. (1) : The friction instrument.

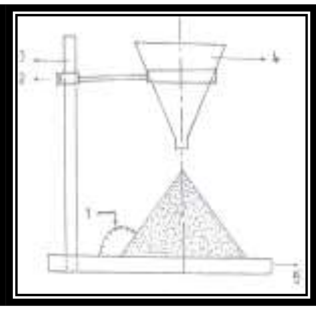

Fig. (2) : Instrument measuring angle of natural slope.
1. Protractor 2. Movable guide 3. Carrier 4. Funnel 5. Base

Fig. (3) : Crashing force instrument.

7 - Grain moisture content (M.C) determination

The moisture content of Rice samples was measured by the standard air oven method using 25 g sample placed in air oven at 130° C for 16 hr. as recommended by Matouk (1976)

Developing Criteria And Specification Of The Seeder Elements :-

The developed seeder was constructed and fabricated at the Agric. Eng. Dept. Faculty of Agric. Mansoura Univ. During the construction of the planting machine the following points have been taken into consideration:

1- All parts are made of local materials.
2- The developed machine should have simple mechanisms and shape.
3- Using the developed seeder caused minimum friction between grains and feeding system elements, therefore it lead to minimum seeds mechanical damage.
4- The developed seeder suitable not only for dry seeds but also for soaked and coated seeds.

Components Of The Developed Planting Machine :-

Based on the results obtained from determine some of physical-mechanical properties of soaked rice grains, a planting machine was developed and constricted in the workshop of faculty of agriculture Mansoura university .

figures (4 & 5 & 6 and 7) show and present overall feature , and dimensions of developed planting machine .

1-The machine Frame:-

The main frame was constructed to be able to assemble all machine components rigidly and safe. It made of steel angle (50 mm. width) and (5 mm. thickness). The frame consisted of rectangular shape, with inside dimensions (110, 20 cm) and two triangular shapes, which welded in both side of frame in vertical position.

The machine frame provided with two land wheels (40 cm diameter each) to carry the machine during field work and supply the machine feeding system of motion.

The first land wheel provided with one gear (20 teeth), fixed on the same wheel axe to transport the motion from the land wheel to group of gears (three gears 13, 25, 39 teeth) fixed on the feeding shaft end.

The second land wheel provided with one gear (20 teeth) to transport the motion from the land wheel to the axe with three cams fixed on it to transport the reciprocating motion to the seed motivate shaft inside the seed hopper.

2 -The seed hopper

The hopper of planting unit fabricated from a 1 mm. steel sheet, it has trapezoid cross section, and its walls inclined angle on horizontal (60 degree), larger than fraction and repose angles between rubber and soaked seeds, to be caused slide of soaked seed too metering device in the seed hopper bottom. The main dimensions of seed hopper demonstrate in figure (3-10).

The inner face of the hopper was covered with rubber to reduce the impact damage. The hopper is set and fixed on the main frame and fixed to it by two blots with nuts.

3 -The seed metering mechanism

Metering of seeds is considered the major and the most critical function of any planting machine type. In the present work it can be divided the planting machine metering device in two shafts and gate opening as flow:-

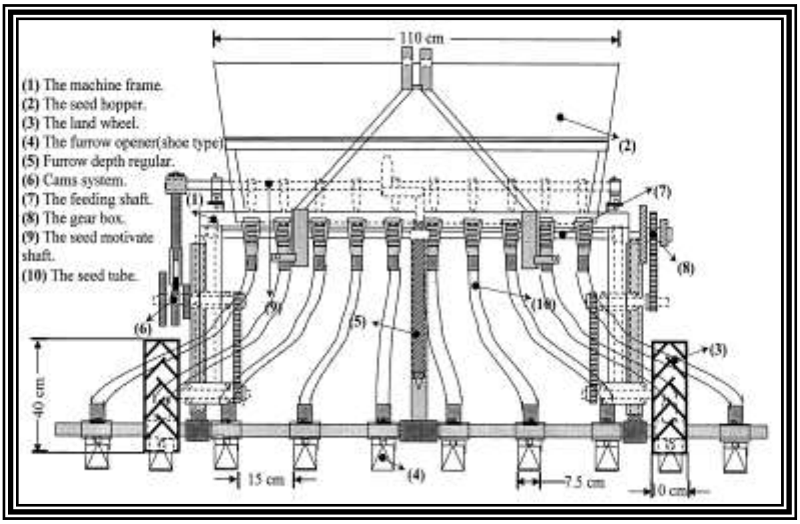

Fig. (4) : Schematic diagram of developed seeder

***a - Seed motivate shaft* :-**

This shaft attending inside seed hopper (10 cm above hopper bottom) it provided with 10 plastic fingers to reduce the seed impact damage. This fingers distributed along the motivate shaft , one finger above every gate opening, as shown in figure (5) .

The motivate shaft take its reciprocate motion from land wheel by means of cams. The main target from provided the motivate shaft with reciprocate motion to be cause the least seed crash.

Number of shaft reciprocating strokes were studied by using three push cams (one, two and three push stroke cams).

