IMPACT OF PLOWING DEPTH AND HOEING ON THE SUGAR BEET QUALITY AND PRODUCTIVITY UNDER TWO DIFFERENT PLANTING METHODS.

AWAD, N. M. M., T. S. EL-AMMARI AND A. M. EL-SAYED GOMAA

Sugar Crops Research Institute, A. R. C. Giza. Egypt

(Manuscript received 20 April 2004)

Abstract

Planting density is the major factor affecting yield and quality of sugar beet. The main aim of this work is to study the effect of planting method, plowing depth and hoeing times on sugar beet yield and quality. The planting machine (Gamma 90) and manual planting with three plowing depths (15, 25 and 35 cm), and one, two and three hoeings were used in this study. Field experiment was carried out at Sakha Agricultural Research Station at Kafr El-Sheikh Governorate in Egypt, through the two successive seasons 2000/2001 and 2001/2002. The obtained results can be summarized as follow:

1- The planting machine gave the maximum root yields (29.875 and 30557 ton/fed) compared with the manual planting (24.820 and 26.450 ton/fed) in both seasons respectively, using plowing depth of 35cm and three hoeings. This superiority caused by higher number of plants per feddan (38267) which resulted from planter machine compared with manual which gave the lowest number of plants per unite area "feddan" (21457) under ploughing depth of 35 cm with three hoeings.

2- The highest percentage of sucrose was recorded with planting machine (Gamma 90) which gave 17.05 and 17.83 %compared with the manual planting which gave 16.56 and 17.34 % at 35 cm plowing depth and three hoeings in both season, resp.

3-The plowing depth of 35 cm and using three hoeings gave the maximum values of sugar yield of 5.074 and 5.525 ton/fed compared with the other depths in both seasons,resp.

4-The other characteristics recorded the highest values with (Gamma 90) planting machine compared with manual planting under 35 cm plowing depth and three hoeings for root dimensions, root volume and upper part of root percentage.

INTRODUCTION

It is well known that sugar beet is grown in a new reclaimed soil in Egypt. This type of soils due to absence of some hills and decrease the density and allaw allaw weeds to compete with sugar beet plants. So, we must be work to increase number of hills and number of plants per unite area (feddan) to prevent the effect of weeds on plants. Based on the available information in respect to this problem, this study was

conducted to face and solve the problem of decreased number of plants per area unit and improve the characters of root to increase the quality and yield of sugar beet. *Awady (1986)* reported that root yield increased significantly depending on the depth of cultivation. *Raininko (1990)* reported that,the losses of sugar beet is due to non-uniform planting depth and non-uniform growth of root upper the soil surface. He described the losses during topping operation as follows: -

i)-If the cut of topping upper the zero level (the critical section of cutting) the loss is 1.8 t/hectare and the percentage of sugar in this part is 10.5 %. If the cut of topping is lower of the zero level by 1 cm the loss is 3.3 t/hectare and percentage of sugar is 16.4%.

ii)-If the cut of topping is lower of the zero level by 2 cm the loss is 6.8 t/hectare and percentage of sugar is 17.2 %.

Imara (1996) reported that, by increasing plowing depth the corn yield tends to increase for all soil moisture contents (17.31, 20.24 and 25.19%), implement forward speeds and plowing machine types.

Derylo (1991) compared between chemical and mechanical weeding for weed control in sugar beet. He found that mechanical control reduced number and Dm of weeds from 3.5–16.0 plants and 0.5–13.9 g, respectively. Whereas, *povilaitis et al. (1992)* pointed out that manual weeding resulted in 100 % weed control in sugar beet. *Abd.El-Aal (1995)* found that manual weeding by hoeing gave the highest sucrose percentage, root and sugar yield (ton/fad). *Westerdijk et al. (1996)* demonstrated that weed control by harrowing at 4-leaf stage gave good control and allowed 1-2 low-dose herbicide sprays to be omitted *Bondarchuk (1998)* found that preemergence harrowing reduced weediness in sugar beet fields by up to 48.3 % (1 harrowing) and 60.1 % (2 harrowing) if compared with untreated control.

Helmy (2002); Imara (2003) and El-Nakib (1990) compared planters and manual planting and concluded that machines caused an increase in percentage of germination of plants per area unit than manual planting which caused an increase in root yield of sugar beet. The aim of the present study is to investigate the effect of plowing depth and hoeing on sugar beet yield and quality.

