EVALUATION OF SEEDBED PREPARATION LEVELS ON PERFORMANCE OF SUGAR BEET PLANTERS

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Abstract

The performance of various types of planters generally used in planting sugar beet in Egypt were evaluated. These planters were locally fabricated planters, imported planters (type of Gaspardo), and pneumatic planters (type of Gamma 90). The influence of various planters on effective field capacity(Fed/h),field efficiency (%),germination ratio(%),uniformity of plant distribution through the row (%),and root yield(Mg/Fed)were investigated. Also, total energy consumed (kW.h/Fed) and operating cost (L.E/Fed) were estimated. All planters were evaluated and tested at three levels of seed bed preparation were chisel plowing two pass followed by land leveler denoted as treatment A, chisel plowing two pass followed by rotary and land leveler denoted as treatment B, and chisel plowing two pass followed by disk harrow and land leveler denoted as treatment C, four forward speeds of 2.5, 3.6, 5.4 and 7.2 Km/h and three planting depths of 1, 2, and 3 cm. The obtained results showed that, Mechanical planting by pneumatic planter gave the best results while, local planter was better than imported planter at all combination of experiment levels. Where, using pneumatic planters recorded the maximum effective field capacity of 3.15 Fed/h and field efficiency of 96%,when using forward speed of 7.2 km/h and planting depth of 1 cm. as well as maximum germination ratio and root yield of 91% and 28.6 Mg/fed when using forward speed of 2.5 km/h and planting depth of 1 cm. Also, maximum distribution uniformity of 88.5% recorded with pneumatic planter at treatment C, forward speed of 2.5 km/h and planting depth of 3 cm .on the other hand , imported planter recorded minimum energy consumed of 29.15 kW.h/Fed were recorded with treatment C, forward speed of 2.5 km/h and planting depth of 1 cm. While, minimum operating cost of 16.41 L.E/Fed were recorded with treatment C, forward speed of 7.2 km/h and planting depth of 1 cm, respectively.

INTRODUCTION

Sugar beet is a strategic crop where it has double advantages (sugar production and animal feeding). In Egypt the cultivated area of sugar beet is about 257667 feddans / year annually produce about 19،919 ton / fed. Equal 5132589 tones.(Agricultural statistics, 2008). The general trend for field area and delivering yield of sugar beet crop tends to increase yearly. The mechanization process is one of the most important factors affecting sugar beet production. Up till now, sugar beet sowing is mostly done manually in Egypt. It is known that mechanical sowing ensures uniform seed spacing, straight furrows and application of the proper seed quantity, saving hand labor, improving production and allowing further mechanization. *Erol (1971)* reported that seed distribution in the horizontal plane depend on the transverse and longitudinal patterns generated by the delivery mechanism. *Klenin et. al. (1985)* reported that for high quality sowing each cell should packe single seed so that it may be ejected by the plate. Seed packing is greatly affected by the relationship between the cell size and the seed thickness. This ratio has an optimal value which is achieved by earlier grading of seeds. *Wanjura (1980)* studied the effect of inter row plant spacing uniformity. During four years of study the general trend was yield increased as plant spacing uniformity increased. *El-zawahry (1994)* studied the effect of two types of planters and forward speed on sugar beet yield. He found that, the increase of planter forward speed lead to decrease the depth of seeds in the soil and increase the seed scattering around the furrow center line. *Srivastava (1975)* developed the hand planter with nylon brush type agitator. He showed that, the performance of this planter was satisfactory with the field capacity 0.1ha/h and walking speed of 2.5 km/h for sowing unpolished sugar beet seeds.El-*Nakib (1975)* investigated the improvement and uniformity of monogerm sugar beet seed emergence in the field. The seed damage or ground up in passing through the planter was screened out and seed laboratory germination test was run on the remaining portion of the seed. The result of the germination test was expressed as the number of normal sprouts per grain of cleaned seed. The planter which led the vertical plate metering devices was more uniform distribution than the others. He added that the uniform distribution was achieved with the row spacing and depth. On the other hand, the speed gave minimum seed damage and the most uniformity of single seed. *Chhinnan et al. (1975)* tested the effect of planting speed on metering and seed accuracy. They reported that higher planting speed resulted in more skips, higher speed placement errors and higher average spacing. *Bahnasawy (1992)* found that the grain yield decreased with increasing forward speed, where the highest yield of grain was recorded at a speed of 3 km/h. but, the lowest yield was recorded at a speed of 8 km/h., these results may be due to the increase in velocity causing disturbance in seed depth and seed spacing; slip percent increases with speed which affects plant population and grain yield. *Jaggard (1990)* reported that uniform seed spacing has been demonstrated to be a significant factor in quality and yield for some crops such as sugar beet with uniform spacing, the roots can grow to a uniform size. *Molin (2002)* indicated that punch planting is one of the possibilities, but is limited on seed spacing adjustment. A prototype was developed based on previous works and consists on a punch wheel that has the ability to adjust its diameter so the tips will change the distance, producing seed spacing that may vary from 0.16 to 0.21 m. Test shown it is feasible as the accessories and seed meter are implemented. *Panning et al. (2000)* evaluated five planters for seed spacing uniformity at three field speeds using a seed location method in the field and a laboratory method involving a pto-electronic sensor system. Planter seed spacing uniformity was described using the coefficient of precision (*cp*) measure. Results showed that (*cp*) measures determined using the laboratory test method were significantly different from those determined using the field test method. *Griepentrog et al. (2003)* studied that a planter type RTKGPS was successfully retrofitted on to a precision seeder to map seeds as they were planted .the average error between the seed map produced by the seeder and the actual plant map was about 32mm to 59 mm.

The current study is devoted to:

1- Evaluate the performance and compare sugar beet growth and yield quality of three main types of planters,

2- Adapt and apply the locally fabricated precision planter for sugar beet sowing,

3- Determine energy consumed and operating cost for these planters.

MATERIALS AND METHODS

The main experiments were carried out at the experimental farm of Sakha Agricultural Research Station in season 2007/2008 on an experiment area of two feddans for sowing sugar beet (Beta poly variety) , to investigate the performance and compare between three different types of sugar beet planters namely: the local precision planter(Abd el-tawwab,2004), imported mechanical planter(type of Gaspardo) and pneumatic planter(type of Gamma 90).Table1 summarizes the technical specifications of the three planters which are shown in Fig. 1.

Table 1: The technical specifications of the different planters used.

