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EFFECT OF PLANTING DENSITIES ON PRODUCTIVITY AND QUALITY OF SUGAR BEET (*Beta vulgaris* L.) UNDER MIDDLE EGYPT CONDITIONS

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ABSTRACT

Recently, there is a great need to find out the proper technical recommendations for improving the productivity and quality of sugar beet under Middle Egypt conditions. Therefore ,this study was conducted at Mallawi Agric. Res., Station, Minia Governorate, Egypt, during ٢٠٠٧/٢٠٠٨ and ٢٠٠٨/٢٠٠٩ seasons to examine the effect of nine planting densities, i.e. ٢٨.٠٠ (١٠^{٣}) plants/fed at ridges, rows and beds , ٣٥.٠٠(١٠^{٣}) at ridges, rows and beds and ٤٦.٦٧(١٠^{٣}) plants/fed. at ridges, rows and beds, on productivity traits and quality characteristics of sugar beet .A randomized complete block design(RCBD) with four replications was used .

The obtained results indicated that plant density ٤٦.٦٧ (١٠^{٣})/fed at beds of sugar beet produced the highest values of roots number/fed. at harvest (٣٥.٨٧(١٠^{٣})roots/fed.) and root length (٤٤.٨٥cm) ,as well as the lowest value of root diameter (١٠.٤٢cm). The lowest values of roots number /fed.at harvest (٢٣.٠٣ (١٠^{٣}) roots/fed) and root length (٢٩.٢٥ cm) were scored for plant density of ٢٨.٠٠ (١٠^{٣})/fed at rows.

High plant density at beds (٤٦.٦٧(١٠^{٣}) plants/fed) achieved the highest values in both of pol% (١٧.٠٢٪), sugar recovery % (١٥.٠٢٪) and quality index (٨٨.٢٧٪) and lowest values in K , Na

and α-N contents (٣.٢٠, ١.٢٨ and ١.٨٣ meq/١٠٠ gm). Low plant density at rows (٢٨.٠٠(١٠^{٣}) plants/fed.) recorded the lowest values in both of pol% and sugar recovery%((١٣.١٠ and ١٠.٤٤٪) and highest values in K, Na and α-N contents being ٤.٥٩, ١.٥٥ and ٢.٤٥ meq/١٠٠gm, respectively.

Under the Middle Egypt conditions, high plant density at beds (٤٦.٦٧(١٠^{٣}) plants/fed.) was recommended because it achieved the highest values of root and recoverable sugar yields(٣٥.٤٦ and ٥.٣٣ ton/fed, respectively). Therefore, increasing income value of grower and sugar production for the factory as well as increase the efficiency of water use .This also will help in reducing the vast gap between sugar consumption and production on the national level .

INTRODUCTION

Sugar beet (*Beta vulgaris* , L.) is a new cultivated crop in Upper and Middle Egypt started in ١٩٩٧ season at El.Minia Governorate and in ٢٠٠١ season at El.Fayum Governorate). It is a crop of short duration and requires less water Egyptian Government imports large amounts of sugar ,i.e. about ١.١٠٩ million ton ,every year to face the rapid demand due to the increase of population . Sugar beet plays a prominent role for sugar production , about ٣٧.٠٨٪ of locally sugar production which reached ١.٦١ million ton in ٢٠٠٩ season. Recently , more attention has been given to grow and development sugar beet crop to overcome the gab between sugar consumption and production.(El. Geddawy *et al.* ٢٠٠١ ; Abd El. All , ٢٠٠٢ ; Gaweesh , ٢٠٠٣ and CCSC,٢٠١٠) .

However, many studies are required to find out proper technical recommendations for improving productivity and quality of sugar beet under Middle Egypt conditions. Recent study by El- Sheref (٢٠٠٧) found that sugar beet grown in ridges or beds gave the highest values of root length and diameter , root weight ,pol %,quality index, root and recoverable sugar yields (ton/fed) .While, the highest values of impurities (K , Na and α-amino N contents) were scored using rows. On the other hand, other studies revealed that increasing the plant density up to ٤٢٠٠٠ plants/fed significantly increased root and sugar yields/fed, after which the increase in plant density was acompanied

with a reduction in root and sugar yields/fed. Also, pol% and sugar recovery % of beet roots were significantly increased with the increase in plant density .This might be attributed to that the increase in plant density reduced root size and consequently provied higher pol%. and decreased impurities (K , Na and α-amino N contents) (Taha ,١٩٨٥ ; Kamal,*et al* ١٩٨٩ ; El.Khatib ,١٩٩١ ; Lauer ١٩٩٥ and Ramadan ,١٩٩٩).