MATERIALS AND METHODS

Two field trails were carried out at Sakha Agricultural Research station, Agricultural Research Center at Kafr El-Sheikh Governorate, Egypt during 2000/2001

and 2001/2002 seasons. Treatments were arranged in split-split plot design with three replicates. The main plots were deu ciited to three plowing depths plots were assigned to one, two and three hoeings while, sub- (15, 25 and 35 cm) and sub- sub plots contained two planting methods (Gamma 90) planting machine and manual planting.. Sowing took place on 15 and 25 Oct. in both seasons, respectively. Seeds of multigerm cultivar (Farida) were sown in hills 20 cm apart by (Gamma 90) planting machine and by manual on side ridges at rate of one seed by machine while 3-4 seeds by manual. Plants were thinned to one plant/hill at 4 leaf stage with manual planting in both seasons.

The mounted pneumatic planter (Gamma 90) was used with a 55.6 kW (75hP) Yanmar tractor in this study. The pneumatic planter consists of four planting units (4 rows). The technical specifications of the planter are in Table 1 as follows: -

Type and model	"Gamma 90"
Source of manufacture.	Italy
No. of rows	4
Row spacing, mm	500 -800
Working width, mm	2000 – 3200
Weight, kg	600
Metering device	Vertical

Table 2. Soil particle distribution and soil water constants for the experimental field.

Soil depth, cm	Soil participle distribution			Textural class	FC, %	W. P, %	a. w, %	Db, g/cm^3
	Sand, %	Silt, %	Clay, %					
0-15	13.30	33.41	53.29	Clay	47.81	26.02	21.79	1.06
15-30	21.00	45.00	45.00	Clay	42.19	21.70	20.49	1.35
30-45	20.60	39.02	39.02	Clay loam	40.36	21.00	19.36	1.37

The measurements: -

Number of hills: -

Number of hills which have one seed and two seeds were calculated from the following formula:

$$No.\ of\ hills = \frac{No.\ of\ hills\ which\ have\ one\ seed\ and\ two\ seeds / m^2}{Total\ number\ of\ hills / m^2} \quad \text{.....(1)}$$

Total number of hills = Theoretical number of hills x slippage % .....(2)

Root yield in ton/fed

The yield of the harvested roots (Ry) was determined by roots lifted by hand–shovel, in the manual harvesting useing the following equation ***(Taieb, 1997)*** was used:

$$Ry = \frac{M \text{ X } 4200}{A \text{ X } 1000}, \quad ton/fed \quad \text{.....(3)}$$

M = The mass of lifted roots, kg

A = The harvested area, m^2.

Germination ratio

The germination ratio was determined using equation:

$$Gr = \frac{NP}{NS} x100 \quad \text{.....(4)}$$

Where:

NP = No. of sugar beet plants within a length 10 m in the manual and the mechanical planting.

NS = No. of sugar beet seeds delivered within the same length in the manual and the mechanical planting.

Sugar yield in ton/fed

It was estimated by multiplying root yield by sucrose percentage.

Sugar yield (ton/fed) = Root yield (ton/fed) x Sugar percentage .....(5)

The N fertilizer in from of urea (46.5 %) as soil dressing was applied in two equals dose one half after thinning and the second half after one month later. Ten guarded plants were taken to estimate root volume, root length, root diameter and sucrose % as well as sugar yield and upper part of root. Sucrose percentage was determined from ten roots by using saccharometer according to *Le-Decte (1927).* The analysis of variance was carried out according to *Gomez and Gomez (1984).* Treatment means were compared by Duncan's multiple range test *(Duncan, 1955).* All statistical analysis was peroformed using analysis of variance technique by means of "M Stat" computer software package.

RESULTS AND DISCUSSION

1- Number of plants.

Figure (1) show that number of hills per feddan, by using planting machine (Gamma 90) gave the highest number of plants of 37482 and 38267 compared with

manual planting method which gave 21457 and 22347 plants /fed in both seasons, respectively. Because the spaces between plants on the row were bigger and hills missing, consequently decreased the density sugar beet plants. The planter is very important to save labour and favorable seed distribution over the area.

