EVALUATION THE FIELD PERFORMANCE OF A DEVELOPED PLANTING MACHINE SUTABLE FOR SOAKED RICE .

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

ABSTRACT

Developed seeder for planting soaked and hasting emergence rice was constructed and fabricated in Mansoura Univ. Faculty of Agriculture , Agric. Eng. Department .   To actual evaluate the developed seed drill performance in the field, field experiments was carried out at the experimental form of El-Gimaza research station El-Gharbia Governorate during the rice growing season of 2008.

The developed seeder was tested with three rice grains treatments. From the other side, Turkish seed drill Master UIK type was used for planting hasting emergence rice as a control treatment.

There are three factors were tested in the experimental field, the first factor was planting forward speeds (0.64 – 0.89 – 1.19 – and 1.42 m/sec). The second factor was grains treatments (dry grains - soaked grain {24hr soaked time} and hasting emergence grains). The third factor was two types of planting machines (the developed seed drill and the Turkish seed drill Master UIK model).

To evaluate the influence of previous factors there were five experimental measurements, (number of plants per square meter & emergence ratio & Longitudinal scattering & plants lateral scattering and weeds number in square meter). The results indicated the maximum weeds fight was 5 weeds per one square meter it gained for planting hasting emergence rice by developed seed drill but this value was 10 weeds/m^2 for planting by Turkish seed drill. From the other hand the developed seeder gained a good results with all mentioned measurements.

INTRODUCTION

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.

*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.

(**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

From the other side, rice considers the staple food for hundreds millions of world population. Furthermore, it is the major strategic crop in Egypt after wheat. In order to increase rice production, the Egyptian government has realized the need to develop and use new technology to increase rice production.

Therefore, the Egyptian government strongly encourage the developing and local manufactured farm machinery.

Evidently, the increase in Rice production does not depends only on the new promising varieties or the improvement of soil fertility, but also on using improved technical methods to develop a desirable planting machinery system, suitable for planting soaked and coated seeds.

Rice can be sowing by broadcasting of dry seeds, it is consider the oldest method of sowing in the history of land cropping. Wheat and Rice, broadcasting carry out manually or by using seeder with disks or by airplanes. But this planting method caused more weeds competition with small emergence plants**, Konokhova (1982). 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 good yield 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. **Sudhir et al. (2007)** in their study which was carried out during 2004 – 2005 to evaluate the effect of different seeding techniques, cultivars and seed rates on the performance of rice direct seeding at Punjab Agricultural University, Ludhiana India, the grain yield was 30% higher in direct – drilled compared with other planting method under their study. **Abd El-Mowlla (1985)** Showed that planting method of rice has an effect on percentage of

losses during mechanical harvesting, and he also showed that drilling of rice gave lower losses than transplanting method. **Ismail and Elbanna (1994)** In their study they cleared that, the strip-sowing methods was investigated as a new technique of rice planting to overcome the disadvantage of some common methods. They added that, a small plate with trapezoidal shape was attached at the sowing device after removing the two opening discs. Cradled drill machine was used to plant the seeds by two different methods. The first, the seeds were put at level of 1-2 cm under soil surface (traditional method). The second, thus, the seeds were dropped from 10, 15 and 20 cm above soil surface. Their field tests were carried out to evaluate split-sowing methods as affected by three levels of seed dropping height and different soil roughness. Seed latitudinal deviation, number of plants per unit area, number of panicles and yield are considered as dependent variables to evaluate the seeds dropping heights and soil roughness. They showed that using traditional methods "Td", the maximum of seeds scattering were found in the first of 3 cm for each side around the seeds dropping line. These values were inversely proportional to the soil roughness (SR). At strip-sowing method "Ss", method recorded the better uniformity compared with traditional method (Td) for all treatments. **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. **Younis et al. (1991)** concluded that the mechanical drilling rice stayed only 124 days (less than the transplanted rice=134 days). Energy requirement for mechanical drilling was about (3.773 m.j/ton) which is less than that required for manual and mechanical transplanting methods. Mechanical drilling recorded the minimum total cost (65 L.E/ton) and the maximum net profit (135 L.E/ton). So they consider the mechanical drilling method is the appropriate method for rice production in Egypt. **Sorour (1988)** concluded that the best rate of seedling emergence in case of "SULKY" drilling machine at forward speed of 3.9 km/h. was 60% and emergence rate was increased when forward speed decreased from 7.5 to