The present study was designed to examine the effect of different plant densities on productivity and quality traits of sugar beet, and find out the optimal plant density which achieve best productivity and quality of sugar beet under Middle Egypt conditions.

MATERIALS AND METHODS

This work was conducted at Mallawi Agric. Res. Station El .Minia Governorate, Egypt, during ٢٠٠٧/٢٠٠٨and ٢٠٠٨/٢٠٠٩ seasons to study the effect of nine plant densities, of sugar beet cultivar namely Kawamera ٢٨.٠٠(١٠^{٣})/fed, ٣٥.٠٠(١٠^{٣})/fed, and ٤٦.٦٧(١٠^{٣})/fed , at ridges, rows and beds. A Randomized Complete Block Design (RCBD) with four replicates was used. Plots area were ٣٠.٠ m^{٢} (each plot consisting of ٦٠ cm wide for ten ridges ,while ١٠٠ cm wide for six beds, each of ٥.٠ meters long) and were distributed as given in Table (١).The soil of experimental site has a silty clay loam texture with pH of ٨.١٠ , ١.٣٥ organic matter , ٢٦.٢٥ ppm available N, ٩.٢٥ ppm available P and ٢١٠ ppm K .Other traditional cultural practices were used as usually followed in sugar beet fields under the Middle Egypt conditions during the two seasons .

Data recorded:

A- **Vegetative traits**: At harvest (١٩٥ days from sowing), samples of ١٠ plants from each plot were taken at random to record:

١- Number of extractable roots /fed.

٢- root length (cm) .

٣- root diameter (cm).

B- **Quality characteristics**:

A samples of twenty roots were taken at random, ,cleaned with running tap water, dried, each sample was ground separately with

grater into cossettes and mixed thoroughly to determine the quality characteristics as described in Cooke and Scott, (١٩٩٣) .

Table ١: Plant densities in ridges, rows and beds .

Plant density	Area / Plant	Ridge spacing (cm)	Hill spacing (cm)	Plant distribution
٢٨.٠٠(١٠^{٣})/fed at ridges	١٥٠٠ cm^{٢}	٦٠	٢٥	One side
٢٨.٠٠ (١٠^{٣})/fed at rows		٦٠	٢٥	One side
٢٨.٠٠ (١٠^{٣})/fed at beds		١٠٠	٣٠	Two sides
٣٥.٠٠(١٠^{٣})/fed at ridges	١٢٠٠ cm^{٢}	٦٠	٢٠	One side
٣٥.٠٠ (١٠^{٣})/fed at rows		٦٠	٢٠	One side
٣٥.٠٠ (١٠^{٣})/fed at beds		١٠٠	٢٤	Two sides
٤٦.٦٧(١٠^{٣})/fed at ridges	٩٠٠ cm^{٢}	٦٠	١٥	One side
٤٦.٦٧ (١٠^{٣})/fed at rows		٦٠	١٥	One side
٤٦.٦٧ (١٠^{٣})/fed at beds		١٠٠	١٨	Two sides

*Feddan area = ٤٢٠٠ m^{٢}

١- Pol % was estimated in fresh samples of sugar beet roots, using saccharometer according to the method described in AOAC, (٢٠٠٥).

٢- Alpha amino nitrogen, sodium and potassium contents were estimated according to the procedure of sugar company by Auto analyzer as describle in AOAC, (٢٠٠٥),The results were expressed as milliequivalent /١٠٠ gm beet.

٣- Sugar recovery % was calculated using the equation reported by Cooke and Scott (١٩٩٣):

Sugar recovery % = Pol,%- [٠.٢٩ + ٠.٣٤٣ (K + Na)+α - N (٠.٠٩٤)],

Where, K, Na and α - N determined as milliequivalent/١٠٠ g beet.