2- Root dimensions:

Data presented in Figures 2 and 3 indicated that root dimensions (length and diameter) increased by increasing both hoeing times and plowing depth to 35 cm when sugar beet seeds planted by planting machine (Gamma 90) compared with manual planting. The longest and thicknest roots (35.63 and 11.45 cm) were obtained in the first season, while in the second season they were 36.91 and 11.75 cm at three hoeings resp. Whereas, longest and thinnest roots were obtained with manual planting (34.26 and 11.75 cm) and (34.40 and11.90 cm) at three hoeings and 35 cm plowing depth in both seasons respectively. Root length was tallest when planted by machine while, with manual planting root length was shortest.

On the other direction, root diameter was highest with manual, if compared with machine planting which recorded the lowest root diameter, This results due to, in machine planting, the space between plants was narrow and caused to small root diameter. While, in manual, the space between plants was wide which caused to gave big root size. Similar results were obtained by *Korany et al (1998)* who tested three plowing depths and concluded that 30 cm depth significantly increased root dimensions.

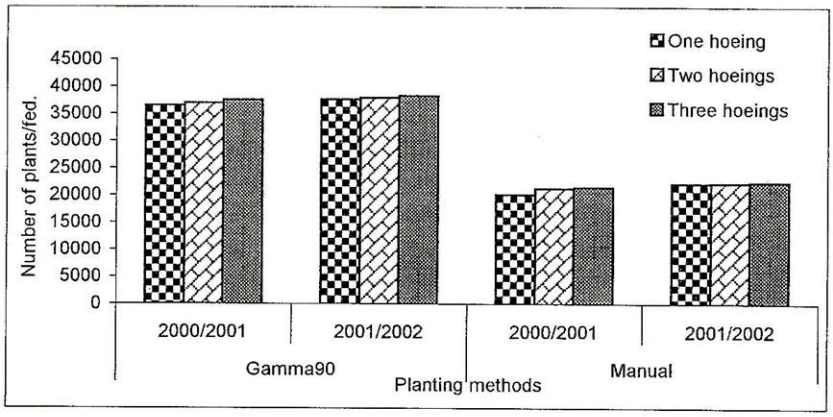

Fig. 1: Effect of number of hoeings and planting methods on number of plants.

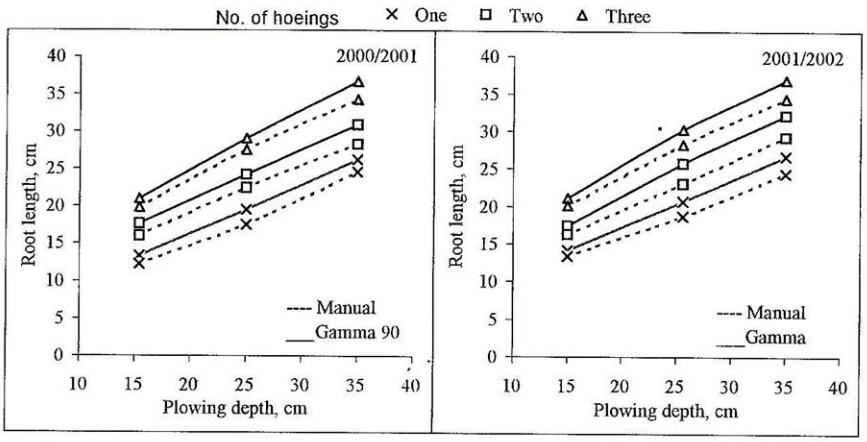

Fig.2: Effect of plowing depths, number of hoeings and planting methods on root length in both seasons

3- Root volume and upper part, %:

Concerning root volume the data presented in Figures (4 and 5) show that the biggest root 965 cm^3 was obtained with planting machine (Gamma 90) in the first season but in the second season was 1000 cm^3, when 35 cm plowing depth and three hoeings was used in both seasons. While manual planting gave high root volume (1036 and 1086 cm^3) compared with planting machine (Gamma 90) at the same conditions.

On the other hand, plowing depth significantly decreased the upper part percentage for root because roots extension easy through the soil and increase hoeing times decreased upper part percentage of root. Also, planter machine significantly decreased the upper part of root to 16.78 and 15.07 %when plowing depth of 35 cm and three hoeings in both seasons resp, compared with manual planting which recorded highest values (20.25 and 17.12 %) in both seasons resp. This results due to, in manual planting, the space between hills was not regular and gave big root volume in contrast with machine planters which controlled the distance between plants and gave small root volume. Similar results were obtained by *Korany (1998).*

4- Sucrose percentage:

The sucrose percentages obtained at both seasons were presented in Figure (6). Significant increase in sucrose percentage was accompanied by substantial increase in hoeing times and plowing depth with planting machine (Gamma 90).

