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THE UTILIZATION OF A ROLLERS PRESS DEVICE FOR SUGAR BEET TRANSPLANTING

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ABSTRACT

The performance of developed seedling device for transplanting sugar-beet was tested and evaluated according to the following criteria: Seedlings longitudinal dispersion; seedlings lateral dispersion; and the quality of seedling index. The aim of the present study has been concerned with a particular problem, associated with the sugar beet seedling transplanting. That aim was seen to be achieved through developing a transplanting machine with feeding system of the elastics disc which its idea depend on using rolling press device with to guide to determine the open and close levels. Under forward speed of 0.6 m/s, the best results were obtained using rolling press diameter of 15mm. The theoretical distance was 19.5 cm and the actual distance was 22.45 cm. This was acceptable result as it was in the right limit (the interference is 10%). while by changing the seedling location on the horizontal belt from 7.0 to 10 cm to the highest value of seedling dispersion 7.3% was obtained under forward speed of 1.16 m/s with rolling press diameter of 21mm. The maximum field efficiency of 94.5 % was obtained at forward speeding of 1.5 km/h and the minimum field efficiency of 83.2 % was obtained at forward speed of 4.2 km/h.

INTRODUCTION

Recently, Sugar beet (Beta vulgaris, L.) crop has an important position in Egyptian crop rotation as winter crop not only in the fertile soils, but also in poor soils. Whereas, it could be economically grown in the newly reclaimed soils such as at the Northern parts of Egypt as one of the most tolerant crops to salinity and wide range of climates ASAE Standards (1989). Sugar beet being, often, the most important cash crop in the rotation, it leaves the soil in good conditions for the benefit of the following cereal crops (Hamed et al. - 1983).

During 2005 season, the total cultivated area of sugar beet in Egypt reached up to 167390 feddan, with an average production of 21.68 ton per fed. (F.A.O. Statistics, 2006). There are two common types of transplanting systems presently available to the farmers, which are manual and mechanical transplanting. Hand transplanting is arduous work, slow process and need consuming more labors than any other operation in vegetable planting (Saleh, 1990) and the transplanting the seedling as new investigation. The advantages of mechanical transplanting are place seedling more uniform than manual transplanting. The uniformity of placing seedlings by the mechanical transplanting attributed to the transplanting mechanism design more than the operation condition (Harb et al. -1993).

Preliminary evaluation showed important improvement in the planting operation with reduction in human effort, more accurate stands and high field capacity. To attain optimum planting condition for productivity, Ladeinde and Verma (1994) undertook a study to compare the performance of three different models of jab planters with the traditional method of planting. In terms of field capacity and labour requirements, there was not much difference between the traditional planting method and the jab planters during sugar beet planting but all of them have high seeds damages. In other words, it is necessary for seeds to be placed at equal intervals within row with uniform spacing, so the roots can grow to a uniform size (Karayel and Ozmerzi (2001) and Pannig (1997). Robinson et al. (1981) studied the effect of uniformity of plant spacing within the row on seed yield and quality. They found that uniformity of plant spacing within the row affected yield, seed size, and consistency of seed size in some of the sites and years of their study. Thus, both seed population and seed spacing at planting time have effects on harvested seed yield and seed size.

Ismail and El shekha (1989) describe the theoretical feeding position of seedling from inertia point to level of seed the seedling in the soil. They added that ground speed of 0.9km/h was suitable for operating the mechanical transplanting.

Two major problems prevented its use in transplanting sugar beet seedling.

The first is that dropping sugar beet seedlings through translation system could easily damage their fragile root. Consequentially, any degree of root damage prevent to low size of beet and more divergence in root body.

The second is sugar beet seedlings at transplanting time have a larger spread of root area than other seedling.

There fore the aim of this research are:-

1- To investigate the feeding system has the ability to transplant the sugar beet seedling in field conditions.

2- Studies the parameters affecting the transplanting performances.

MATERIALS AND METHODS

The new investigated of transplanter machine must be meeting the following requirements during transplant the sugar beet seedling:-

1-Seedling should be planted perpendicular to the soil without roots being unduly curved (max. permissible deviation from the vertical of plants grounded should not exceed 3 %).