***b - Feeding shaft and its reels* :-**

The planting machine is provide with feeding shaft, it attending lower seed hopper, and equipped with ten aluminum reels distributed along the feeding shaft one reel under every gate opening. A rubber toothed belt wrap around every reel circumference, which shown in figure (6).

Fig. (5) : Developed seeder motivate shaft.

Fig. (6) : Developed seeder feeding shaft and its reels

Wrap the reels with rubber toothed pelt cause easy seeds passing throw feeding system , without crash. The feeding shaft take rotate motion from machine land wheel, by four gears and chain, one gear 20 teeth fixed on land wheel axe, and three gears 13, 25, 39, teeth fixed on feeding shaft end outside the seed hopper. This construction enable to study, the distance between planting hill, and feeding rate, and absent hill at varies planting speed.

Many of preliminary experiments were done to defined the best reel dimensions. The reel dimensions were found 6 cm diameter and 3 cm width. Every reel wrap with toothed rubber pelt, which have 20 teeth , formed 20 seed cells (the distance between two teeth consider as one seed cell .)

c - Gate opening:-

Planting machine hopper bottom provide with ten gates opening sliding above ten feeding holes in seed box bottom this gate were , distributed along the hopper bottom.

To be controlling the feeding opening size in seed box bottom, during carried out the laboratory calibration of developed seeder, all seeder gate opening were fixed in the same position to keep the equal area for every hopper perforate, the perforate area was choose after seeder calibration to give the best grains weight in the suitable planting area.

The feeding shaft provides with ten reels existing under seed hopper, every reel close of one hopper perforate by its circum surface. At planting time reels take its rotate motion from feeding shaft, and seeds in hopper falling down in seed cell which carry it to the seed tube.

4-Planting machine furrow openers and covering seeds system :-

The planting machine was provided also with ten furrow openers (shoe type) in order to open a shallow furrow where seed delivering and fall.

The common method of covering planting seeds was done by pulling a small drag bar behind all machine furrow openers.

The Nordsten Seed Drill :-

To determine the influence of passing soaked and coating seeds through feeding system of the developed seeder , estimate the impact damage and crash of seeds caused by this procedure, in this respect to be necessary using the Denemarken seed drill (Nordsten type lift-o-matic model) 18 rows with a working width 220cm , and 12cm a distance between each two rows , as shown in figure (3-14) as a control treatment

The Second Experimental Group :-

This experimental group was carried out at the Agricultural, Engineering department, Faculty of Agriculture Mansoura University. To carried out this experimental group, both developed seeder and Nordsten seed drill , were provided with a lathe as a source of power with converted rotating speed, the power transported from lathe to feeding shaft through two pulleys and belt, and group of gears .

Fig. (7) : The developed seeder

Fig. (8) : Denmark seed drill "Nordsten type lift-O-matic model"

The performance of developed metering mechanism and feeding mechanism of Denmarken seed drill Nordsten type (lift-o-matic model) were compared at four different rotating speed for feeding shaft namely (30, 40, 50 and 60 r.p.m). Therefore the second experimental group could be divided into two experimental sup-group according to numbers of tested feeding mechanism. Thus each sup-group of the laboratory experiments included 20 experimental treatments in three replicates. These treatments are four rotating speed for feeding shaft (Rs_1, Rs_2, Rs_3 and Rs_4), and five rice grain treatments. the experimental treatments in the second experimental group referred in this work as shown in table (1).

To determine the effect of passing rice grains through feeding system of the developed seeder and traditional seed drill (Nordsten type) , there were three main measurements were estimated as the following:

(A):Percentage of visible grain damage (external) (VD%) :-

Visible grain damage was determined by using convex lens for each sample before and after its passing through feeding system of planting machine .

Percentage of visible grain damage was estimated through the following equation :-

$$(VD\,\%) = [\,(V_1 - V_2)\,/\,500\,] \times 100$$

Where **:-**

V_1 = Number of damaged seeds in sample (500 seeds) , which randomly segregate from every rice main sample before its passing through seeder feeding system .

V_2 = Number of damaged seeds after passing seed sample (500 seeds) through seeder feeding system.

(B): Percentage of invisible grain damage (internal) (ID%)

Germination test was carried out to determine the invisible damage of seeds . A randomized sample of 100 seeds visible unharmed grains were taken and planted in Petri dishes to determine the germination percentage . the results were recorded after ten days from planting , and the germination percentage was estimated through the following equation

$$(ID\,\%) = [\,(N_2 - N_1)\,/\,N_2\,] \times 100$$

where :-

N_1 = Number of growing seeds

N_2 = Number of planting seeds (100 seeds).

(C): The total grains damage (TD%)

The percentage of visible grains damage (VD%) summated with invisible grains damage percentage (ID%), for all second group experiments, and the values of total grains damage (TD%) were estimated basing for the following equation:

$$TD\% = VD\% + IV\%$$

Table (1) : The second experimental group treatments.