The highest sucrose percentage was 17.05 and 17.83 % obtained in both seasons when sugar beet seeds were planted by machine while manual planting gave lowest values (16.56 and 17.34 %) in both seasons, at 35 cm plowing depth and three hoeings. While, one hoeing under tillage depth 15 cm produced the lowest values with two planting methods (machine or manual). This finding stand in conformity with those recorded by *Abd-El-Aal (1995)* who found that manual weeding by hoeing gave the highest sucrose percentage.

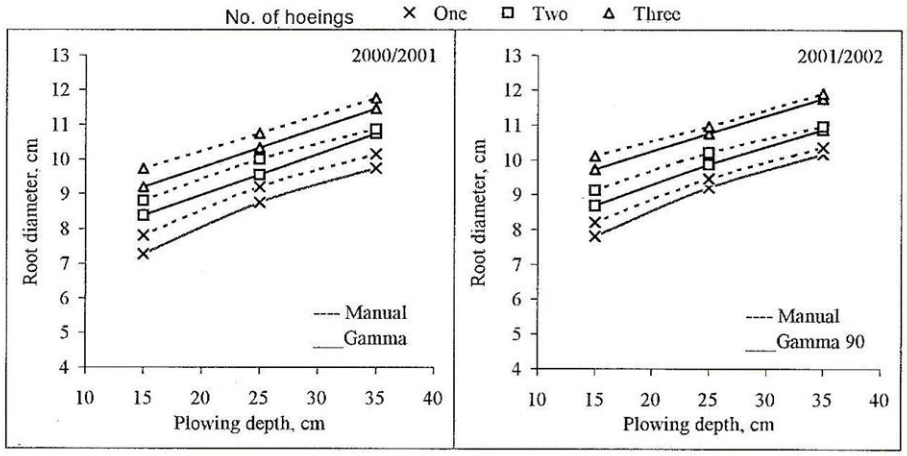

Fig. 3: Effect of plowing depths, number of hoeings and planting methods on root diameter in both seasons

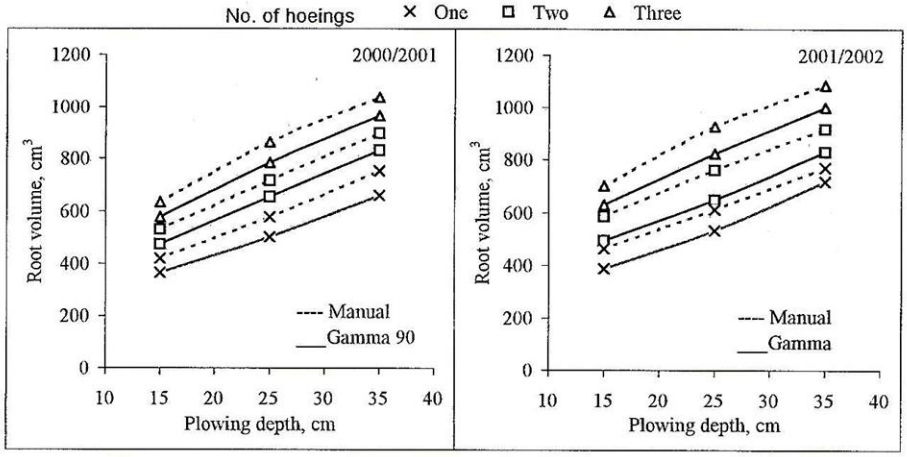

Fig. 4: Effect of plowing depths, number of hoeings and planting methods on root volume in both seasons.