2-Planting should be done at the required depth (15-20cm) depending on the size of seedling bulb (± 2cm)

3-deviations from required spacing between seedlings in row should not exceed that 10% and No damage to seedling in planting (maximum up to 1 .0 %)

To utilize these conditions the main descriptions of the proposed design are:-

1- The feeding unit

1-1-**The Seedling System**, the seedlings are manually placed in a horizontal belt in a certain distance by the operators. As shown in Fig. (1), the two pulleys with dimensions of 10mm diameter and width of 220mm are connected with the transplanter frame. The distance between the two pulleys center is 700mm and with belt width of 200mm. The driver pulleys take the motion from the transmission system, which transmits the power from press wheels (land wheel). And also it designed the functioning of cloth (belt) suitable for the transplant sugar beet moves on two axes and ball bearing.

1-2-Vertical conveyor, It has two vertical belts as shown in Fig. (2). the interactions in space between the two vertical belts help the seedling to convey from the highest contact level to the lower point. Then, the seedling drops between the elastic discs. To keep a good contact between the seedling and vertical belts and to overcome the seedling inclination, the vertical belts are supplied with elastic excessive.

1-3-Elastic disc, two elastic discs, 520mm in diameter and 0.3mm thickness, are inclined toward a vertical plane of an angle of 22°. Spacing between the disc center amount to 45mm, the length of the discs contact arc is 380mm. The two discs are driven by two gears on the press wheel .The transmission system from press wheel to the elastic discs is as shown in Fig. (3). The discs lie flat against each other at the front but are kept apart at the rear by small rollers press which enable a plant to be placed up side-down between the tops of the discs just before they meet and to be planted in the ground when the discs move apart.

1-4- Rollers press device, the elastic discs are driven by the two press wheel with diameter of 600mm and width of the wheel rim is 60mm (Fig. 1). They are inclined to the horizontal motion with angles to press the soil around the seedlings. In the event of a momentary difference in the slipping of the right and the left hand press wheel, due to a difference in adherence to the soil, even a slight jumping of the plant in between the discs produces a stretching of the helical belt and the speed of the left-hand disc becomes equal to that of the right-hand. The rollers press device have two units which each one is fixed in two both side of elastic disc (Fig. 4). The location of roller press determines the angels of pick up the seedling inside the elastic disc and the angle of seedling lout from the disc. Under the field experiments three different location angles and three different diameters of rollers on the fingers of rollers press are identified.

2- The minor Units

2-1- cart holding seedling, hopper, and boxes is located on platforms, which seedlings are removed manually into transplanting device.

2-2-furrow opener, the frame is attached a furrow opener, the number of furrow depending on the transplanter unit. The shape of openers is such that they form a furrow with cross section approximating a rectangle. The used furrow opener is shaped at that the furrow shape formed, the depth of the furrow is about 200 mm and the width is 150mm. The furrow openers are usually employed, while a pair of press wheels tilted outward at the top accomplishes furrow closing and soil fir.

2-3- Coverers units, it is consists of two units, namely, close discs and two rollers which formed the furrow (Fig. 5).