No.	***Soaking and coating procedures***	***Feeding shaft rotating speed r.p.m (Rs)***	***Treatment symbols***
1	Dry Rice " grains without coating or soaking process" **(T_1)**.	$Rs_1 = 30$	$T_1\ Rs_1$
2		$Rs_2 = 40$	T_1Rs_2
3		$Rs_3 = 50$	T_1Rs_3
4		$Rs_4 = 60$	T_1Rs_4
5	Soaked grains " 12 hr. soaking time" **(ST_1)**.	$Rs_1 = 30$	$ST_1\ Rs_1$
6		$Rs_2 = 40$	$ST_1\ Rs_2$
7		$Rs_3 = 50$	$ST_1\ Rs_3$
8		$Rs_4 = 60$	$ST_1\ Rs_4$
9	Soaked grains " 24 hr. soaking time" **(ST_2)**.	$Rs_1 = 30$	$ST_2\ Rs_1$
10		$Rs_2 = 40$	$ST_2\ Rs_2$
11		$Rs_3 = 50$	$ST_2\ Rs_3$
12		$Rs_4 = 60$	$ST_2\ Rs_4$
13	Soaked grains " 36 hr. soaking time" **(ST_3)**.	$Rs_1 = 30$	$ST_3\ Rs_1$
14		$Rs_2 = 40$	$ST_3\ Rs_2$
15		$Rs_3 = 50$	$ST_3\ Rs_3$
16		$Rs_4 = 60$	$ST_3\ Rs_4$
17	Hasting emergence grain treatment **(IS)**.	$Rs_1 = 30$	IS Rs_1
18		$Rs_2 = 40$	IS Rs_2
19		$Rs_3 = 50$	IS Rs_3
20		$Rs_4 = 60$	IS Rs_4

RESULTS AND DISCUSSION

The obtained results of this study can be discussed under two main heads.

First Experimental Group

In order to determine some physical and mechanical properties of Rice grains before and after soaking procedures, the changed in grain shape and physical characteristics were investigated as the fundamental base for developed new feeding mechanism suitable for planting soaked seeds.

The investigation included grain moisture content (M.C), coefficient of friction (F), grain repose angle (Ra), shape and size index, weight of 1000 grains (W), actual grains volume (V), real density (D) and grain crashing force (CF). The obtained results are summarized in table (2).Data in table (2) shows the highst values for coefficient of friction were estimated for grains and rubber at all Rice grains treatments under study, while the lowest friction coefficients were for Rice grains and steel sheet, this trend may be due to increase the adhesion force between Rice grains and rubber more than grains and steel, particulary at hight grain moisture content as a results of soaking and coating process On the other side it can be seen increment the coefficient of friction whith the increasing in soaked grain time, this behavior was expected to increasing grain moisture content whith increas the soaked time. It can be seen that also the high coefficient of friction (F) was obtained for hasting emergence seeds which have the highest moisture content. In despite of coefficient of friction for Rice grains and rubber cause the lowest impact force with grain, therfor the seed hopper of developed seeder was paded with rubber sheet.

Table (2) shows also increasing in repose angle for Rice grains with increasing in soaked time and grain moisture content, and this trend also due to increment in grains moisture content produce more grain water surface and more adhesion between grains.

The highest repose angle (39.9°) recorded with hasting emergence grains. This enable us to make walles of seed hupper with slope higher than (39.9°) on horizontal, to cause continuity slope grains to the hupper bottom.

Inspections of the data in table (2), it can be seen that all values of shape index (SI) higher than 1.5, this intend that all Rice grain shape befour and after all grain teatments take oval shape.

Table (2) : Mean values of physical and mechanical properties results.

No.	Rice grains treatments	Coefficient of friction (F)		(Ra) Degree	Shape index (SI)	(W) grams	(V) $cm^3/g.$	(D) g/cm^3	(CF) Newton	Grain moisture content w.b% (M.C%)
		Grain + Rubber	Grain + Steel							
1	(Dry rice)	1.01	0.72	32.1	2.81	33.03	1.36	0.733	99.96	12.6
2	Soaked grains (12 hr. soaking time)	1.02	0.73	36.2	2.52	67.81	0.9	1.11	80.75	23.2
3	Soaked grains (24 hr. soaking time)	1.03	0.74	37.5	2.22	70.04	0.78	1.29	72.32	26.3
4	Soaked grains (36 hr. soaking time)	1.04	0.74	38	2.01	73.36	0.76	1.31	60.51	30.1
5	Hasting emergence grains.	1.06	0.76	39.9	2	78.47	0.75	1.33	48.13	35.2

This contributed us to fabrecat seeder seed cells as a cylinderical shape and to disquality spherical form.

Results of weight of 1000 grains (W), actual grains volume (V), and real density (D) are summarized in table (2) also. From demonstrated data, it can be seen that weight of 1000 grains (W), and grain real density (D) take the same trend, whereas its values were significantly increasing with increasing in moisture content but this behavior is contrary with actual grains volume (V), which decreasing with increasing grains moisture content. Table (2) also shows, the highest crashing force (CF) value was recorded for rough rice sample it was (99.96 Newton), and it gradually decreasing, to equal (48.13 Newton) at hasting emergence seeds which have the highest moisture content (35.2%).

second experimental group

The measurements of visible and invisible grain damage percentage (VD % and ID % respectively), were collected as an average of three measurements replicates. Confining that the values of these measured quantities for developed seeder and seed drill (Nordsten type) are tightly related to the two investigated engineering parameters[feeding shaft rotating speed and grains treatments " soaking , or hasting emergence"]. The laboratory results could be refereed as follows:-

Visible , invisible and total grain damage:-

All visible, invisible and total grain damage data were calculate as the mean values of three measurements at different motivate shaft reciprocate motions under study (one & two and three strokes every one revolution of land wheel).