Characteristics	Local fabricated planter	Imported planter (Gaspardo)	Pneumatic planter (Gamma 90)
type	mounted	mounted	mounted
Manufacture country	Egypt	Italy	Italy
No. of rows	4	4	4
Distance between rows, cm	60 (Adjustable)	60 (Adjustable)	60 (Adjustable)
Working width, cm	200	200	200
Metering device	Horizontal cell plate (mechanical)	Horizontal cell plate (mechanical)	Air metering device
Distance between hills in row, cm	18.5	18.5	18.5
Furrow openers	Shoe	Runner	Runner
Covering device	Paddles	Knives	Knives
Soil pressing wheel	Hard rubber wheel	Iron wheel	Double inclined iron wheel
Transport and drive wheel	Carrying wheels	Iron wheel(press wheel)	Carrying wheel

Experimental procedure:

Experimental area divided into three equal plots. Every one was planted by a type of planter. Planting operation was conducted under four forward speeds and three planting depths. During the entire experiments, effective field capacity was determined by accurately measuring the time consumed during planting operation, the required power was calculated by evaluation fuel consumption then energy requirements was calculated. Also, distribution uniformity, germination ratio and root yield were estimated. On the other hand, mechanical analysis for the surface soil layer of the experimental field indicated that, the soil texture is clay. The soil fraction is 30.96 % silt, 13.8 % sand, 52.96 % clay and 2.28 % caco3. The soil moisture content was12.12 % and the average soil bulk density was 1.17 g/cm^3.

Investigated variables:

The present study was carried out to evaluate the effect of seed bed preparation quantity, planter type, forward speed and planting depth on the growth and yield quality of sugar beet. The following procedures were taken for evaluation test:

1- **Seed bed preparation** : Three levels of seed bed preparation were used in this study as follows

a)**Treatment (A)**: chisel plowing two pass followed by land leveler.

b) **Treatment (B)**: chisel plowing two pass followed by rotary and land leveler.

c) **Treatment (C)**: chisel plowing two pass followed by disk harrow and land leveler

2- **Planter type:** Three types of planter machines were used in this study which one locally fabricated planter, imported mechanical planter and pneumatic planter.

3- **Planter type:** Three types of planter machines were used in this study which one locally fabricated planter, imported mechanical planter and pneumatic planter.

4- **Forward speed:** Four forward speeds of 2.5, 3.6, 5.4 and 7.2 km/h were used in this study.

5- **Planting depth: Three planting depths were used, which were: 1, 2 and 3 cm depth.**

Measurements:

1- Effective field capacity (E.F.C.): The effective field capacity was calculated as follows:

$$E.F.C = \frac{1}{\text{Total operation time, h/fed.}} \text{, fed./h......1}$$

Where: total operation time (T) = T1+T2+T3+T4 2

T1 = planting time;

T2 = turning time;

T3 =repairing and adjustment time; and

T4 = feeding time.

2- Field efficiency (F.E.): The field efficiency was calculated from the following equation:

$$\eta f = \frac{E.F.C}{Th.F.C} \times 100,\% \quad \text{.................3}$$

Where:

ηf = Field efficiency, %;

E.F.C = Effective field capacity, fed/h; and

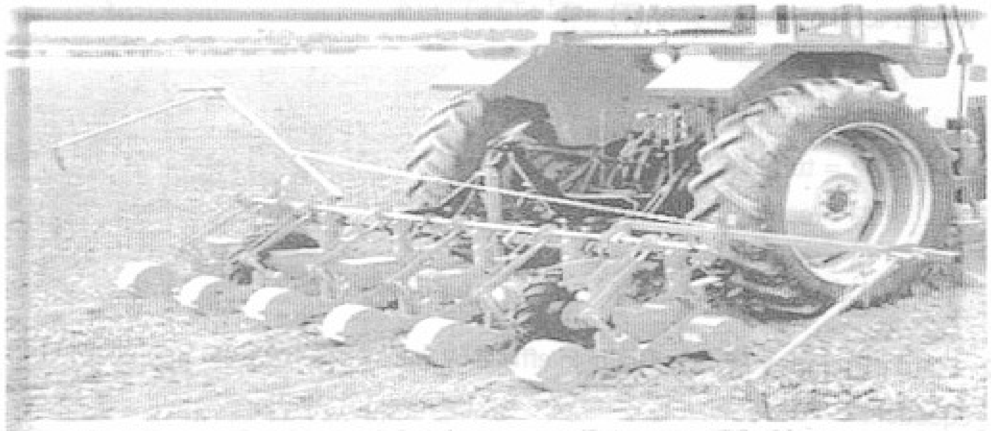
Th.F.C = Theoretical field capacity, fed/h.

3- Germination ratio, %: The number of plants per 10 square meters was determined under different treatments. It was estimated according to the following formula (Taieb, 1997):

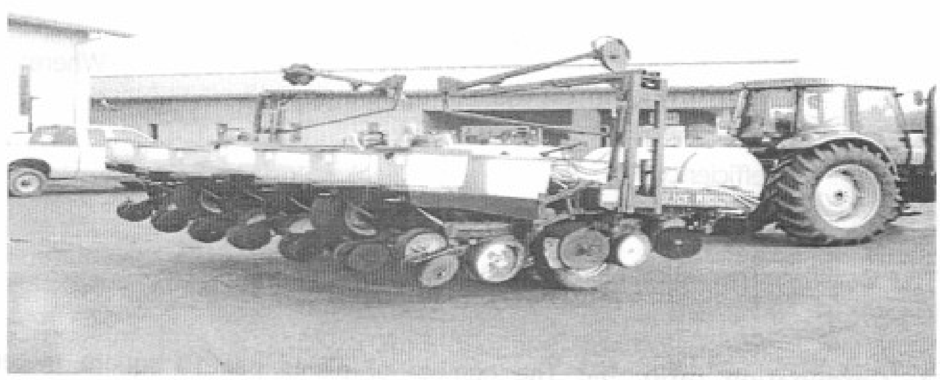
Germination, % = (p/s) x 100 4

Where: p = Number of plants per 10 meter square.

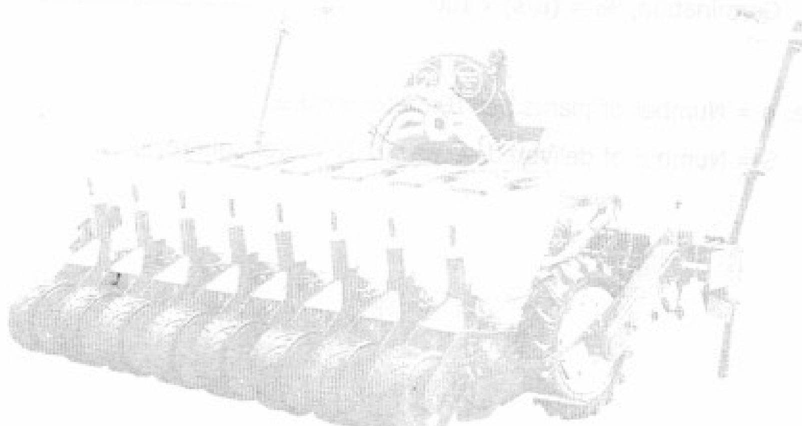
S = Number of delivered seeds per 10 meter square.



a) Locally fabricated planter.



b) Imported mechanical planter.



c) Pneumatic planter.