3.9 km/h. **Abd El-wahab et al. (1987)** studied the effect of mechanical planting seedling rates on the yield and characteristics of lentil plants. The results revealed that the plant characteristics such as branches, pods, grain yield and straw were highly affected by planting methods and rate of seeding under the mechanical methods. The yield of grain and straw increased by 30% and 16% respectively as compared with manual method at seeding rate of 35 kg/fed. **Chhinnan et al. (1975)** showed the effect of planting speed on seeding accuracy. They reported that higher planting speeds resulted to more skips, higher seed placement errors, and higher average spacing.

MATERIALS AND METHODS

The actual field experiments were conducted at the experimental farm of El-Gimaza El-Gharbia Governorate. The field experiments were carried out in a clay loam soil during the rice growing season of 2008. The chemical and mechanical properties of the experimental soil are summarized in table (1).

Table (1) : The chemical and mechanical analysis of the experimental field soil.

Particle size distribution %				Soil texture	PH	CaCo₃ (%)	Soil bulk density gm/cm³
Clay	**Silt**	**Fine sand**	**Coarse sand**				
42.85	40.95	14.72	1.48	Clay loam	7.83	3.1	1.46
Average soil moisture content was 13.2 % w.b							

Seed bed preparation :-
After harvesting the clover crop , the experimental field was prepared by chisel plow in two directions (15 to 20 cm depth) , followed by rotary tiller (10cm depth) , in the final A leveling scraper was used.
To evaluate the developed seed drill performance in the field, anther seed drill (Turkish seed drill-Master UIK type) was used for planting hasting emergence rice grains as the control treatment.

The developed seed drill :-
        The developed seed drill 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 seed drill caused minimum friction and impact force between grains and feeding system elements, therefore it lead to minimum grains mechanical damage.

4- The developed seed drill suitable not only for dry seeds but also for soaked and coated seeds.

The main component of the developed seed drill and its dimensions demonstrated in figures (1 and 2) .
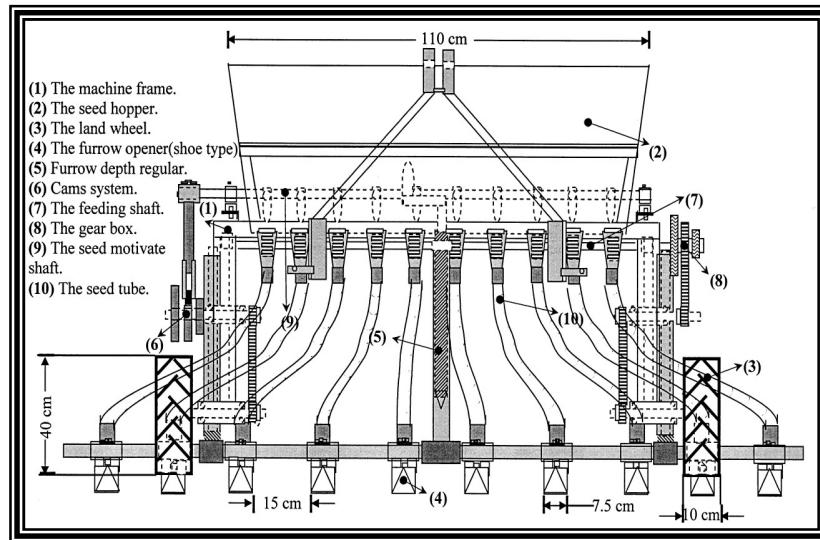