1 : Visible grain damage (VD)

The data illustrated in figures (9 to 13) shows the effect of feeding shaft rotating speed r.p.m (Rs) at different grains treatments under study for developed seeder and seed drill (Nordsten type) on visible rice grains damage.

The demonstrate data shows that, for the same grains treatments and feeding shaft rotate speed, all results of visible grain damage gave high values for traditional drill (Nordsten type) and demonstrate high significant differences between using seed drill and developed seeder.

The mentioned data indicated the highest value of visible grains damage 17.33% was gained by using seed drill (Nordsten type) for hasting emergence seeds at feeding shaft rotating speed 60 r.p.m., but this value was 5% by using developed seeder at the same conditions.

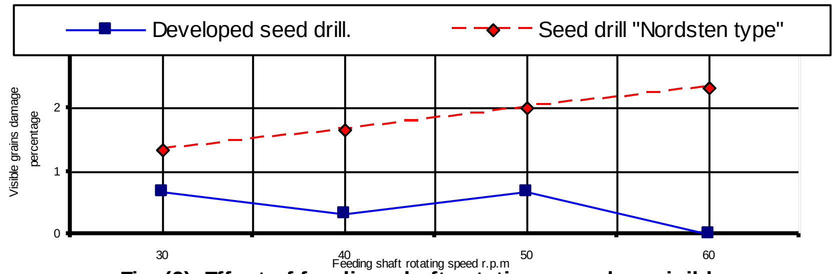

Fig. (9): Effect of feeding shaft rotating speed on visible damage of dry rice grains for two feeding mechanism under study

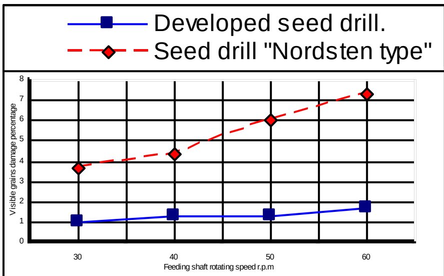

Fig.(10): Effect of feeding shaft rotating speed on visible damage of soaked rice grains (12 hr.) for two feeding mechanism under

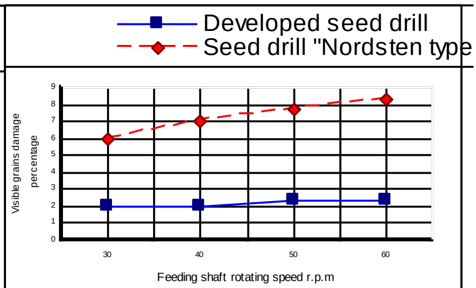

Fig.(11): Effect of feeding shaft rotating speed on visible damage of soaked Rice grains(24 hr.) for two feeding mechanism under study

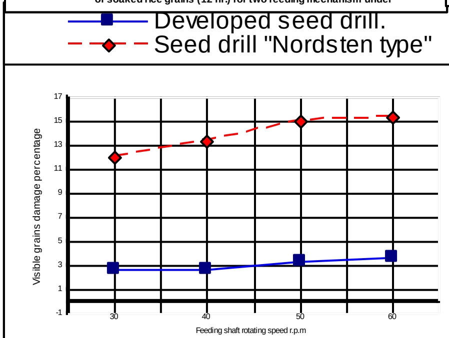

Fig.(12): Effect of feeding shaft rotating speed on visible damage of soaked rice grains(36 hr.) for two feeding mechanism under study

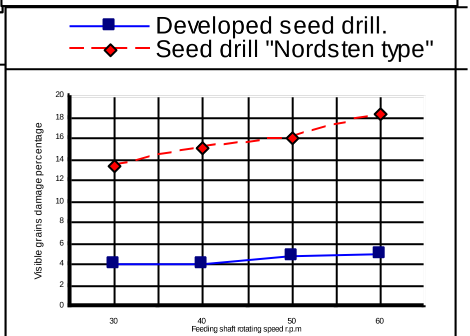

Fig.(13): Effect of feeding shaft rotating speed on visible damage of hasting emergence grains for two feeding mechanism under study

In general from obtained data it can be seen that, coating and soaking processes caused more visible grains damage, and its values increase with increasing soaked time, this trend attributed to increasing the grain moisture content with increasing grains soaked time, cause absence of grains hardens, and make it more softy and decrease its endure of impact and friction forces during passing it through planter feeding system

2 : Invisible grains damage (ID)

Data illustrated in figures (14 to 18) indicated that the feeding shaft rotating speed and grains treatments were directly effected on invisible grains damage. The highest value of invisible grains damage was 17.33%, this value to be realized by using traditional seed drill (Nordsten lift-o-matic type) at feeding shaft rotating speed (60 r.p.m) for hasting emergence grains.