Fig. 1: The various sugar beet planters used.

4- Distribution uniformity: high seed spacing uniformity value mean the planter metering system is doing well, seed precision picking and dropping it uniformity. The theoretical seed spaces was designed to be 18.5 cm according to the recommended (sugar beet extension bulletin No.209). The quality of uniformity spacing index was the proportion of spacing between 0.5 to 1.5 X ref. the multiple indexes was the proportion of spacing equal to or less than 0.5 X ref and the miss index represented the percentage of spacing greater than 1.5 X ref as indicated by *Kachman and Smith (1995).*

5- Root yield: The yield of sugar beet roots (Mg/fed) was determined by weighting the lifted roots by a manual shovel.

6-Energy consumed: Energy consumed can be calculated by using the following formula as reported by ***(Imbabi, 1997)***:

C.E = F.C x 1/3600 x ρ x L.C.V. x 427 x 1/75 x 0.746 x 1/EFC, kw.h/fed...6

Where:

C.E = Energy consumed, kw.h/fed;

F.C = The fuel consumption, l/h;

ρ = Density of the fuel, kg/l (for solar fuel is 1000 kcal/kg);

L.C.V= Lower calorific value of fuel (for solar fuel is 1000 kcal/kg);

427 = Constant (thermal- mechanical equivalent, w/kcal.); and

EFC = Effective field capacity, fed/h.

7- Operating cost: The total cost needed for operation was estimated by the following formula according to **(Awady, 1982**):

$$\textbf{Operating cost} = \frac{\text{Machine cost , L.E/h}}{\text{Yield output , ton/h}} \quad , \text{ L.E/ton.........7}$$

Where, machine cost was determined by the following formula (**Awady, 1978)**

C= p/h (1/a + i/2 + t + r) + (0.9 w.s.f) + m/144....................8

Where:

c	=	Hourly cost , L.E/h.	0.9	=	Factor accounting for lubrication
p	=	Price of machine , L.E.	w	=	Engine power,hp
h	=	Yearly working hours, h/year.	s	=	Specific fuel consumption, l/hp.h.

a	=	Life expectancy of the machine ,h.	f	=	Fuel price , L.E/l
i	=	Interest rate/year.	m	=	Monthly average wage ,L.E.
t	=	Taxes ratio	144	=	Reasonable estimation of monthly working hours.
r	=	Repairs and maintenance ratio			

RESULTS AND DISCUSSION

Performance evaluation of the three planters:

1- Effective field capacity:

The obtained data revealed that seedbed preparation, planter type, forward speed and planting depth affected extremely effective field capacity as shown in Fig. 2. Where, effective field capacity increased with increasing forward speed and with decreasing planting depth. Also, it can be noticed that the highest value of effective field capacity was recorded with planting treatment (C) and pneumatic planter usage at all experimental levels. Using pneumatic planter and increasing forward speed from 2.5 to 7.2 km/h with planting depth of 1 cm , the effective field capacity increased from 0.9 to 2.94 Fed/h (+226.6%) , from 0.95 to 3.10 Fed/h (+226.3%) and from 1.03 to 3.15 Fed/h(+205.8%) with treatments A,B and C ,respectively. The highest value of effective field capacity was 3.15 fed/h recorded at planting treatment (C) by pneumatic planter at forward speed of 7.2 km/h and planting depth of 1 cm on the other hand, local planter was better than imported planter. On the other hand, there were no significant differences ($p<0.05$) in the bed preparation. Although significant differences ($p>0.05$) were observed with planter type, forward speed and planting depth.

2- Field efficiency:

Field efficiency is determined as a percentage between theoretical field capacity and effective field capacity. According to field dimensions, the theoretical field capacity at forward speed of 2.5, 3.6, 5.4 and 7.2 km/h equaled 1.19, 1.70, 2.53 and 3.42 Fed/h, respectively. Fig .3 illustrate the effect of forward speed and planting depth on field efficiency, % at different seed bed preparation levels and different planter types, in which it increased by increasing forward speed and with decreasing planting depth. Also, planting treatment (C) by means of pneumatic planter recorded high value of field efficiency. whereas, it increased from 86 to 96%(+10.41%) by increasing forward speed from 2.5 to 7.2 km/h with planting depth 1 cm. While , it was increased from 82 to 94%(+12.76%) and from 75 to 80%(+6.25%) when using local and imported planters with the previous planters, respectively. While, it decreased from 86 to 71%(-17.44%),75 to 64%(-14.66%), and 82to 69%(-15.85%) by increasing planting depth from 1 to 3 cm and forward speed of 2.5 km/h with the same planter, respectively. The differences between variables were all significant at p>0.1 % level.

3- Germination ratio:

Data shown in Fig.4 indicated that seed bed preparation, planter type and planting depth under study gave little effect on germination ratio. While, forward speed was very important effecting factor. Results observed too that, pneumatic planter and treatment (C) gave high value of germination ratio. Otherwise, local fabricated planter was better than imported planter for all parameters. Considering , planting treatment (C) as shown in Fig.4 by increasing forward speed from 2.5 to 7.2 km/h at planting depth 1 cm, germination ratio decreased from 89 to 77% (-13.48%),from 81 to 67% (-17.28%) and from 91 to 79%(-13.18%) by using local planter, imported planter and pneumatic planter, respectively. While, it decreased from 89 to 84 %(-5.62%), from 81 to 76%(-6.17%) and from 91 to 86 %(-5.49%) by increasing planting depth from 1 to 3 cm, forward speed of 2.5 km/h and the same previous planter respectively. Generally, this variation in germination ratio may be attributed to increase of the slippage of machine wheel, increase of hill missing, disturbance in seed depth and seed spacing, decrease the cell filling in metering device and increase of mechanical damage by using a higher speed compared with the lower one . Also, static analysis illustrated that variables were significant at p>0.1% level while, planter type was significant at p>0.5%level.