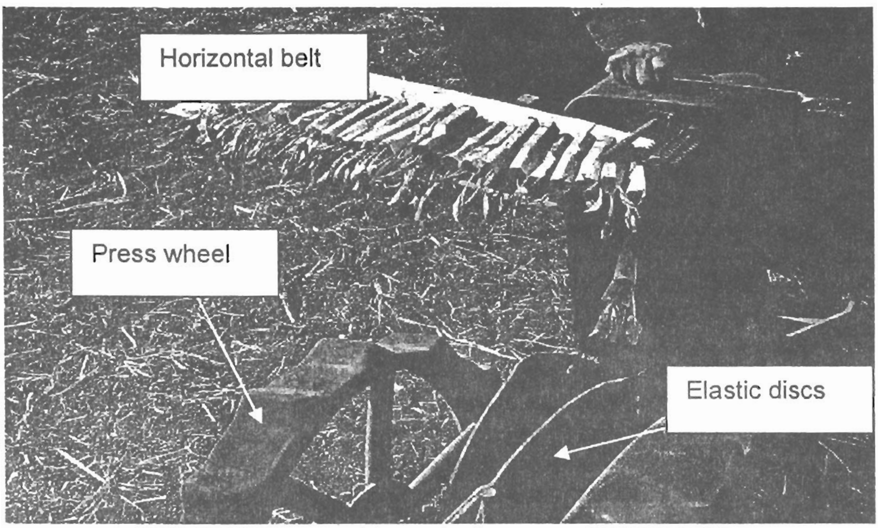

Fig. (1): The general layout of transplanting machine

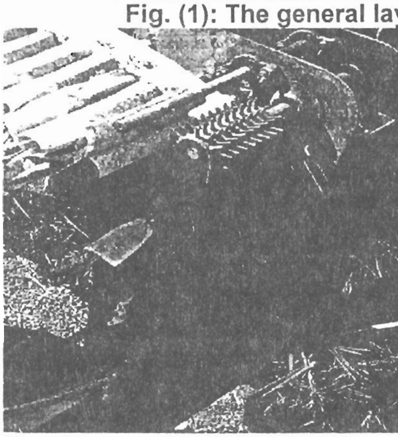

Fig. (2): A two vertical belts press device

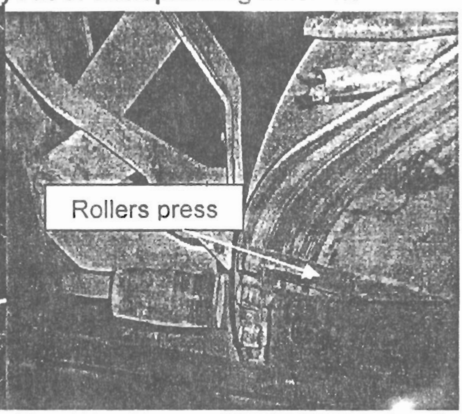

Fig. (3): The elastic discs and rollers

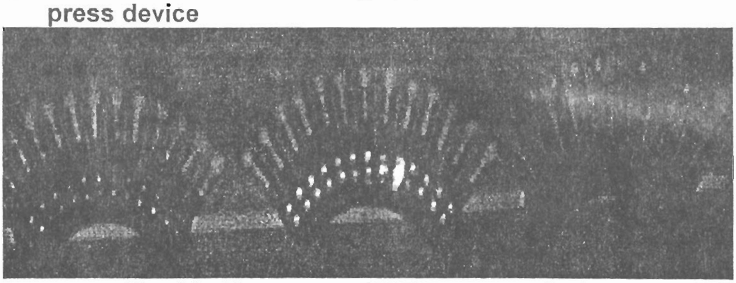

Fig. (4): The types of rollers press device

The Seedling Preparation: Sugar beet "Helna–variety" of mono-germs seeds was planted in paper-pot, which it set in 15 cm length for two sizes diameters "2.5 and 4 cm". The seedlings were prepared in 22[ed] August 2005 and in 25[Th] November 2006. A nursery was irrigated weekly. Sugar beet seeds grew after a week.

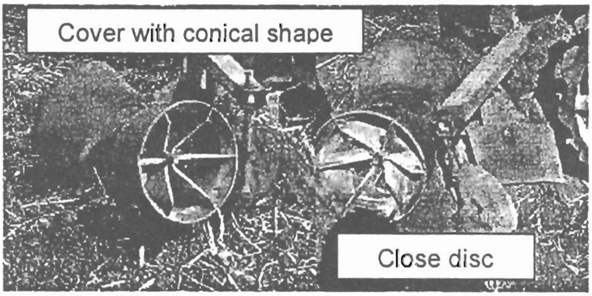

Fig. (5): The covers units in transplanter

The Variables Parameters: For optimization of the affecting performance of investigated transplanter, experiments were conducted with three transplanter traveling speeds of 0.4; 0.8 and 1.16 m/s. the seedling location on the horizontal belt are 5, 7 and 10cm which realizing the distance between seedling in row of 15, 25 and 35cm. the number of the rubber disc of 21.4; 29.8; and 36.69 rpm. The transmitted systems ratio between the revolution numbers of rubber disc and the press wheel is regulated to keep the ratio between seed space and seedlings dropping from transplanting device synchronize. The clearance between the feeding rubber discs is regulated by the roller press diameters therefore; three levels of roller press diameter of 15, 18 and 21 mm are used. The last variables parameters are the size or diameters of paper pot diameters, two parameters of 2.5 and 4 cm are recommended by the authors. The tests were replicated three times for each treatments of transplanter.

Source of Power: the experimental field is conducted by providing the investigated transplanter with the tractor as a source of power. The power transported from transplanter land wheel to press wheel shaft through flexible joint, which converted the rotating speed by transmitting gears.

Seedling Miss Index (Sm, %)

The seedling miss index could be considered as the seedling disposing performance. It was estimated for each treatment by counting the number of location that have no seedlings and counting the total number of the seedling in each treatment. Then the percentage of miss index can be calculated as follows (Srivastava, 1995):

$$Sm,\% = \frac{B_n}{M} * 100 \qquad (3)$$

Where:

S_m = The percentage of seedling miss index, %

M = The total number of the used seedling.