Figure (1) : schematic diagram of developed seed drill

Figure (2):The developed seed drill

The same authors in the previous research was investigated Physical and mechanical properties of rice grains before and after soaking as a fundamental base to developed the new seed drill , and the laboratory experiments was conducted to evaluate the new machine **(Ibrahim et al 2008).**

Table (2) : The technical specifications of the used tractor

No.	Items	Technical specifications
1	Model	230 Massey Ferguson.
2	Made in	America.
3	Engine	4 cylinders water cooling.
4	Fuel type	Diesel.
5	Power	40.
6	Mass (kg)	1500.

The Turkish seed drill :-

A 21 rows Turkish seed drill master UIK type with a working width 210 cm, and 10 cm distance between each two rows as shown in Figure (3), was used in field experiments to planting hasting emergence rice at four planting forward speeds under study (0.64 & 0.89 & 1.19 and 1.42 m/sec.) as a control treatment.

Source of power :-

A 35 H.P 230 Massey Ferguson tractor was used in field experiments as the power source. The tractor specifications presented in table (2) .

Figure (3) : Turkish seed drill (Master UIK type).

Field experimental procedures :-
To evaluate the developed seed drill, there were many factors and measurement under study.
Scope of factors :-
The main factors used in field experiment were as follows:-
1- *Planting forward speeds* **(FS)** : (0.64 & 0.89 & 1.19 and 1.42 m/sec).
2- *grains treatments* **(GT)** : three grains treatments were carried out before planting , there are [dry grains & hasting emergence & soaked grains (24 hr soaked time).
3- Two planting machine **(the developed seed drill and the Turkish seed drill –Master UIK type).**
3.8.1.2 : Experimental measurements
There were five measurements were calculated as follows:
1- *plants density* **(HD)**: Number of plants in square meter (plants /m^2) was measured after two weeks from plants .
2- *The emergence ratio* **(E.R)**: it was calculated after two weeks from sowing and irrigation, by using the following formula

$$\textbf{E.R.} = \frac{PN}{SN} \times 100$$

Where:

PN = Average plant number per one square meter.

SN = Average number of delivered seeds per one square meter. This value was calculated during seeder calibration.

3- *The longitudinal scattering* :
Deviation in the longitudinal and transverse direction from the average distance of 10 meters along the planting row , were determined by using the following equation :-

$$\textbf{C.V} = (\textbf{Sd}/\textbf{x}^*) \; \textbf{x} \; \textbf{100}$$

$$\textbf{Sd} = \sqrt{\frac{\sum(x - x^*)^2}{n}}$$

Where :-

C.V = The coefficient of variation .

Sd = Standard deviation .

x = Distance between hills in the row , (cm.)

x* = The mean distance between hills along planting row

n = number of observation .

The coefficient of variation under 10% considered excellent , and the value fewer than 20% generally considered acceptable for must field application as reported by **Coates (1992)**

4-*Plant lateral distribution around the planting row centerline* :

To determine the cross scattering of grains around the rows , the distribution of the plants around the row centerline was determined 15 days after planting and irrigation . The distribution was estimated by relating the number of plants at different lateral distances from the row center to the total number of plants at ten meters along of the row . The frequency distribution curves were employed for expressing this relationship for each experiment.

5- *Weeds number in square meter* :-

Weeds control rate determined for all planting treatments under study, whereas, the number of weeds was counted using a square meter wooden frame. After three weeks from planting and irrigation.

RESULTS AND DISCUSSION

This experiments was conducted in the field in order to evaluate a precision performance the developed seeder for planting soaked Rice, and also to determine the best working engineering parameters for the developed metering mechanism.