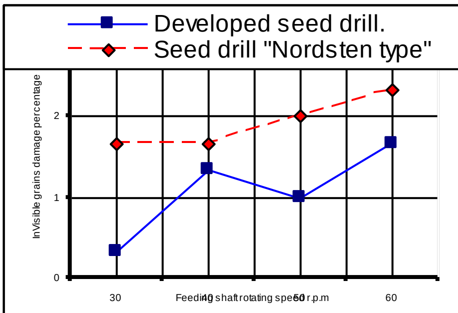

Fig. (14): Effect of feeding shaft rotating speed on invisible damage of rough rice grains for two feeding mechanism under study

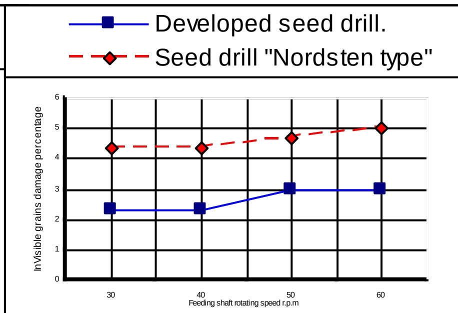

Fig. (15): Effect of feeding shaft rotating speed on invisible damage of soaked rice grains (12hr.) for two feeding mechanism under study

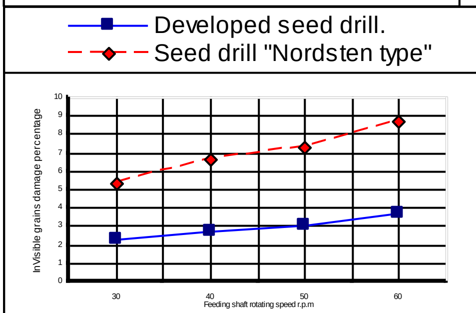

Fig. (16): Effect of feeding shaft rotating speed on invisible damage of soaked rice grains (24hr.) for two feeding mechanism under study

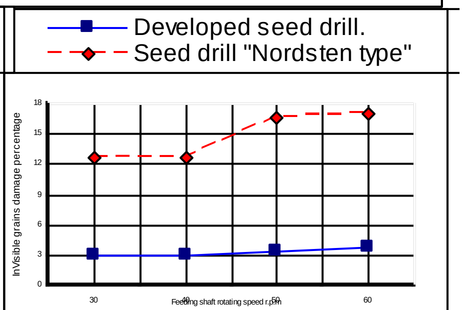

Fig. (17): Effect of feeding shaft rotating speed on invisible damage of soaked rice grains (36hr.) for two feeding mechanism under study

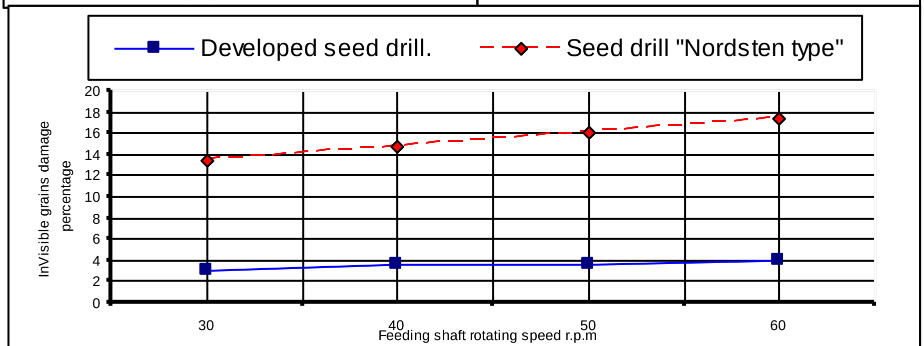

Fig. (18): Effect of feeding shaft rotating speed on invisible damage of hasting emergence grains for two feeding mechanism under study

From the other side, it can be seen from the obtained results that the highest value of invisible grains damage by using developed seeder (4%)

gained at the same feeding shaft speed (60 r.p.m) and the same grains treatment.

In general, from the collected data indicate clear trend to increase the invisible grains damage at increasing soaked time and feeding shaft velocity. At the same time it can be recognize, highest values of invisible grains damage always materialize by using seed drill (Nordsten type) , but using developed seeder all the time caused the lowest values of invisible grains damage at the same conditions from feeding shaft speed and grains treatments. For example the lowest value of invisible grains damage was (0.33%) obtained by using developed seeder for rough Rice grains at the lowest seeder feeding shaft speed (30 r.p.m), in the same time it can be seen that this value was (2%) at the same Rice treatment (rough rice) and the same feeding shaft speed (30 r.p.m).

From the obtained data and previous explanation, which indicated high significant influence for using developed seeder on decrease the values of invisible grains damage comparing with using traditional seed drill (Nordsten type). The previous results may be connected with engineering considerations which take into developed seeder metering system, such as:

1- Motivate shaft reciprocate motion.

2- Covered the inner face of the seed hopper with rubber sheet.