٤- Quality index was calculated as in Cooke and Scott (١٩٩٣) using the following formula: Quality index, % = Sugar recovery % X ١٠٠ ÷ Pol %

C- Productivity traits :

١. Roots yield (ton /fed): were determined as roots yield ton /fed on fresh weight basis at harvest (at ١٩٥ days from sowing) .

٢. Recoverable sugar yield (ton/fed) was calculated from the following equation : Recoverable sugar yield (ton/fed)= Roots yield (ton/fed) X Sugar recovery % .

Data collected were subjected to the proper analysis of variance (ANOVA). The proper statistical of all data was carried out according to lined by Gomez and Gomez (١٩٨٤). Differences among treatments were evaluated by the least significant difference test (LSD) at ٥ per cent level .

RESULTS AND DISCUSSION

Vegetative traits :

Results in Table ٢ reveal that plant density had a highly significant effect on vegetative traits of sugar beet, i.e. number of extractable roots/fed.at harvest in the ١st season, root length (cm) in the ٢nd season and root diameter (cm) in the two growing seasons. It could be noticed from combined analysis that increasing plant density of sugar beet from ٢٨ up to ٣٥ and ٤٦.٦٧ ($١٠^{٣}$)roots/fed. led to an increase in the number of extractable roots/fed.at harvest by ٢٠.٨٢ and ٤٢.٣٦٪ and root length (cm) by ١٥.٩٧ and ٣١.١٦٪,while, root diameter (cm) was decreased by ١٣.٨١ and ٢٢.١٣ % respectively. These results might be due to the increase in plant density of sugar beet may led to competition for growth elements. The present findings are in line with those reported by Kamel *et al.*(١٩٨٩) and Ramadan (١٩٩٩) who found that increasing plant density from ٣٣٦٠٠ to ٥٦٠٠٠ plants /fed decreased number of roots at harvest. The also added that plant population loss at harvest was more at higher density .

Table ٢ also shows that beds planting of sugar beet recorded the highest values of extractable roots number/fed. at harvest ٣٠.٢١ ($١٠^{٣}$ roots/fed.) and root length (٣٩.٤٣cm), while, the highest value of root diameter (١٢.٣٧cm) were scored for ridges planting. These results might be due to different shares of utilized nutrients, water and other factors growth.Hilal (٢٠٠٠) and El.Sheref(٢٠٠٧) reported the same results.They pointed out that planting systems had a significant effect on vegetative traits of sugar beet .

Table ٢: Effect of plant density on the number of extractable beet roots (١٠^{٣})at harvest , root length and diameter (cm) .