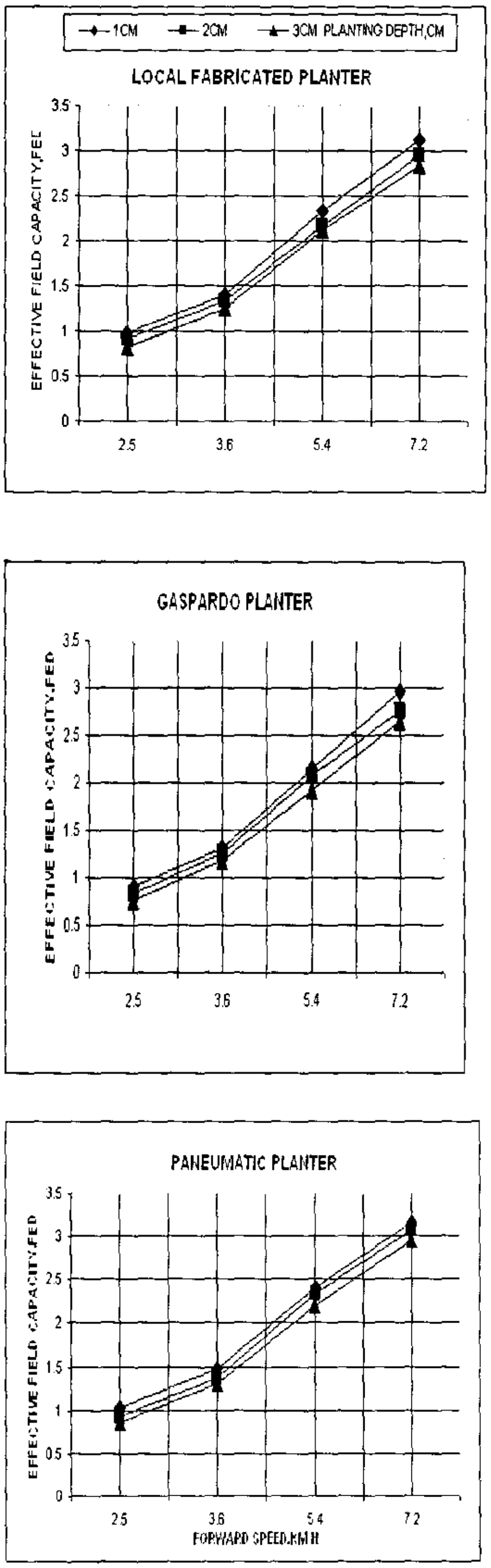


Fig 2:Effect of forward speed and planting depth on effective field capacity, Fed/h for different types of planters used with seedbed preparation method C

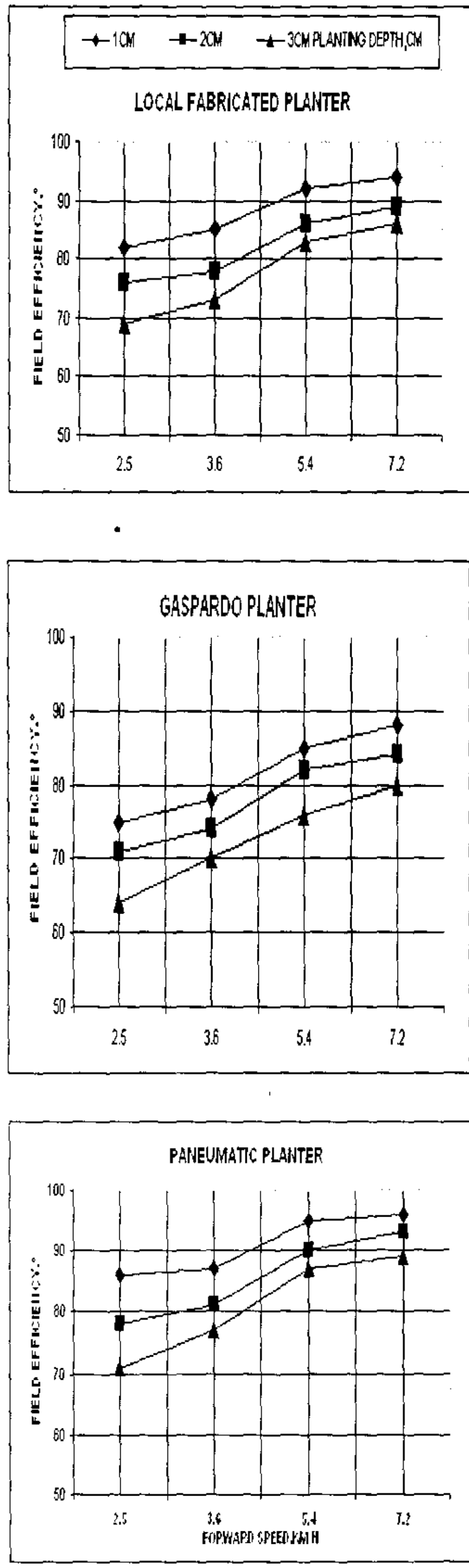


Fig 3:Effect of forward speed and planting depth on field efficiency, % for different types of planters used with seedbed preparation method C

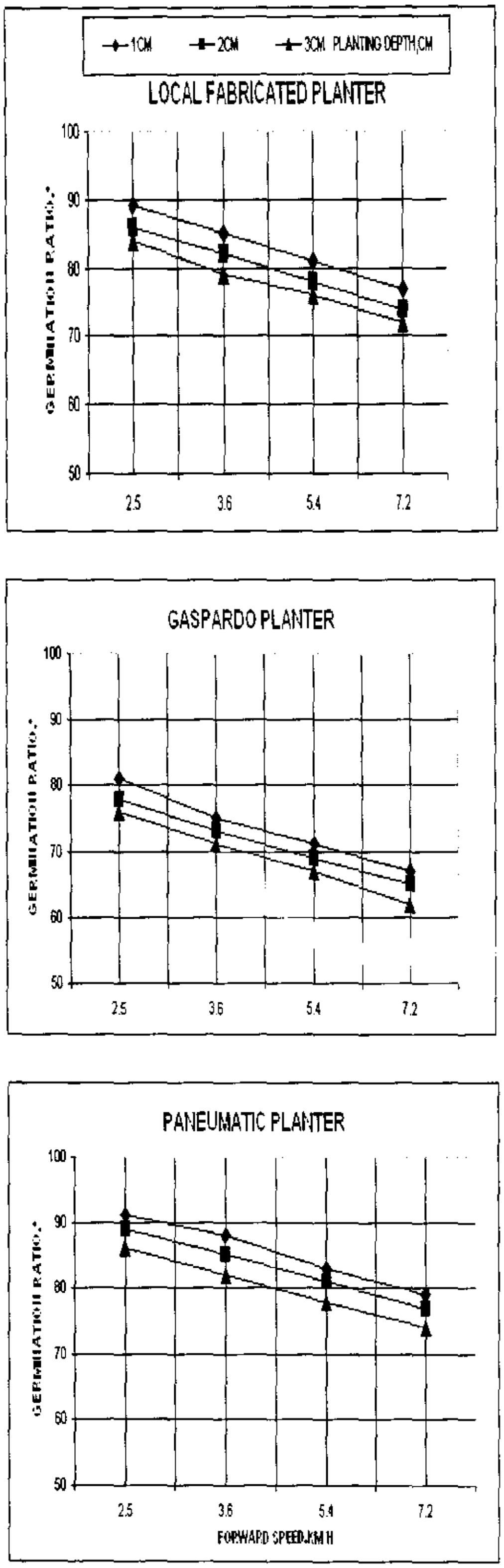


Fig 4:Effect of forward speed and planting depth on germination ratio, % for different types of planters used with seedbed preparation method C