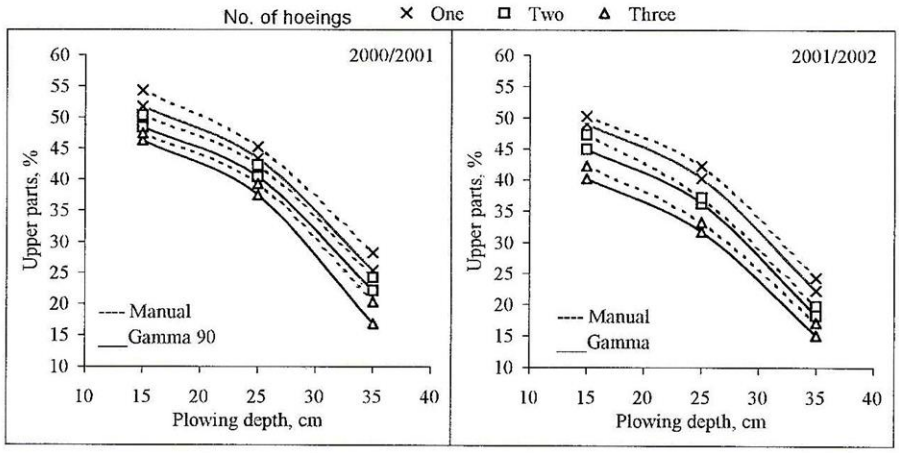

Fig. 5: Effect of plowing depths, number of hoeings and planting methods on upper parts in both seasons

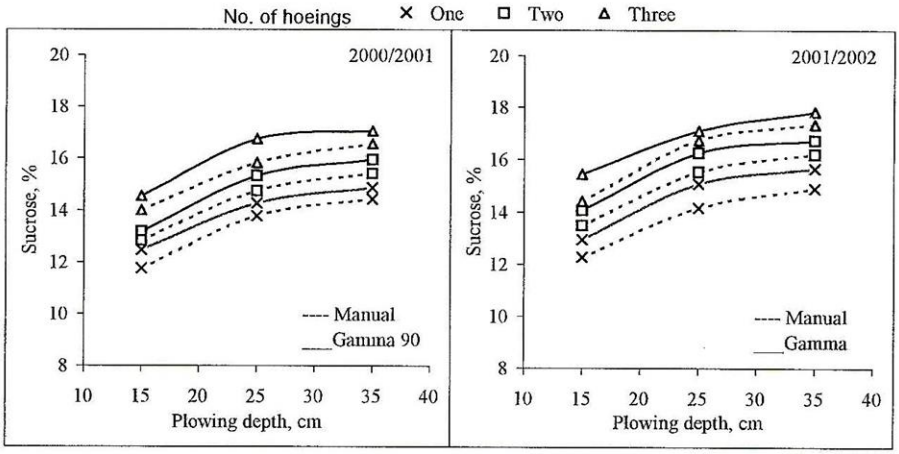

Fig. 6: Effect of plowing depths, number of hoeings and planting methods on sucrose in both seasons.

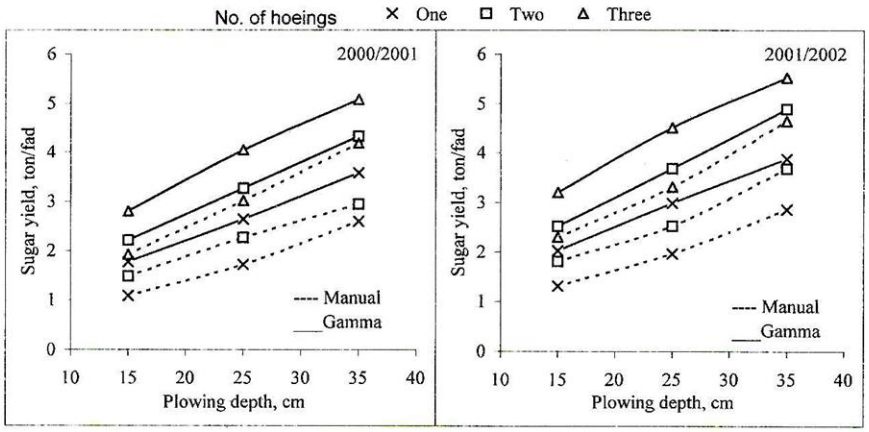

Fig. 7: Effect of plowing depths, number of hoeings and planting methods on sugar yield in both. seasons