The obtained results of this study could be explained as following :-

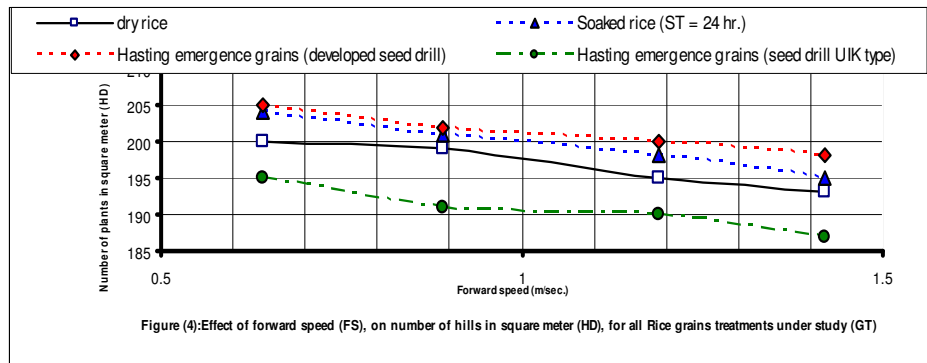**Effect of the tested factors on number of plants/m^2 (HD)**

Inspection of data demonstrated in figure (4) shows the effect of planting forward speed (FS) for two planting machines, at all grain treatments (GT) under study on number of plants/m^2 .

Effect of forward speed (FS) on number of plants/m^2 (HD)

The results show that increasing the tractor forward speed tends to decrease the number of plants/m^2, and there was an indirect proportional between of them in all grain treatments under study, as an example, increasing the tractor forward speed from 0.64 to 1.42 m/sec decreased the number of hills/m^2 from 200 to 193 hills/m^2 for rough Rice, but the results indicated values of plants/m^2 for planting hasting emergence grains by developed seed drill (205 to 198) but this values (198 to 194) were gained by planting rice using Turkish seed drill (Master UIK type) . This values indicated that seed drill (Master UIK type) caused high mechanical damage in rice grains after hasting emergence process

comparing with developed seed drill. The same trend was appeared during planting soaked grains at 24 hr soaked time .

The results illustrated in fig(4) shows also that the highest value of plants per square meter (HD) was 208 gained

Figure (4):Effect of forward speed (FS), on number of hills in square meter (HD), for all Rice grains treatments under study (GT)

at the lowest forward speed under study (FS = 0.64 m/sec), and from the other side the lowest value of (HD) was 52 obtained at the highest forward speed (FS = 1.42 m/sec). These results can be attributed to increasing the forward speed cause decreasing the opportunity to fill all seed cells completely and this gained absent hills, which obtained to decrease number of hills in square meter (HD).

Generally, The previous explanation, reflect intensive inverse proportional between forward speed (FS) and number of plants/m^2 (HD) and this trend was appeared for two machine under study, developed seed drill and Turkish seed drill (Master UIK type). From the other side it can be seen that the highest number of plants in square meter (HD) was also appear with hasting emergence and soaked grains and this trend may be due to immersing rice grains in water increased grains density which prevent push it by water during the first irrigation to the field end

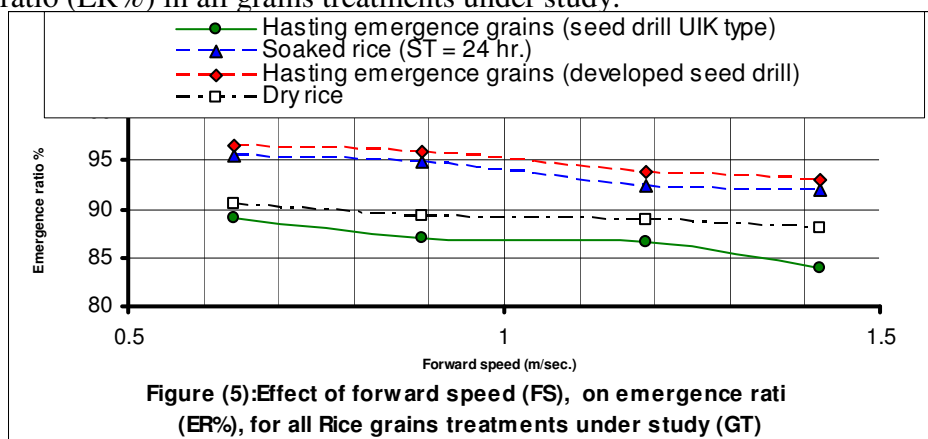**Effect of the tested factors on the emergence ratio (ER %)**