3- Wrap a rubber toothed pelt around feeding reels.The previous engineering consideration may be decreased impact and fraction forces between grains and feeding system elements, which obtained the lowest values of visible and invisible grains damage.

3 : Total Rice grains damage percentage (TD%)

Summation of visible and invisible grains damage after passing it through feeding system of traditional seed drill (Nordsten lift-o-matic type) and the developed seeder was calculated as one measurement to express the total grains damage (TD).

The calculated values of (TD) which illustrated in figures (19 to 23) indicate the same trend to decrease total grains damage by using the developed seeder comparing with the traditional seed drill (Nordsten lift-o-matic type), and also total grains damage values, were increased with grains soaked time increasing, and on the other hand the increasing in speed of feeding shaft, obtained high values of total grains damage. The lowest value of total grains damage (1%) was gained for rough Rice by using the developed seeder, at the lowest feeding shaft speed (30 r.p.m), while this value was (3%) by using traditional seed drill (Nordsten lift-o-matic type). From the other side the highest value (25.76%) was obtained for hasting emergence grains and the highest feeding shaft speed (60 r.p.m) whereas this value was (5.67%) by using the developed seeder at the same experimental conditions.

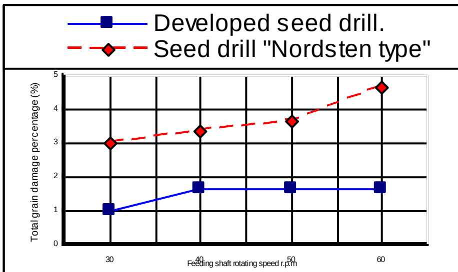

Fig. (19): Effect of feeding shaft rotating speed on total damage of rough rice grains for two feeding mechanism under study

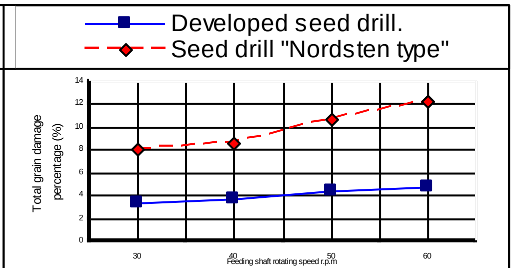

Fig. (20): Effect of feeding shaft rotating speed on total damage of soaked rice grains (12 hr.) for two feeding mechanism under study

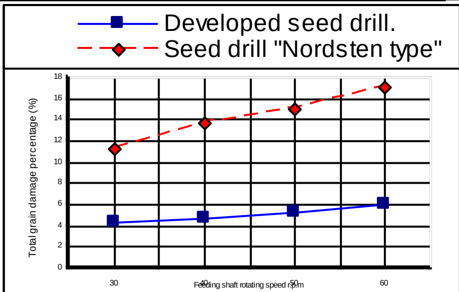

Fig. (21): Effect of feeding shaft rotating speed on total damage of soaked rice grains (24 hr.) for two feeding mechanism under study

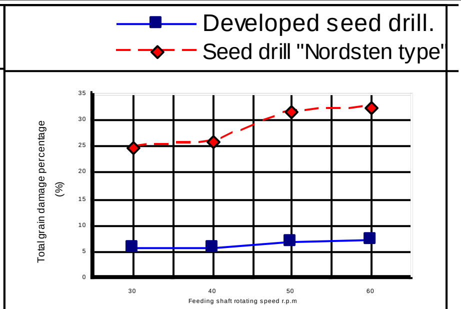

Fig. (22): Effect of feeding shaft rotating speed on total damage of soaked rice grains (36 hr.) for two feeding mechanism under

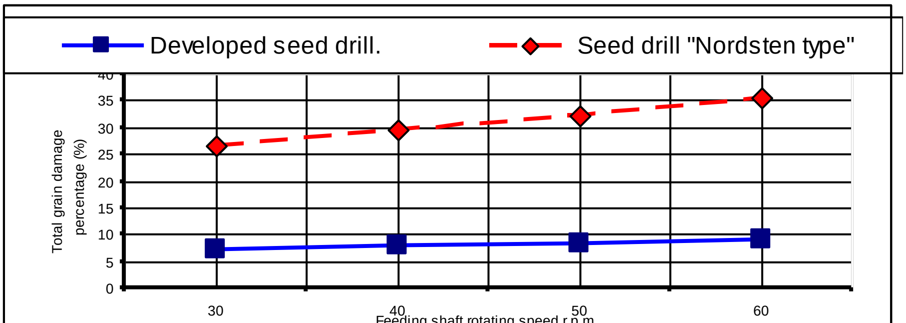

Fig. (23): Effect of feeding shaft rotating speed on total damage of hasting emergence grains for two feeding mechanism under study

CONCLUSION

Developed planting machine for planting soaked rice was fabricated and tested .

Laboratory measurements were carried out on rice grains (G178) before and after soaking to determined physical and mechanical properties , and the collecting data takes as a fundamental basic to introduce the most suitable engineering parameters for design and developed a seed drill suitable for planting soaked seeds .