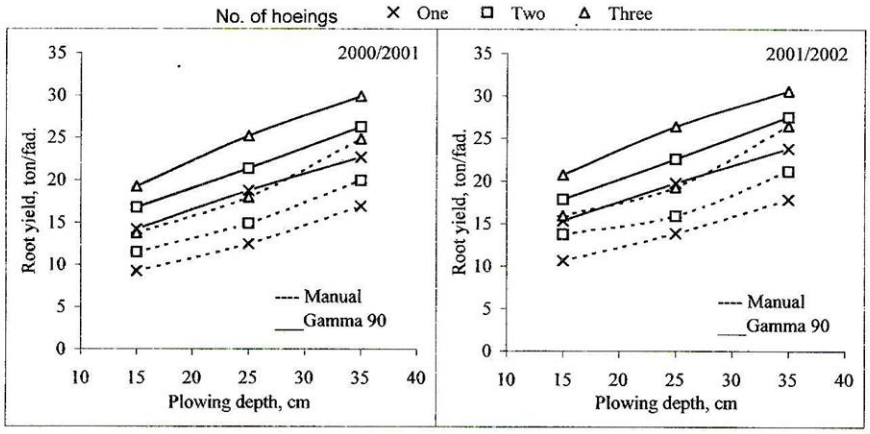

Fig. 8: Effect of plowing depths, number of hoeings and planting methods on root yield in both seasons.

5- Root and sugar yields(ton/fed):

From data in Figures 7 and 8, it could be seen that increasing hoeing three times and plowing depth to 35 cm recorded the highest root and sugar(29.875 and 5.070 ton/fed) (30.557 and 5.525 ton/fed) yields/fed. In the first and second seasons, resp. Where. the plowing depth of 15 cm with one hoeing gave the lowest values of root and sugar yields especially when planting was by manual compared with planting machine (Gamma 90) in both seasons. This results may be due to high density which resulted from planting machine (Gamma 90) compared with manual planting.

CONCLUSION

The mechanical planting of sugar beet is very necessary to increase the number of plants to 38267 plant/fed. and increase root and sugar yield per area unit if compared with manual planting which recorded the lowest values of plants number of 21457 plants per feddan. Also, plowing depth of 35 cm and three hoeings significantly increased sucrose percentage and root yield than other plowing depths or hoeing times. So, we pointed out to the importance of these mentioned factors to increase sugar yield from area unit to decrease the costs.

REFERENCES

1. Adel, Abd-El-Aal 1995. Integrated weed control in sugar beet with relation to yield and quality. M. Sc. Thesis, Agronomy dep., Faculty of Agric. Ain Shams university.
2. Awady, M. N 1986. Mechanization of soil cultivation appropriate to Egyptian agriculture. 1st Tech. Rep. Misr J. Ag. Eng., 3(2):27-37.
3. Bondarchuk, A. A 1998. A proven method of weed control. Sakharnaya Svekla. 1998, No. 10:8-10 C. F. CAB Absts. 1999.
4. Derylo, S. 1991. Sugar beet yield levels depending on the cultivation method. Biuletyn Instytutu Hodowli-I- Aklimatyzacji Roslin. 178:99-102 C. F. CAB Absts. 1994.
5. Duncan, B. D. 1955. Multiple range and multiple F- test Biometrics. 11:1-42.

6. Gomes, K. A. and A. A. Gomez 1984. Statistical procedures for Agric. Res. 2 nd Ed. Jhon Wiley and Son.

7. Helmy, M. A.; Z. M. Imara and N. M. Awad 2002. The feeding device modification of a planter to suit sugar beet planting. Misr J. Ag. Eng., 19 (3): 556-570.

8. El-Nakib, A. A 1990. Sugar beet precision planting and emergency with cooled seed. Misr J. Ag. Eng., 7(3):208-223.

9. El-Zawahry, A. S. M. 1994. A study on mechanization of some operations in sugar beet production M. Sc. Thesis,Ag. Eng. Dep, Faculty of Agric. Al Azhar.Univ., Egypt.

10. Imara, Z. m. 1996. Development a combined machine for primary and secondary tillage under local conditions. Ph. D. Thesis, Fac. of Agric. Kafr El-Sheikh, Tanta Univ.

11. Imara, Z. M; N. A. Awad and M. A. Metwally 2003. Effect of different leveling and planting methods on yield Misr J. Ag. Eng., 20(1):102-114.

12. Korany, M. S.; Z. M. Imara and E. M. Kalifa (1998). Effect of plow type on some physical properties of a clay soil. Misr J. Ag. Eng., 15 (2): 276-290.

13. LE Docte, A. 1927. Commercial determination of sugar beet roots using Sacks Le Docte process. Int. Sugar J. 29:488-492.