B_n = The number of seed location that have no seedling.

The seedlings multiples index, (S_{mu} %)

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

$$S_{mu},\% = \frac{A_n}{M} * 100 \qquad (4)$$

Where:

S_{mu}, % = the percentage of seedlings multiples index, %

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

The quality of feed index (UH, %)

The uniformity of the seedling in row could be considered as the third indicator for the seed disposing performance. It was estimated by calculating the seed miss index and the seed multiples index. Then the percentage of the quality of feed index in row can be calculated as follows:

$$UH,\% = 100 - (Sm,\% + Smu,\%) \qquad (5)$$

The amount of seedling rate (Q, seedling/s)

The actual amount of seed rate (Ismail, 2004) was measured according to the equation of

$$Q = \frac{M_1 \times 100}{\psi}, \quad Seed / s \qquad (6)$$

Where:

M_1: The mass of seed out from devices per certain times, g

Ψ : The mass of 1000 seeds, g

The static analyses: The data were statistically analyzed to determine the effect of the traveling speed of transplanter under two different of the paper pot diameters (2.5 and 4.0 cm) on performance indices. Namely, mean seed spacing, miss and multiples indexes, quality of feed index, precisions in spacing and the amount of seed rate. The ASA programming was used to analyses the obtained data under different variables.

RESULTS AND DISCUSSION

The performance of developed seedling device for transplanting sugar-beet was tested and evaluated in field according to the following criteria: Seedlings longitudinal dispersion; seedlings lateral dispersion; and the quality of seedling index.

1- Effect of transplanter speed (m/s) on the longitudinal dispersion

Figs. from (6) and (7) illustrate the relationship between forward speed and means of distance between seedlings under different metering speeds on longitudinal dispersion for sugar beet seedlings. General trends clearly revealed that, the longitudinal dispersion is directly proportional to forward speed (V), and also it is directly proportional to the roller press diameter (P_r). From mentioned Figs, under forward speed of 0.4 m/s with different roller press diameters of 15; 18 and 21 mm were 24.72, 31.56 and 28.5 cm respectively. By increasing forward speed to 0.8 m/s the actual distances were 31.6, 33.1 and 35.78 cm, respectively. With changing forward speed to 1.16 m/s. the distances were 30.1, 34.55 and 44.78 cm respectively. These results were with theoretical distances of 29.29; 39.95 and 42.83 cm. All previous results were under using paper pot diameter of 2.5 cm and at the same forward speed of feeding disc of 22rpm. There was approximately similarity between both theoretical and actual distances. As actual distances ranged from 38 cm (the highest limit) to 18 cm (the lowest limit) while sugar beet originally transplanting seedling on 20-25 cm distance intervals, the theoretical distances ranged from 20 to 30 cm. Under forward speed of 0.4, the best results were obtained by using feeding metering speed of 0.16 m/s. The theoretical distance was 29.5 cm and the actual distance was 32.45 cm. This was acceptable result as it was in the right limit (the interference is 10%). Under paper pot of 4.0 cm, the same trend was found. For example, with forward speed of 1.16 m/s accompanied by feeding metering speed of 0.20 m/s, the acceptable result of 35.5 cm actual distance with 25.4 cm theoretical distance was obtained. Also, feeding metering speed of 0.25 m/s gave a relative result. On the other hand, actual distance of 27.3 cm with theoretical distance of 21.6 cm was obtained under feeding metering speed of 0.25 m/s and forward speed of 1.16 m/s. Finally, using forward speed of 0.75 m/s and metering speed of 0.16 m/s gave the best results in all treatments with sugar beet.

Generally, any increment of forward speed resulted in increment of longitudinal dispersion (directly proportion) with paper pot of 2.5 or 4.0 cm. These results were logical as increasing forward speed led to and increase of machine vibration and consequently seedlings through feeder unit dispersed. This vibration and skipping had to disperse seedlings on the surface of soil especially with higher forward speeds.

2- Effect of seedling location on the seedlings dispersion, %

The seedling location on the horizontal belt is considered as the primary factors affecting on the plant distribution as shown in figures 8 and 9. Data and figures showed that there was a directly proportion among the used parameters throughout the treatments. Obviously, the increment of forward speed resulted in increasing seedling dispersion.