Effect of four tested factors on the emergence percentage (ER%) was investigated. The obtained data was illustrated in figure (5) , and it can be discussed under the following headings:-

Effect of forward speed (FS) on the emergence ratio (ER%)

From the obtained results which demonstrated in figure (5) could be summarized the effect the forward speed increasing resulted to

decreasing the emergence ratio of rice. This result could be explained as the excessive crushing in the Rice grains specially after soaked and hasting emergence treatment.

Increasing the forward speed cause increasing the absent hills, which attribute to decrease the chance to fill all seed cells completely, which tend to decrease the emergence ratio (ER%). Also increasing the forward speed resulted to increasing the seeder land wheel slippage, which tend to increasing the distance between hills and decrease the number of plants in the unit area . Generally, it can be seen that, increasing the planting forward speed (FS) indicated the indirect proportional with emergence ratio (ER%) in all grains treatments under study.

Figure (5):Effect of forward speed (FS), on emergence rati (ER%), for all Rice grains treatments under study (GT)

Effect of the tested factors on the plants longitudinal scattering

The coefficient of variation (CV) was estimated as the plants longitudinal scattering indicator. The obtained data was illustrated in figure (6) . The effects of all tested factors on the longitudinal scattering of plants were discussed under the following titles :-

Effect of the forward speed (FS) and rice grains treatments on plants longitudinal scattering :-

Inspection of data illustrated in figure (6) shows the effect of tractor forward speed on coefficient of variation (CV) of Rice plants longitudinal scattering.

The results show that increasing the tractor forward speed tends to increase the (CV) of longitudinal scattering and there was a positive relationship between them in all rice grains treatments for both planting machine under study. As an example increasing the tractor forward speed

from 0.64 & 0.89 & 1.19 to 1.42 m/sec, caused increasing the (CV %) of longitudinal scattering from 9.5 & 9.7 & 10.9 to 11.8 % respectively for hasting emergence grains by using developed seeder.