14. Povilaitis, J. A. Onaitis and S. Rocius 1992. Herbicide app;ication on sugar beet seedlings. Moksliniu- Straipsniu- Rinkinys 70:127-137. C. F. CAB Absts. 1994.

15. Raininko, K. 1990. Sweeden sugar beet production. J. of sugar No. 1, 29, 32, 62.

16. Westerdijk,C.E.;R.Y.Weide-Van-derandJ.D.A. Wevers 1996. Integrated weed control (harrowing) in sugar beet. Publicate proefstation-Voorder Akkerbouwende Groenteteelt in de vollegrond, Lelystad. 81A, 69-73. C.F.CAB Absts.1998.

تأثير أعماق الحرث و العزيق على جودة وإنتاجية محصول بنجر السكر لطريقتين للزراعة

نبيل مرسى محمد عوض ، طارق سهرى العمارى ، عبد الفتاح متولى السيد جمعة

معهد بحوث المحاصيل السكرية-مركز البحوث الزراعية-جيزة ج.م.ع

أجرى هذا البحث في المزرعة البحثية بمحطة البحوث الزراعية بسخا – كفر الشيخ (مركز البحوث الزراعية) خلال الموسمين الزراعيين ٢٠٠٠/٢٠٠١، ٢٠٠١/٢٠٠٢ حيث أجريت تجربتين حقليتيـــن لدراســـة تأثـــير الزراعة بالميكنة حيث استخدمت ماكينة زراعة البنجر (GAMMA 90) ومقارنـــتها بالطريقة اليدوية على أعماق حرث مختلفة (١٥، ٢٥، ٣٥ سم) مع العزيق مرة ومرتين وثـــلاث مرات على محصول بنجر السكر وجودته. ودراسه تكلفة الإنتاج لوحدة المساحة وقد استخدم تصميم القطع المنشقة مرتين في ثلاث مكررات.

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

١. أدى اســـتخدام ماكيـــنة الـــزراعة لـــبذور بنجر السكر تفوقا في طول ووزن ونسبة السكر والجذور بالزيادة عند مقارنتها بالطريقة اليدوية للزراعة. كذلك أدى زيادة عمق الحرث من ١٥ إلـــي ٣٥ ســـم وكذلـــك عدد مرات العزيق إلى ثلاث مرات آلي تحسين هذه الصفات بالزيادة بينما آدت زيادة عدد مرات العزيق وكذلك عمق الحرث إلى التقليل من نسبة ظهور الجزء العلوي من الجذر الذي لم يتغلغل في التربة وهذا يؤدى إلى زيادة نسبة السكروز في الجذور.

٢. كذلـــك ســـجلت أكـــبر قيم لمحصول الجذور وكذلك محصول السكروز بالطن/ف عندما تم استخدام ماكينة الزراعة الآلية (GAMMA 90) عند مقارنتها بالطريقة اليدوية وكان لعمق الحرث للتربة الكبير ٣٥ سم وكذلك زيادة عدد مرات العزيق إلى ثلاث عزقات اكبر الأثر فـــي زيـــادة محصـــول الجـــذور الذي ترتب علية إنتاج اكبر محصول للسكروز في وحدة المســـاحة وهى الفدان مقدرا بالطن وكان للتقليل من عمق الحرث وعدد مرات العزيق اثر سلبي على تلك الصفات.

٣. تفوقت الزراعة اليدوية على الزراعة بالماكينة فى صفات حجم وقطر الجزور وذلك نتيجة لـــزيادة المســـافات البينـــية بين النباتات و إنخفاض الكثافة النباتية فىالزراعة اليدوية عن الزراعة الآلية.

ومما سبق يمكن الوصول إلى أن استخدام الميكنة في زراعة بنجر السكر لها اكبر الأثر في زيادة الإنتاج كما ونوعا وهذا يرجع إلى زيادة الكثافة النباتية في وحدة المساحة حيث وصلت الكثافة

النباتـــية وفي حالة الزراعة بالميكنة إلى ٣٨٢٦٧ نبات/ف بينما سجلت الزراعة اليدوية كثافة نباتية بلغـــت ٢١٤٥٧ نـــبات/ف، ولما لهذه الكثافة العالية من تأثير على صفات الجودة الأخرى مثل نسبة السكروز وبالتالي محصول السكروز طن/ف. وكذلك لعمق الحرث وعدد مرات العزيق الذي قلل من الأثر السيئ للحشائش على المحصول وجودته.