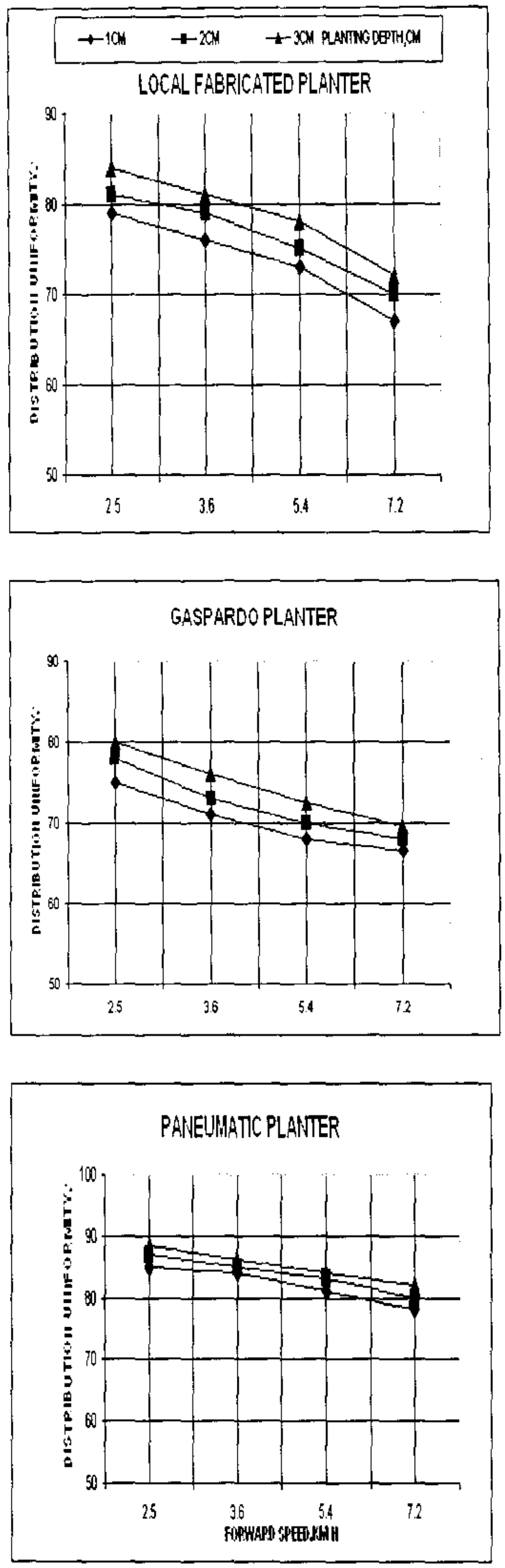


Fig 5:Effect of forward speed and planting depth on distribution uniformity ,% for different types of planters used with seedbed preparation method C

4- Distribution uniformity:

The examining planters were adjusted and calibrated on 18.5 cm distance between hills in the same row. But, there were high differences in seed spacing uniformity because of differences among seed bed preparation treatments, planter's types, forward speed and planting depth. Data showed that, distribution uniformity decreased with increasing forward speed and vice versa with planting depth. Results illustrated that the highest distribution uniformity was obtained at the lowest forward speed 2.5 km/h under different planters. Meanwhile, the lowest value of uniformity was recorded at 7.2 km/h .This may be due to the increase of forward speed lead to increase in seed spacing as affected by planter wheels slip. In addition to, planter vibration increase by increasing forward speed. Consequently, reducing the filling efficiency of the seed metering device. Pneumatic planter provided the largest distribution uniformity; however, local planter provided uniformity larger than the imported one . From Fig.5 with planting treatment (C) , increasing forward speed from 2.5 to 7.2 km/h at planting depth of 1 cm , distribution uniformity decreased from 79 to 67 %(-15.19%) , from 75 to 66.5 %(-11.33%) and from 85 to 78%(-8.23%) at using local planter, imported planter and pneumatic planter respectively. While it was increased from 79 to 84 %(+6.33%), from 75 to 80%(+6.66%) and from 82 to 88.5% (+7.92%) at increasing planting depth from 1to 3 cm and using forward speed of 2.5 km/h and the same previous planters respectively. Also, there were all variables were significant at $p>0.5\%$ level while seed bed preparation treatment was significant at $p>0.1\%$ level.

5- Root yield:

Data in Fig.6 show the effect of forward speed and planting depth with different planter's types and seed bed preparation treatment on root yield Mg/Fed. The results indicated that root yield decreased by increasing both planting machine forward speed and planting depth. While, it gave very high value using pneumatic planter and treatment (C). Root yield decreased from 27.1 to 23.3 Mg/Fed (-14.02%), from 26.2 to 21.9 Mg/Fed (-16.4%) and from 28.6 to 26.5 Mg/Fed (-7.34%) at planting treatment c with increasing forward speed from 2.5 to 7.2 km/h, constant planting depth on 1 cm and using local fabricated planter, imported planter and pneumatic planter respectively. Also, root yield decreased from 27.1 to 25.7 Mg/Fed (-5.16%) ,from 26.2 to 25.1 Mg/Fed (-4.19%) and from 28.6 to 27.3 Mg/Fed (-4.54%) at