Increasing forward speed from 0.4 to 1.16 m/s increased seedling dispersion percentage about 13.32% under seedling location on horizontal belt of 5.0 cm. While increasing seedling location to 7cm caused an increase of seedling dispersion from 2.18 under increasing the forward speed to 1.16 m/s. These results were obtained under paper pot of 2.5 cm (Fig.5). The same trend was shown as seedling dispersion percentage changed from 40.2

to 55.8 by increasing forward speed from 0.4 to 1.16 m/s at seedling location of 10cm. On the other side, increasing seedling location speed from 5.0 to 10.0cm changed seedling dispersion percentage from 40.2 to 53.8 at the same conditions. Medium forward speeds of o.8 m/s with different seedling location distance of 5.0; 7.0 and 10,0cm for both paper pot diameters of 2.5 and 4.0 showed similar results and gave the same trend on figures.

Shortly, under seedling location distance Of 5.0 cm, the lowest values of seedling dispersion percentage of 19.38% was achieved under forward speed of 0.4 m/s at metering speed of 25rpm. Meanwhile, the highest value was 42.82 % was under forward speed (V) of 1.16 and metering speed (R) of 25rpm; while by changing the seedling location from 7.0 to 10 cm to the highest value of seedling dispersion 4.22% was obtained under forward speed of 1.16 m/s with metering speed of 25rpm (Fig. 9)

Analysis of variance was also employed to test the difference of seedling location with different forward speeds under different paper pot diameters. This analysis indicated a highly significant difference of engineering parameters under study with all treatments (table-1).

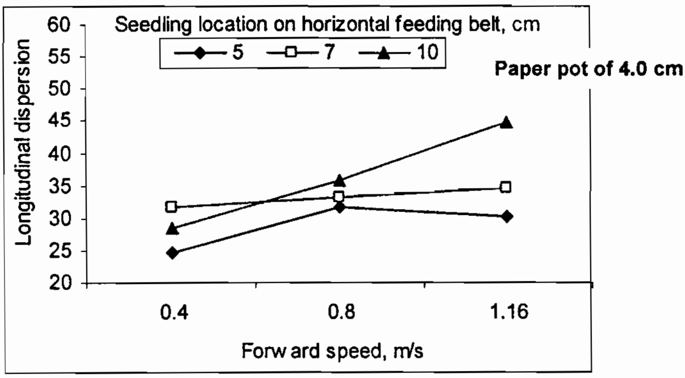

Fig.(6): Effect of forward speed on the average distance between seedlings in row at different roller press diameters

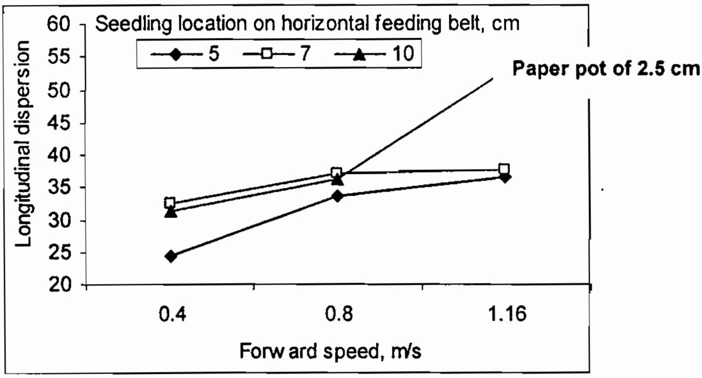

Fig.(7): Effect of forward speed on the average distance between seedlings in row at different roller press diameters

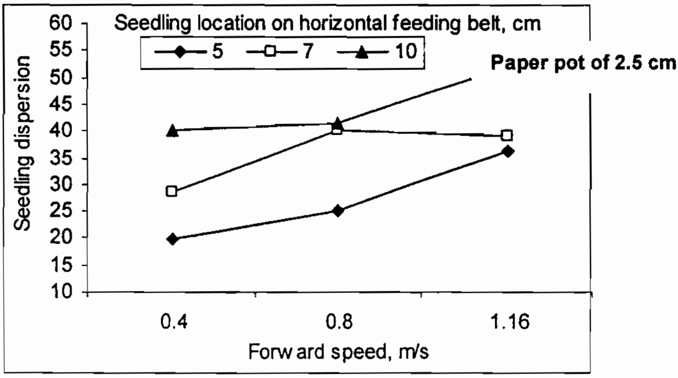

Fig. (8): Effect of seedling location on the seedlings dispersion, %.