Figure (6):Effect of forward speed (FS), on hills longitudinal scattering, for all rice grains treatments under study (GT)
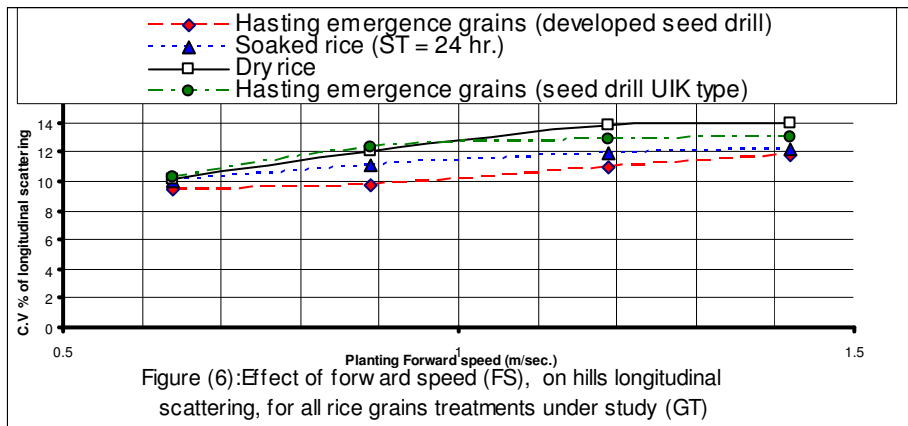
The obtained data indicated also that, the previous trend between forward speed (FS) and values of (CV %) (direct proportional) was replicated with soaked grains (24 hr soaked) and dry rice for planting by developed seed drill. The same trend was extensive present with seed drill (Turkish seed drill UIK type) which gained the highest values of (C.V) of longitudinal scattering during planting hasting emergence grains at all forward speed under study. For example , increasing the planting speed from (0.64 & 0.89 & 1.19 to 1.42 m/sec) tend to increasing the (C.V) of longitudinal scattering from (10.2 & 12.2 & 13 to 13.4%). These results can be attributed to increasing the forward speed tend to more absent hills, and in the same time increase the seeder land wheel slippage, and also caused increasing the seeder vibration during field work which tend to the grains not laid in the expect place in the centerline of planting rows.
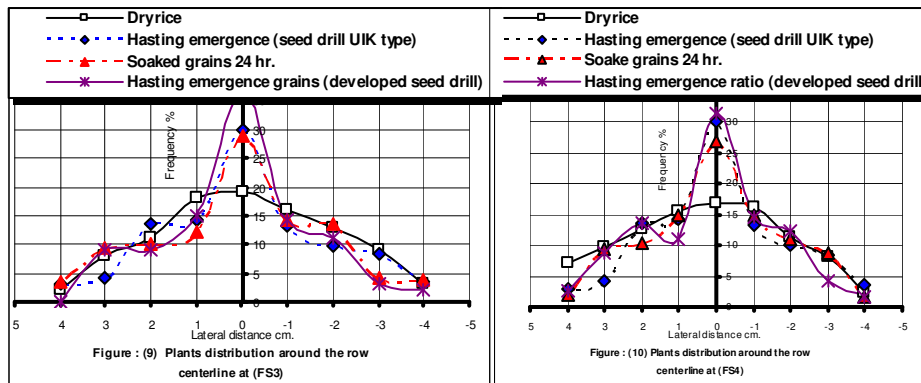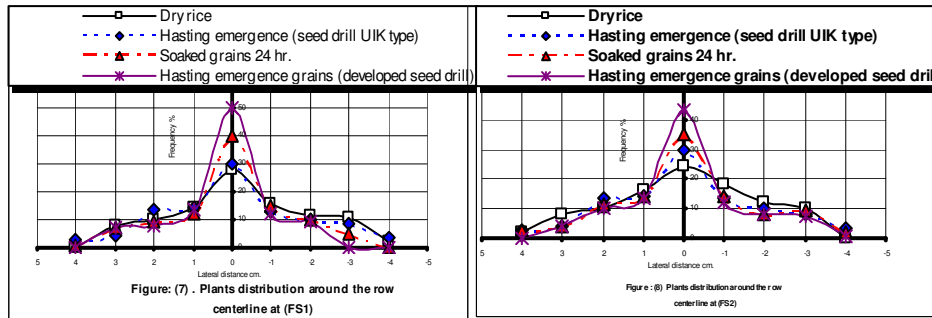
Effect of the tested factors on hills transverse scattering

The lateral rice grains scattering around the rows centerline was investigated. The effects of factors under study on the transverse scattering were inspected, and the obtained results could be discussed under the following leadings :-

4.3.4.1 : Effect of the forward speed (FS) and the rice grains treatment on the lateral scattering :-

From the obtained data which demonstrated in figures (7 , 8, 9 , and 10) it could be summarized the effect of forward speed (FS) on transverse scattering by using frequency distribution method. To find the lateral scattering of rice plants around the planting row center, the lateral distance between row center line and rice plants location was measured,

two weeks after planting and frequency relationship was accounted. The obtained results were drawn in forms frequency curves graphs which illustrated in figures from (7through10)

Figure: (7) . Plants distribution around the row centerline at (FS1)