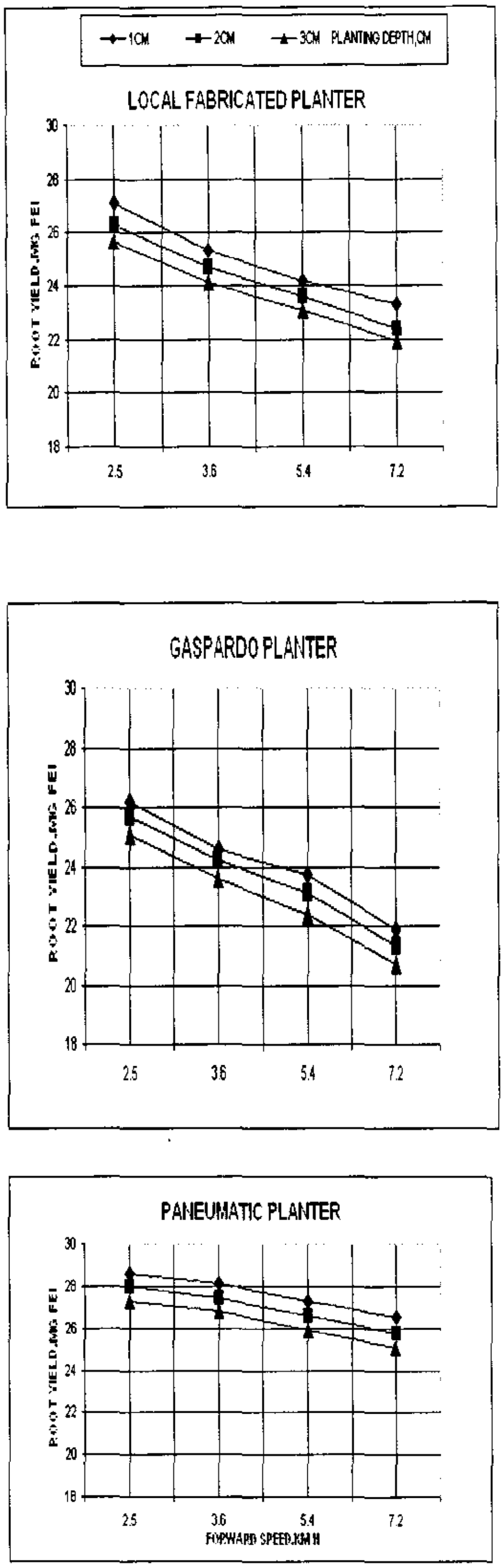


Fig 6:effect of forward speed and planting depth on root yield ,Mg/Fed for different types of planters used with seedbed preparation method C

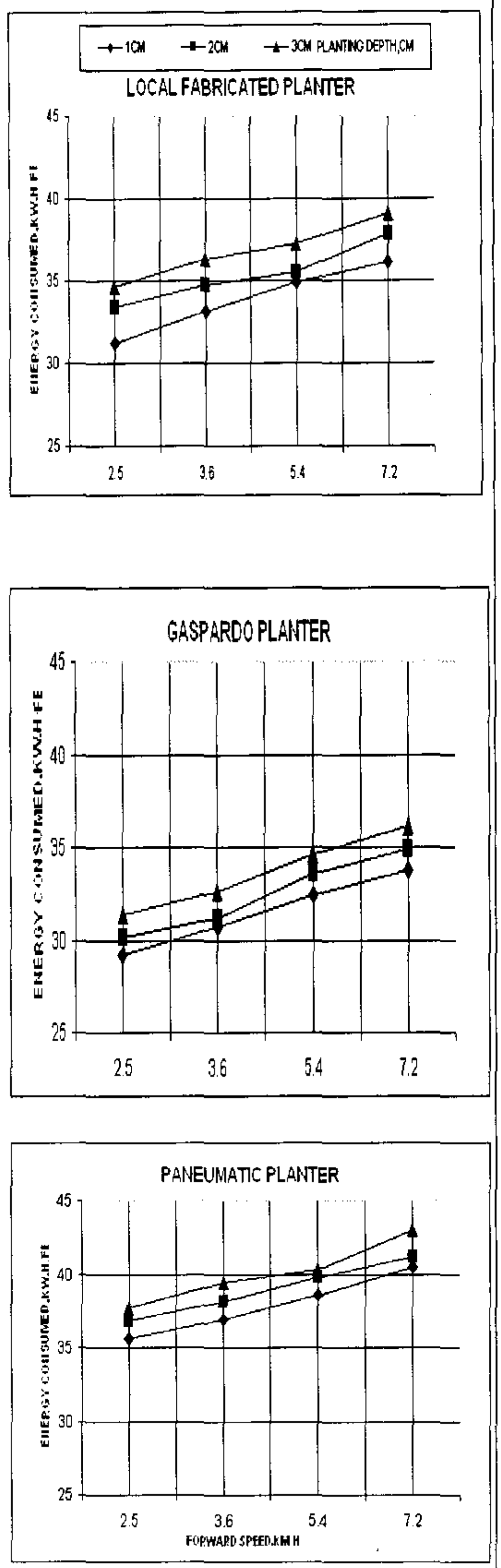


Fig 7:effect of forward speed and planting depth on energy consumed , kW .h /Fed for different types of planters used with seedbed preparation method C

planting with the same previous treatment and planters type respectively with increasing planting depth from 1 to 3 cm , constant forward speed on 2.5 km/h . on another hand , low value of root yield recorded using imported planter at planting treatment (A) where this treatment have little seed bed preparation and little germination ratio. On the other hand all variables were significant at p>0.5% level.

6- Energy consumed:

Data shown in Fig .7 that energy consumed decreased with increasing seed bed preparation. So, planting treatment (C) had little amount of energy requirements. But, it was increased with increasing planting depth. Also, results noticed that the large amount of energy consumed recorded at using pneumatic planter where, it needed additional energy for including suction fan consuming large amount of energy. Data in Fig.7 Showed that energy consumed increased from 31.27 to 36.12 kW.h/h(+15.51%), from 29.15 to 33.72 kW.h/h (+15.67%) and from 35.61 to 40.52 kW.h/h (+13.78%) at planting treatment (C) by increasing forward speed from 2.5 to 7.2 km/h , constant planting depth on 1 cm and using planter type (local, imported and pneumatic respectively). While it increased with increasing planting depth where, it increased from 31.27 to 34.64 kW.h/h (+10.77%), from 29.15 to 31.41 kW.h/h (+7.75%) and from 35.61 to 37.72 kW.h/h (+5.92%) for the same previous treatment and planters type respectively when using forward speed of 2.5 km/h and increasing planting depth from 1 to 3 cm.

7- Operating cost:

From results in Fig. 8 . It was illustrated that planting treatment (A) caused high value of operating cost. While, planting treatment (C) produced low operating cost. Also, local planter gave low value of operating cost compared with other planters. It was observed too that, operating cost decreased with increasing forward speed while, it increased with increasing planting depth .This may be because of increasing actual field capacity with increasing forward speed and decreasing it with increasing planting depth. The lowest value of operating cost of 16.41 L.E/Fed recorded at planting treatment (C) by imported planter with forward speed of 7.2 km/h and planting depth of 1 cm. While, the highest value of 62.17 L.E/Fed recorded at planting treatment (A) by using pneumatic planter with forward speed of 2.5 km/h and planting depth of 3 cm.

Table 2 : Effect of different forward speed and planting depth on operating cost, L.E/Fed.