The developed seeder had three engineering considerations to protect soaked seeds against mechanical damage , there are :-

1- The inner face of the seed hopper was covered with rubber to reduce the grains impact damage.
2- Seed motivate shaft was provided with reciprocate motion from developed seeder land wheel, to be cause the least seed crash.
3- Feeding reels and seed cells :- the feeding shaft of the developed seeder was provided with ten aluminum reels wrap around its circumference with rubber tothed pelt to prevent the crashing of soaked seede.

After fabricate the developed seeder , a second experimental group was conducted in laboratory also , to evaluate the new seeder comparing with seed drill (Nordesten type) . Four feeding shaft rotating speeds (30 – 40 – 50 – and 60 r.p.m) five rice grain tretments were tested , and three measurements were recorded .

in general the resultes could be summarized as flow :-

1- Soaking or hasting emergence process changed physical and mechanical properties of rice grains , which make it lower endurance to impact and friction forces inside feeding systemems of traditional seed drills .

2- The laboratory experiments indicate also that the seed drill (Nordesten type caused mechanical damage in soaked rice grains more than the developed seeder .

REFERENCES

Abo El-Ees, N. A. (1985) " The effect of seed-bed preparation and method of planting on crop yield". Misr J. Agr. Eng. 2(4): 131 – 136.

Awad, A. A. S., (1999), Engineering studies on sunflower planting in Egyption farms. M. Sc. Th., Ag. Eng. Dept., Fac. Ag., Mansoura Univ., Egypt: 1 – 2.

Baloch, M.S. ; I.U. Awan ; G. Hassan and Zubair, M. (2007) " Studies on plant population and stand establishment techniques for increasing productivity of rice in Dera Ismail Khan, Pakistan." Rice science, volume 14, Issue 2, June 2007 : 118 – 124.

El-Nakib, A. A. (1990), " Sugar-Beet precision planting and emergence with coated seed." Misr J. Agric. Eng., 7 (3) : 208 – 223.

Ghonimey, M. I. and M. N. Rostom (2002), Tech. Economical approach to

combine harvesters evaluation. Misr J. Agr. Eng. 19(1): 83 – 98.

Hill, J.E. ; S.R. Roberts ; D.M. Brandon ; S.C. Scardaci ; J.F. Williams and R.G. Mutters (1998), "Rice production in California (5/13)" California rice promotion board. Aug. 1998 New selectter.

Ismail, Z.E. (1988), "Same of the phsio-mechanical properties for potato tubers. J. Agric. Sci. Mansoura Univ. 13 B (4): 2259 – 2270.

Khan, A.U. and A.F. El-Sahrigi, (1990), "Selective mechanization of rice farming system in tropical Asia". Agric. Eng. Today 14(3,4): 40 52.

Matouk, A.M., (1976), "Heat and moisture movement during low temperature drying and storage of maze grain". Unpublished Ph.D. Thesis, Dept. of Agric. Eng., University of Newcastle Upon Tyne, United Kingdom.

Rao, A.N. ; D.E. Johnson ; B. Sivprasad ; J.K. Ladha and A.M. Mortimer (2007) " Weed management in direct – seeded rice" Advances in Agronomy, volume 93(2007) : 152 – 255.

Nour, H.M., (1990), "Evaluation of rice harvesting". Unpublished M. Sc. Thesis, Ag. Mech. Dept., Faculty of Agric., Mansoura Univ. Egypt.

Stout, B.A., (1966), Equipment for rice production. Agri. Development paper No. 84, Food and Agric. organization (FAO) of the united Nations.

- نشرات وزارة الزراعة المصرية ٢٠٠٧م

الملخص العربي

تطوير وتقييم آلة صغيرة للزراعة المباشرة لحبوب الأرز المبتلة .

* ماهر محمد إبراهيم ** هشام ناجى عبد المجيد
*** طارق حسنى الشبراوى

تتم زراعة الأرز في مصر إما بالبدار اليدوي ويكون ذلك باستخدام حبوب مكمورة بحيث لا نعطى فرصة لنمو الحشائش, إلا أن ذلك لا يكون فيه انتظام لنمو النباتات مما يتطلب معه عمليات ترقيع عن طريق نقل بعض النباتات من الأماكن الكثيفة إلى الأماكن الخالية مما يزيد من تكاليف عملية الزراعة , أو بالشتل اليدوي وهذا يتطلب تكاليف عالية كما أنه لا تكون هناك انتظامية في توزيع النباتات في الحقل أيضا – وتصل تكلفة الفدان الواحد إلى ١٠٠٠ جنيه مصري ، وقد تتم الزراعة أيضا بالشتل الآلي وهذا يكون أفضل في توفير التقاوي وانتظام الزراعة , إلا أن التكلفة أيضا تكون عالية (حيث يصل سعر الشتالة ١٨٠٠٠٠جنيه مصري) – وقد تتم زراعة الأرز أيضا بالتسطير باستخدام حبوب جافة في أرض جافة , وهذا يوفر في التقاوي ويجعل الزراعة أكثر إنتظاما , إلا أن هذه الطريقة للزراعة تعرض البذور للانجراف بمياه الري والرياح وذلك نظرا لقلة الوزن النوعي للبذور الجافة مما يسبب أيضا عدم انتظامية في توزيع النباتات في الحقل – بالإضافة إلى أن زراعة البذور الجافة تعطى فرصة أكبر لنمو الحشائش ومنافستها للنبات النامي - مما دعانا إلى التفكير إلى زراعة بذور الأرز المنقوعة والمكمورة بالآلة – إلا أن آلات التسطير المتاحة لا تناسب حبوب الأرز المنقوعة لتجمع الحبوب في كتل يصعب مرورها خلال جهاز التلقيم كما أن الحبوب المبتلة تكون أكثر عرضة للضرر الميكانيكي إذا مرت في أجهزة التلقيم لآلات التسطير العادية .