Figure : (8) Plants distribution around the row centerline at (FS2)

Figure : (9) Plants distribution around the row centerline at (FS3)

Figure : (10) Plants distribution around the row centerline at (FS4)

4.3.5 : Weeds number in square meter

The number of weeds in square meter was measured (after three weeks from planting) at all forward speeds (FS), under study and the mean values were calculated for every rice grains treatments. The obtained data was demonstrated in figure (11) shows that, high values of weed number was presented for dry rice (20 weeds/m^2), but this values were (8 and 5 weeds/m^2) for [soaked rice (24 hr. soaked time) and hasting emergence treatment by using developed seed drill.

Figure (11): Effecr of rice treatments on weeds number per squar meter.
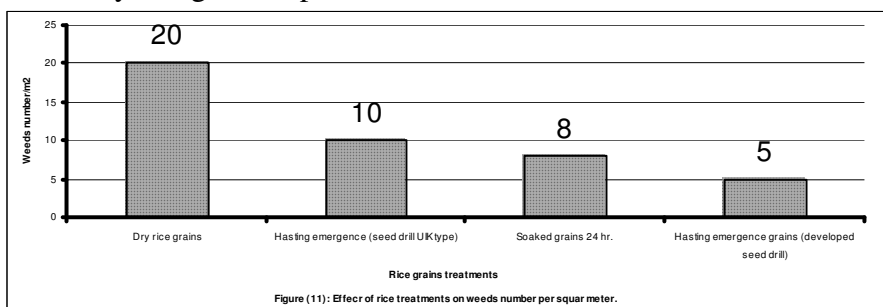
From the other side planting hasting emergence rice grains by Turkish seed drill (Master UIK type) demonstrate more number of weeds (10 weeds/m^2), this trend due to decrease the rice plants number in square meter, because the hasting emergence rice grains exposed to more mechanical damage in seed drill feeding system, and this decrease the competition between rice plants and weeds.

From the previous data, it can be seen high decrement in weeds number per square meter with soaking and hasting emergence treatments, this trend may be due to soaking and hasting emergence treatments cause grains have more haste growing than weed seeds, which gave rice sprouts high fight against weeds.

CONCLUSION

Experiments were carried out using the developed seeder and Turkish seed drill (Master UIK type) as a control treatment, to test and evaluate its performance under different operating of field conditions.

The main factors used in field experiments were :-

1- Four levels of planting forward speeds (FS) {0.64 & 0.89 & 1.19 and 1.42 m/sec.}.

2- The theoretical space between two successive hills on the same planting row (DH cm) there were three spaces (4 & 8 and 12 cm).

3- Number of motivate shaft reciprocating stroke every one land wheel revolution (MS), there were three strokes (1 & 2 and 3 strokes).

4- Rice grains treatments (GT): three grains treatments were carried out before planting there were [dry grains & hasting emergence grains and soaked grains (24 hr soaked time)].

5- Turkish seed drill (Master UIK type) was used for planting hasting emergence rice grains as the control treatment.

To evaluate the developed seeder under field conditions, there were five measurements were carried out as follows:-

(Plant density (PD): number of plants in square meter (plant/m^2). & The emergence ratio (ER): it was calculated after ten dayes from planting and irrigation. & The longitudinal scattering. & The transverse scattering. & Number of weeds per square meter.) .

The main results of the present study could be summarized in :-

1- The uses of the developed seeder considered a new technology under Egyption conditions.

2- There is an indirect proportional between planting forward speed and number of hills/m^2.

3- Increasing the planting forward speed (FS) resulted to decreasing the emergence ratio of rice (indirect relationship).

4- There is a direct proportional between (CV) of longitudinal scattering, and planting forward speed at all treatments under study.

5- Increasing the planting forward speed (FS) causes an increase in the lateral scattering of Rice grains around planting row center line.