Planting type	Planting depth, cm / Forward speed, km/h	Operating cost, L.E/Fed.								
		Treatment A			Treatment B			Treatment C		
		1	2	3	1	2	3	1	2	3
Local planter	2.5	40.42	43.42	47.40	37.49	39.97	43.17	34.89	36.12	39.46
	3.6	32.61	36.80	39.93	26.57	28.45	31.27	27.94	29.88	31.37
	5.4	25.00	27.13	29.38	21.11	23.36	25.50	21.58	23.15	24.04
	7.2	22.67	24.98	26.48	19.62	21.51	22.43	18.81	19.65	20.40
Imported planter	2.5	40.68	43.89	45.42	34.61	37.07	40.49	30.25	33.39	36.41
	3.6	29.05	31.23	33.94	24.12	26.85	29.98	21.06	23.76	25.11
	5.4	24.26	25.55	27.45	20.79	21.54	23.48	18.56	19.75	21.36
	7.2	18.91	20.40	21.76	18.39	19.79	20.80	16.41	17.59	18.98
Pneumatic planter	2.5	55.46	57.67	60.17	46.26	49.00	52.11	40.82	42.09	46.83
	3.6	41.91	46.69	51.00	35.76	38.98	43.77	32.56	34.52	37.99
	5.4	25.45	28.44	31.28	27.62	29.69	32.63	23.23	24.42	25.92
	7.2	20.04	22.97	24.39	22.73	24.23	25.43	20.57	21.78	23.44

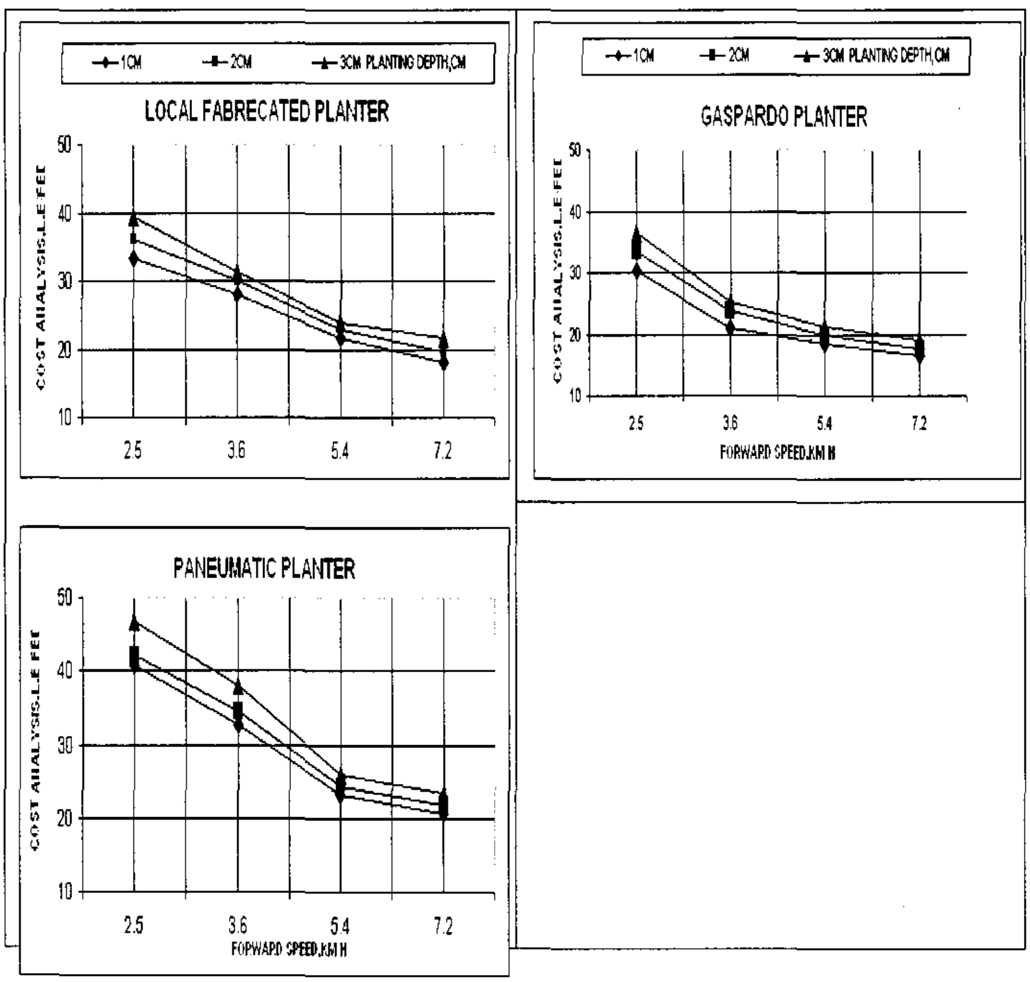


Fig 8 : effect of forward speed and planting depth on cost analysis ,L.E/Fed for the different types of planters used with seedbed preparation method C.

CONCLUSION

The conclusions of this study can be summarized as follows:

1- Effective field capacity and field efficiency increased with increasing forward speed and seed bed preparation. While, they decreased with increasing planting depth. The maximum value were 3.25 fed/h and 96% respectively which were recorded at planting treatment C using pneumatic planter with forward speed of 7.2 km/h and 1cm planting depth.

2- Germination ratio decreased with increasing forward speed and planting depth .while it was increased with the increase in seed bed preparation. Local fabricated planter recorded high rate of germination.

3- Distribution uniformity decreased with increasing forward speed .while; it increased with increasing planting depth and increase of seed bed preparation. Where, the maximum ratio was 88.5% recorded at planting treatment c using pneumatic planter with forward speed of 2.5 km/h and planting depth of 3 cm.

4- Root yield decreased with increasing both forward speed and planting depth .while, it was increased with increasing seed bed preparation. Pneumatic planter recorded high value of root yield at all experimental levels. Also, local fabricated planter was better than imported planter generally.

5- Local fabricated planter and imported planter used energy lower than pneumatic planter. Generally, energy consumed increased with increasing forward speed and planting depth. While, it decreased with increasing seed bed preparation.

6- Operating cost was high when using low forward speed and vice versa. Increasing forward speed to 5.4 km/h was suitable for decreasing operating cost. Generally, it decreased with increasing forward speed and with increasing seed bed preparation. While it increased with increasing planting depth.local and imported planter had low operating cost compared with pneumatic planter in view of increasing principal price.

Finally, local fabricated planter had convenient results because of its low price, decreasing operating cost and its superiority compared to imported planter.

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تقييم الأداء الحقلي لبعض آلات زراعة بنجر السكر

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يعتبر محصول بنجر السكر من المحاصيل الاستراتيجية الهامة في إنتاج السكر وأيضا فأنة يعتبر كمصدر لتغذية الحيوان. لذا فأنة يتم زراعة مساحة كبيرة منة سنويا والتى وصلت الى ٢٥٧٦٦٧ فدان فى عام ٢٠٠٨ و انتاجية فدانية قدرها ١٩،٩١٩طن/ فدان باجمالى إنتاجية كلية حوالي ٥١٣٢٥٨٩ طن سنويا (الإحصائيات الزراعية لوزارة الزراعة عام (٢٠٠٨). و محصول البنجر يحظى باهتمام كبير من الجهات المسؤلة بالتنمية الزراعية نظرا لعدة أسباب: لتقليل الفجوة بين إنتاج واستهلاك السكر، يستهلك كمية مياة اقل من محصول قصب السكر بنسبة الثلثين تقريبا، كما تجود زراعتة في مختلف الأجواء ومختلف أنواع الاراضى سواء كانت طينية ثقيلة أو رملية جيرية أو ملحية أو قلوية.