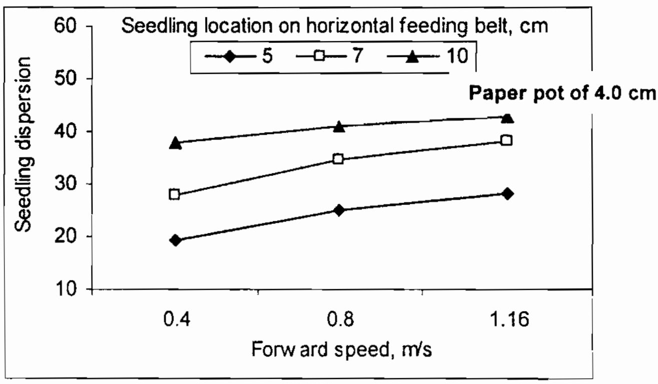

Fig. (9): Effect of seedling location on the seedlings dispersion, %

From the above table, the total mean effect of the roller press wheel on the seedling of sugar beat deposition in row are found at the roller press of 21cm follow by 18cm and the low effect is the roller press of 15cm diameter. While the transplanted speed for any seedling speed is more significant. The best values were found at 15cm rolling press wheel, 0.4 m/s transplanting speed, seedling location distance of 7cm and paper pot diameters of 4.0cm.

3- Effect of seedling location on seed spacing uniformity at different rolling press

The data of distance between seedlings (spacing uniformity, %) of sugar beet seedling for relationship between seedling locations at different rolling press were summarized and plotted in figure (10). They clearly show that, the average of distance between seedlings percentage with all treatments decreased by increasing each of seedling location and rolling press of feeding systems. The distance between seedlings was more uniform with lower distance between seedling location on the horizontal feeding belt and lower transplanting speed and consequently higher planting speeds resulted in more skips, higher speed placement errors and higher average spacing. It is obvious that, increasing seedling location from 7 cm to 10 cm resulted in increasing seedling spacing uniformity from 26.44 to 29.373 % at rolling press diameter of 15mm and forward speed of 0.4m/s. Meanwhile, increasing the press wheel diameter from 15 to 21cm resulted in increasing the seedling uniformity by about 7.27% at 10 cm seedling location on horizontal feeding belt.

Table (1): the analysis of dependent Variable in field test

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	53	105744.6491	1995.1821	32.11	<.0001
Error	1026	63750.3500	62.1348		
Corrected Total	1079	169494.9991			

R-Square	Coeff Var	Root MSE	FTest Mean
0.623881	23.01417	7.882566	34.25093

Cont. of table (1):

Source	DF	Type III SS	Mean Square	F Value	Pr > F
C	2	11856.89074	5928.44537	95.41	<.0001
S	2	20233.45185	10116.72593	162.82	<.0001
FS	2	51723.06852	25861.53426	416.22	<.0001
PPV	1	2469.15648	2469.15648	39.74	<.0001
C*S	4	8910.64815	2227.66204	35.85	<.0001
C*FS	4	220.04815	55.01204	0.89	0.4720
S*FS	4	2083.85370	520.96343	8.38	<.0001
C*S*FS	8	2769.01296	346.12662	5.57	<.0001
C*PPV	2	80.56852	40.28426	0.65	0.5231
S*PPV	2	1128.22963	564.11481	9.08	0.0001
C*S*PPV	4	636.60370	159.15093	2.56	0.0371
FS*PPV	2	123.00185	61.50093	0.99	0.3720
C*FS*PPV	4	757.91481	189.47870	3.05	0.0164
S*FS*PPV	4	1707.18704	426.79676	6.87	<.0001
C*S*FS*PPV	8	1045.01296	130.62662	2.10	0.0330

The SAS System

C = Rolling press wheel diameter, mm **S = Forward speed, m/s**
FS = Seedling location on horizontal feeding belt, cm **ppv= Paper plot, cm**

4- Effect of transplanter speed on seedling miss index

Fig. (11) showed the effect of transplanting speed on seedling miss index (S_{mi}). Staring directly to the shown figure, it is easy to notice that increasing transplanting speed resulted in increasing seedling miss index percentage (directly proportion). Also, the above relationship indicated that there were a higher significant. Increasing the transplanting speed the S_{mi} increased for all treatment, but the less value was found at 0.9 m/s traveling speed and 2.5 cm paper pot diameters. Analytically, press wheel diameter had no effect on seedling miss index percentage (S_{mi}) as no correlation between transplanting speed and seedling location on the horizontal feeding belt. These were logical results as increasing seedling speed (S_R) affected speed of feeding system. This high motion of the translated belts may cause seedling voided in feeder disc. This shoehorning led to seed void and gave the true obtained results. Multiple regression analysis revealed a highly significant linear relationship was found.