لذا كان الهدف من هذا البحث هو تطوير آلة زراعة تناسب زراعة حبوب الأرز المبتلة والمكمورة ولتحقيق هذا الهدف تم دراسة الخواص الطبيعية والميكانيكية لحبوب الأرز الجافة والمنقوعة والمكمورة .

وقد أجريت الدراسة على محصول الأرز جيزة ١٧٨. حيث تم دراسة الخواص الطبيعية مثل معامل الاحتكاك بين البذور المبتلة والمطاط والحديد – زاوية الاستقرار – معامل الشكل – الكثافة الحقيقية – القوى ألازمة لكسر الحبة – وزن أل ١٠٠٠ حبة – نسبة الرطوبة على أساس رطب، وقد تم تقدير هذه القياسات على (حبوب الأرز الجافة – والمنقوعة ١٢ ساعة – والمنقوعة ٢٤ ساعة – والمنقوعة ٣٦ ساعة – والحبوب المكمورة).

- وأظهرت نتائج هذا الجزء من التجربة فروق كبيرة بين قيم القياسات بين الحبوب الجافة والحبوب المنقوعة ، وميل الحبوب المنقوعة والمكمورة إلى أخذ الشكل الكروي بينما الحبوب الجافة تأخذ الشكل الإسطوانى

- تم أخذ نتائج الخواص الفزياقية للبذور المبتلة كقاعدة بيانات لتطوير آلة زراعة لبذور الأرز المبتلة .

* أستاذ الهندسة الزراعية - كلية الزراعة - جامعة المنصورة.
** أستاذ الهندسة الزراعية - وعميد كلية الزراعة - جامعة المنصورة.
***مدرس مساعد- قسم الهندسة الزراعية- كلية الزراعة - جامعة المنصورة.

ويمكن إجمال النقاط الهندسية فى آلة الزراعة المطورة لتلائم زراعة البذور المبتلة فى الآتى:-

١- تم تبطين خزان البذور بالبلاستيك لتقليل قوى التصادم بين البذور وجدار الخزان.
٢- تزويد عمود التقليب بأصابع بلاستيك بدل من المعدن لتقليل قوى الاحتكاك والتصادم بين ريش عمود التقليب والبذور المبتلة.

٣- تم إمداد عمود التقليب بحركة ترددية بدلا من الحركة الدائرية فى أعمدة التقليب لآلات التسطير العادية والتى من شأنها هرس البذور المبتلة وإحداث قدر كبير من التلف الميكانيكى.
٤- تم تصنيع تروس التلقيم على عمود التلقيم من الكاوتشوك حتى لا تتعرض البذور المبتلة إلى الهرس والتكسير نتيجة لصناعة هذه التروس من الحديد فى آلات التسطير العادية.
٥- كما تم أيضا إعطاء الحركة لعمود التقليب من إحدى العجلات – وأيضا تم إعطاء الحركة لعمود التلقيم من العجلة الأخرى للآلة حتى يتم توزيع الحمل على العجلتين ويقل الإنزلاق لعجل الآلة وهذا أيضا عكس آلات التسطير العادية حيث يأخذ كل من عمود التلقيم والتقليب الحركة من عجلة واحدة.

– وقد تم إختبار هذه الآلة معمليا على النحو التالى:

- تم إختبار الآلة المطورة وآلة التسطير الدينامركية الصنع (Nordesten type) كمعاملة مقارنة حيث تم إمرار البذور بعد معاملات نقع وكمر مختلفة خلال جهازي التلقيم للآلتين بعد إمداد الآلتين بسرعات متغيرة لجهاز التلقيم عن طريق توصيل الحركة من ظرف مخرطة معادن إلى جهاز التلقيم للآلتين . وكانت سرعات التلقيم المستخدمة هى (٣٠ & ٤٠ & ٥٠ & ٦٠ لفة/دقيقة) ومعاملات البذور هى (بذور جافة – بذور منقوعة ١٢ ساعة – بذور منقوعة ٢٤ ساعة – بذور مكمورة).
- وقد تم تقدير (الكسر الظاهري والكسر الداخلي وجملة التلف الميكانيكي الحادث للبذور قبل وبعد مرورها فى أجهزة التلقيم للآلتين).

- وقد أظهرت النتائج أن آلة الزراعة المطورة تعطى نتائج جيدة في تقليل نسبة الكسر بأنواعه المختلفة عن آلة التسطير (Nordesten type) لجميع معاملات البذور وجميع سرعات جهاز التلقيم.