و تعتبر عملية زراعة بنجر السكر يدويا من أكثر العمليات الزراعية تكلفة حيث تحتاج لعدد كبير من العمال وتستهلك كمية تقاوي كبيرة وبالتالي تسبب نقص صافى الربح لمزارع البنجر.لذلك أصبح استخدام آلات الزراعة الميكانيكية عند زراعة بنجر السكر من أهم البنود لتقليل تكاليف الإنتاج وزيادة المحصول وبالتالي زيادة صافى دخل مزارعي البنجر في مصر.لذلك كانت فكرة هذة الدراسة هي تقييم الأداء الحقلي لأنواع متباينة من آلات الزراعة المحلية والمستوردة بهدف الخروج بتوصية نهائية عن أكثر الأنواع ملائمة للظروف المصرية.

العوامل تحت الدراسة:

١- **نوع ألة الزراعة:** تم استخدام ثلاث أنواع مختلفة من آلات الزراعة كانت إلة زراعة هوائية ، آلة زراعة مستوردة ، آلة زراعة محلية الصنع .

٢- **إعداد مرقد البذرة:** تم استخدام ثلاث مستويات خدمة كانت

ا- محراث حفار وجهين + تسوية بالقصابية.

ب- محراث حفار وجهين+محراث دوراني + تسوية بالقصابية.

ج- محراث حفار وجهين+ديسك + تسوية بالقصابية

٣- **سرعات التقدم:** تم استخدام أربعة سرعات تقدم أمامية كانت ٢,٥، ٣,٦، ٥,٤، ٧,٢ كم/ساعة.

٤- **عمق الزراعة:** تم استخدام ثلاثة أعماق كانت ١،٢،٣سم.

وقد تم تقييم أداء الآلات المختلفة من خلال دراسة المتغيرات آلاتية:

١- السعة الحقلية الفعلية، فدان/ساعة. ٢- الكفاءة الحقلية، %.
٣- نسبة الإنبات، %. ٤- انتظام التوزيع، %.
٥- إنتاجية الدرنات، ميجا جرام/فدان. ٦- الطاقة اللازمة، كيلووات. ساعة/فدان.
٧- تكاليف التشغيل، جنية/فدان.

أهم النتائج:

١- السعة الحقلية الفعلية و الكفاءة الحقلية: كانتا تتناسب طرديا مع زيادة سرعة التقدم ومع زيادة معدل الخدمة بينما كانتا تتناسب عكسيا مع زيادة عمق الزراعة وكانت أقصى قيم لهما تسجل عند زراعة الأرض ذات معدل الخدمة (ج) باستخدام آلة الزراعة الهوائية.

٢- نسبة الإنبات: كانت تقل بزيادة سرعة التقدم لآلات الزراعة وبزيادة عمق الزراعة بينما كانت تزداد مع زيادة معدل خدمة الأرض قبل الزراعة وكانت أعلى قيمة لهل ٨٩% سجلت عند سرعة تقدم ٥,كم/ساعة وعمق زراعة ١ سم وذلك باستخدام آلة الزراعة المحلية في زراعة الأرض ذات معاملة الخدمة (ج).

٣-انتظام التوزيع: كانت تقل بزيادة سرعة التقدم بينما كانت تزداد بزيادة عمق الزراعة وبزيادة معدل خدمة الأرض قبل الزراعة وكانت أعلى قيمة لهل ٨٨,٥% سجلت عند زراعة الأرض ذات معدل الخدمة (ج) باستخدام آلة الزراعة الهوائية عند سرعة تقدم ٢,٥ كم/ساعة وعمق زراعة ٣ سم.

٤- إنتاجية الدرنات: كانت تقل بزيادة سرعة التقدم عند الزراعة و بزيادة عمق الزراعة بينما كانت تزداد بزيادة معدل خدم الأرض قبل الزراعة و قد كالنت اغلى قيمة للإنتاجية هي ٢٨,٦ ميجا جرام/فدان سجلت عند زراعة الأرض ذات معدل الخدمة (ج) باستخدام آلة الزراعة الهوائية باستخدام سرعة تقدم ٢,٥ كم/ساعة وعمق زراعة ١ سم. علما أن آلة الزراعة المحلية قد تفوقت على آلة الزراعة المستوردة عند جميع النقاط التجريبية.

٥- الطاقة اللازمة: كانت قليلة عند استخدام الآلة المحلية أو الآلة المستوردة ولا توجد فروق كبيرة بينهما بينما كانت مرتفعة بشكل ملحوظ عند استخدام آلة الزراعة الهوائية وذلك لاحتوائها على مروحة شفط كبيرة تحتاج إلى كمية طاقة إضافية. وعموما فان معدل استهلاك الطاقة كان يزداد بزيادة سرعة التقدم أو زيادة عمق الزراعة بينما كانت تنخفض بزيادة معدل خدمة التربة قبل الزراعة. واقل طاقة مستهلكة كانت ٢٩,١٥ كيلووات.ساعة/فدان وذلك عند زراعة ارض ذات معدل خدمة (ج) باستخدام آلة الزراعة المستوردة وذلك عند سرعة تقدم ٢,٥ كم/ساعة وعمق زراعة ١ سم.

٦-اجمالى تكاليف التشغيل كانت مرتفعة بشكل كبير عند استخدام سرعات تقدم منخفضة ولكن بزيادة سرعات التقدم إلى ٥,٤ كم/ساعة كانت تنخفض بشكل كبير وعموما فاتها كانت تنخفض بزيادة سرعة التقدم و بزيادة معدل خدمة التربة بينما كانت تزداد بزيادة عمق الزراعة وكانت اقل ما يمكن مع آلة الزراعة المستوردة التي كانت اقل من الآلة المحلية بقيم بسيطة بينما آلة الزراعة الهوائية فأنها كانت مرتفعة في تكاليف تشغيلها نظرا لارتفاع السعر الاساسى لهذة الآلات.

ومن خلال ما سبق يمكن القول أن آلة الزراعة الهوائية كانت تتفوق في أحيان كثيرة إلا إن الآلة المحلية تعتبر ذات نتائج مرضية نظرا لرخص ثمنها وانخفاض تكاليف تشغيلها وتفوقها على الآلة المستوردة.