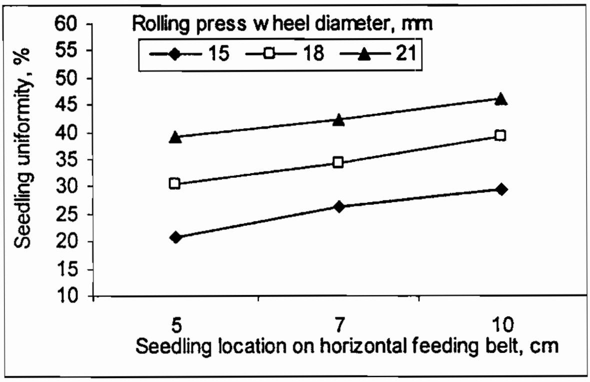

Fig. (10): Effect of seedling location on seedling uniformity, %

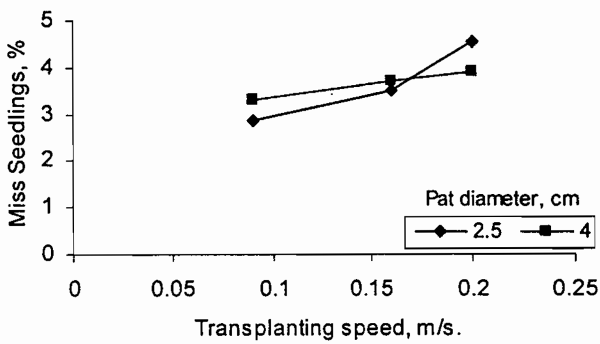

Fig (11): Effect of transplating speed, m/s on miss seedlings.

5- Effect of transplanter speed on seedlings multiples index, (S_{mu} %)

Figs (12) showed the effect of transplanting speed on seedling multiples index, (S_{mu} %) at different press wheel diameters (15, 18, and 21cm). Staring directly to the shown figure, it is easy to notice that increasing transplanting speed resulted in decreasing seedling multiples index, (S_{mu} %) in percentage (inversely proportion). Also, the above relationship indicated that there were a higher significant. Increasing the transplanting speed the seedling multiples index, (S_{mu} %) decreased for all treatment, but the less value was found at 1,16m/s traveling speed and 21cm roll presses diameters. Analytically, paper pot diameter had no effect on seedling multiples index percentage (S_{mu} %) as no correlation between transplanting speed and seedling location. These were logical results as increasing seedling speed (S_R) affected speed of feeding system numbers. This high motion of the translated belts may cause seedling to decrease in feeder disc. This shoehorning led to seed multiples and gave the true obtained results. Multiple regression analysis revealed a highly significant linear relationship was found.

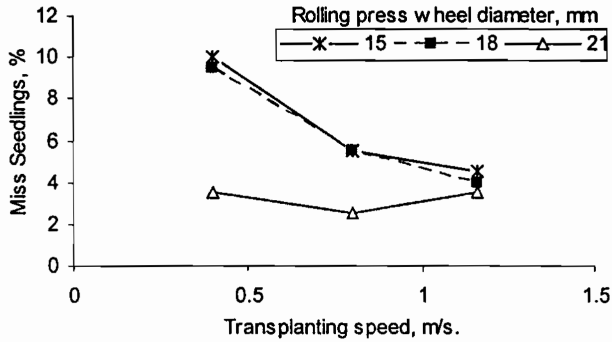

Fig (12): Effect of transplanting speed, m/s on seedling multiples index, (S_{mu} %).

6- The amount of seedling rate (Filed capacity and field efficiency)

Figs. 13 and 14 illustrate the relationship between field capacity and field efficiency at press wheel diameters and different machine forward speed. Fig. (10) Shows the effect of press wheel diameter on actual field capacity. From the figure the increasing in transplanting speeds from 1.5 to 4.2 km/h the actual field capacity increased from about 0.2 to 0.46 fed./h. Then the press wheel diameter for transplanting of 15cm increment about 0.47 fed./h when compared with the press wheel of 21cm.

On the other wise, the Fig. (11) clarify that the field efficiency of seedlings transplanter machine decreased by increasing forward speed for all press wheel under studies. The maximum field efficiency of 94.5 % was obtained at forward speeding of 1.5 km/h and the minimum field efficiency of 85.6 % was obtained at forward speed of 4.2 km/h.