6-The lowest number of weeds/m2 was gained whin planting hasting emergence rice by developed seeder.

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نشرات وزارة الزراعة المصرية (2007م)

<u>**الملخص العربى**</u>

تقييم الأداء الحقلي لآلة زراعة مطورة تناسب حبوب الأرز المبتلة .
*ماهر محمد إبراهيم عبد العال   ** هشام ناجى عبد المجيد
*** طارق حسنى الشبراوى

محصول الأرز يعتبر أهم محصول بعد القمح في مصر ، ولهذا تولى الدولة اهتمامـا كبيرا لزيـادة إنتاج هذا المحصول – وعملية الزراعة المباشرة للأرز باستخدام البذور الجافة تسبب نمو عديد من الحشائش مما يضعف إنتاج المحصول ، كما أن الزراعة بالشتل تعتبر من أشق العمليات على العامل الزراعي إذا تمت يدويا ومن أكثرها تكلفة إذا تمت بالآلة

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* أستاذ الهندسة الزراعية ـ كلية الزراعة ـ جامعة المنصورة.
** أستاذ الهندسة الزراعية ـ وعميد كلية الزراعة ـ جامعة المنصورة.
***مدرس مساعدـ قسم الهندسة الزراعيةـ كلية الزراعة ـ جامعة المنصورة.

– ولهذا كان الهدف من هذا البحث هو اختبار آلة زراعة تناسب البذور المبتلة والمكمورة – حيث أن زراعة البذور المبتلة أو المكمورة تجعل نبات الأرز يسبق بذور الحشائش في النمو فيستطيع منافستها – وأيضا يقلل من الإجهاد البدني و التكلفة الاقتصادية لإجراء عمليات الشتل سواء اليدوي أو الآلي .

تم تطوير آلة لزراعة البذور المبتلة والمكمورة بورش كلية الزراعة جامعة المنصورة – وقد أجرى الاختبار الحقلي لهذه الآلة بمحطة البحوث الزراعية بالجميزة غربية ج م ع أثناء زراعة محصول الأرز جيزة (178) في موسم الزراعة 2008م – وكانت معاملات الدراسة كما يلي :-

1- أربع سرعات للزراعة (64و - 89و - 19و1 - 42 - 1و1 متر/ثانية) .

2- ثلاث معاملات لحبوب الأرز (حبوب جافة - حبوب منقوعة 24ساعة - حبوب مكمورة) وقد أجريت عملية الكمر حسب معطيات نشرات وزارة الزراعة المصرية (نقع 24ساعة ثم كمر 48ساعة) .

3- لإتمام الحكم على الآلة المطورة تم استخدام آلة التسطير التركية **(Master UIK)** في زراعة حبوب الأرز المكمورة على نفس سرعات التقدم السابقة كمعاملة مقارنة .

*وللحكم على الأداء الحقلي لآلات الزراعة تحت الدراسة تم أخذ خمسة قياسات وهى:-

(عدد النباتات في المتر المربع بعد أسبوعين من الزراعة - نسب ظهور البادرات[نسبة البزوغ] بعد أسبوعين من الزراعة - التشتت الطولي للنباتات على خط الزراعة - التشتت العرضي للنباتات على خط الزراعة - عدد الحشائش في المتر المربع) .

*وقد أظهرت نتائج هذه الدراسة نجاح وانتظامية في زراعة حبوب الأرز المبتلة والمكمورة – فعلى سبيل المثال كانت نسبة ظهور البادرات في المتر المربع للبذور المكمورة باستخدام الآلة المطورة 97% بينما كانت هذه النسبة 89% في آلة التسطير التركية وذلك على سرعة زراعة 64و متر/ثانية للآلتين . بينما كان متوسط عدد الحشائش في المتر المربع عند زراعة البذور المكمورة بالآلة المطورة خمسة حشائش بينما كان هذا العدد عشرة حشائش باستخدام الآلة التركية .