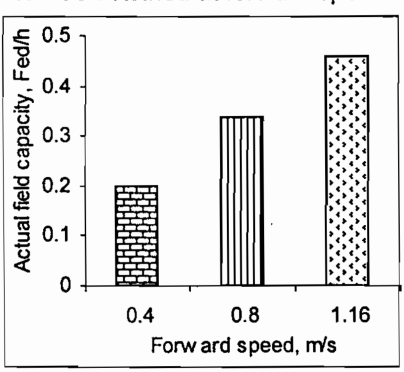

Fig. 13 Effect of transplanting methods on actual field capacity.

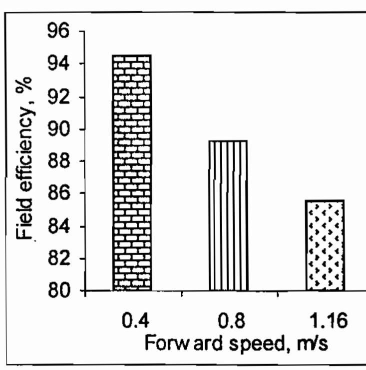

Fig. 14: Effect of transplanting methods on field efficiency.

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استخدام جهاز الضغط اللأسطواني لشتل بادرات بنجر السكر

زكريا إبراهيم إسماعيل وعبد الملاك سعد غطاس
قسم الهندسة الزراعية- كلية الزراعة جامعة المنصورة

يعد بنجر السكر من المحاصيل الإستراتيجية الهامة فى العالم لإنتاج السكر بعد محصول قصب السكر بل ان المنتجات الثانوية منة تدخل فى استخراج بعض الأحماض وفى صناعة العلف الحيوانى كما أن عرش البنجر يستخدم كعلف للماشية إما فى حالة طازجة أو خضراء وتحويلة الى سيلاج بالإضافة إلى دورة فى تحسين صفات التربة من حيث تحسين تركيب وبناء التربة ويزيد من نفاذيتها وخصوبتها لتعمق مجموعة الجذرى وكثرة مخلفاتة التى تتحلل فى التربة .

هذا وقد عرفت مصر زراعة بنجر السكر فى أوائل الثمانينات وقدأقامت بعض المصانع الخاصة لإنتاج السكر من بنجر السكر ومن المميزات النسبية التى يتميز بها عن قصب السكر تتمثل فى قصر فترة مكوثة فى التربة (٦-٧ شهور بالمقارنة بقصب السكر) وانخفاض

احتياجاتة المائية حوالى ٣٠٠٠٠متر مكعب أما قصب السكر ١٣٠٠٠متر مكعب كما تنجح زراعتة في جميع أنواع الأراضى منها الملحية والرملية والجيرية أما قصب السكر فلا ينجح إلا في الأراضى جيدة الخصوبة . لهذا إتجهت الحكومة بوضع خطط استراتيجية لزيادة المساحة المنزرعة من هذا المحصول وذلك لتضييق الفجوة الغذائية بين إنتاج السكر واستهلاكة والتى تسبب عبئا كبيرا على ميزانية الدولة والتى ترجع إلى كثرة المستورد منة لمواكبة الزيادة المضطردة فى عدد السكان حيث قامت الدولة بإقامة مصنع بالحامول بكفر الشيخ بطاقة إنتاجية ٢٤٠ألف طن سكر (خطين إنتاج) ومصنع بلقاس بمنطقة قلابشو بمحافظة الدقهلية بطاقة إنتاجية ١٢٠ ألف طن ومصنع أبو قرقاص بمصر الوسطى ٥٠ ألف طن سكر وقد بلغت المساحة المنزرعة من هذا المحصول عام ٢٠٠٥ حوالى١٦٧,٣٩ ألف فدان بمتوسط إنتاجية ٢١,٦٨ طن للفدان *(النشرة الإحصائية لمنظمة الأغذية والزراعة ٢٠٠٦) ومحصول بنجر السكر مازال يزرع يدويا وهذا يحتاج إلى وقت كبير وعمالة كثيرة وبالتالى تزداد تكاليف الإنتاج بالإضافة إلى زيادة نسبة الجور الغائبة حيث لاتتحمل بادراتة نسبة الملوحة مما يقلل من عدد النباتات فى وحدة المساحة وبالتالى يؤثر على كمية الإنتاج وللتغلب على هذة المشكلات أجرى هذا البحث فى موسمى ٢٠٠٥/ ٢٠٠٦، ٢٠٠٦/ ٢٠٠٧ بمحطة بحوث الجميزة محافظة الغربية لدراسة بعض العوامل المؤثرة على الشتل الآلى للوصول إلى الظروف المثلى للشتل.