Plant density	Number of extractable beet roots (١٠^{٣}) /fed at harvest			Root length (cm)			Root diameter (cm)		
	١st	٢nd	combined	١st	٢nd	combined	١st	٢nd	combined
٢٨.٠٠(١٠^{٣})/fed at ridges	٢٣.١٠	٢٣.٨٠	٢٣.٤٥	٣١.٤٧	٣٢.١٣	٣١.٨٠	١٣.٨٣	١٣.٨٧	١٣.٨٥
٢٨.٠٠ (١٠^{٣})/fed at rows	٢٢.٨٠	٢٣.٢٧	٢٣.٠٣	٢٩.٢٠	٢٩.٣٠	٢٩.٢٥	١٣.٢٠	١٣.٤٠	١٣.٣٠
٢٨.٠٠ (١٠^{٣})/fed at beds	٢٤.٣٠	٢٥.٦٧	٢٤.٩٨	٣٣.٧٣	٣٤.٦٣	٣٤.١٨	١٢.٣٠	١٢.٥٣	١٢.٤٢
Mean	٢٣.٤٠	٢٤.٢٤	٢٣.٨٢	٣١.٤٧	٣٢.٠٢	٣١.٧٤	١٣.١١	١٣.٢٧	١٣.١٩
٣٥.٠٠(١٠^{٣})/fed at ridges	٢٨.٤٠	٢٩.٠٠	٢٨.٧٠	٣٦.٣٣	٣٧.٠٣	٣٦.٦٨	١٢.١٠	١٢.٤٧	١٢.٢٨
٣٥.٠٠ (١٠^{٣})/fed at rows	٢٧.٤٣	٢٨.٣٠	٢٧.٨٧	٣٤.٢٠	٣٤.٨٠	٣٤.٥٠	١١.٥٣	١١.٨٠	١١.٦٧
٣٥.٠٠ (١٠^{٣})/fed at beds	٢٩.٣٣	٣٠.٢٣	٢٩.٧٨	٣٨.٣٠	٤٠.٢٠	٣٩.٢٥	١٠.٦٧	١١.٠٠	١٠.٨٣
Mean	٢٨.٣٩	٢٩.١٨	٢٨.٧٨	٣٦.٢٨	٣٧.٣٤	٣٦.٨١	١١.٤٣	١١.٧٦	١١.٥٩
٤٦.٦٧(١٠^{٣})/fed at ridges	٣٣.٢٠	٣٤.٠٠	٣٣.٦٠	٤١.٣٧	٤٢.٣٣	٤١.٨٥	١٠.٨٧	١١.٠٧	١٠.٩٧
٤٦.٦٧ (١٠^{٣})/fed at rows	٣١.٩٧	٣٢.٥٣	٣٢.٢٥	٣٨.٦٣	٣٨.٦٠	٣٨.٦٢	١٠.٩٣	١١.١٠	١١.٠٢
٤٦.٦٧ (١٠^{٣})/fed at beds	٣٥.٥٠	٣٦.٢٣	٣٥.٨٧	٤٤.٠٠	٤٥.٧٠	٤٤.٨٥	١٠.٢٣	١٠.٦٠	١٠.٤٢
Mean	٣٣.٥٦	٣٤.٢٦	٣٣.٩١	٤١.٣٣	٤٢.٢١	٤١.٧٧	١٠.٦٨	١٠.٩٢	١٠.٨٠
Average of ridges	٢٨.٢٣	٢٨.٩٣	٢٨.٥٨	٣٦.٣٩	٣٧.١٧	٣٦.٧٨	١٢.٢٧	١٢.٤٧	١٢.٣٧
Average of rows	٢٧.٤٠	٢٨.٠٣	٢٧.٧٢	٣٤.٠١	٣٤.٢٣	٣٤.١٢	١١.٨٩	١٢.١٠	١١.٩٩
Average of beds	٢٩.٧١	٣٠.٧١	٣٠.٢١	٣٨.٦٨	٤٠.١٨	٣٩.٤٣	١١.٠٧	١١.٣٨	١١.٢٢
Overallmean	٢٨.٤٥	٢٩.٢٣	٢٨.٨٤	٣٦.٣٦	٣٧.١٩	٣٦.٧٨	١١.٧٤	١١.٩٨	١١.٨٦

F value	**	Ns	**	Ns	*	**	**	**	**
LSD ٠.٠٥	٠.٣١	-	٠.٥٨	-	٠.٨١	٠.٥٦	٠.٢٢	٠.٢٤	٠.١٦

Combined analysis show that plant density(٤٦.٦٧ (١٠^{٣})/fed at beds)of sugar beet contained the highest values of extractable actual roots number /fed.at harvest (٣٥.٨٧(١٠^{٣})roots/fed.) and root length (٤٤.٨٥cm) as well as the lowest value of root diameter (١٠.٤٢cm) . While,the lowest values of extractable actual roots number /fed.at harvest (٢٣.٠٣(١٠^{٣})roots/fed) and root length (٢٩.٢٥ cm) were scored for plant density (٢٨.٠٠ (١٠^{٣})/fed at rows) . These results might be due to different shares of utilized nutrients, water and other factors growth . Plant density ٢٨٠٠٠ plants/fed at ridges achieved the maximal value of root diameter (١٣.٨٥ cm). Similar results were reported by Ramadan (١٩٩٩) Hilal (٢٠٠٠) and El.Sheref(٢٠٠٧) who pointed out that planting density had a significant effect on vegetative traits of sugar beet.

Quality characteristics :

Data in Tables, ٣ and ٤ reveal significant differences among plant densities in quality traits of sugar beet, i.e. pol and α- N content in the two growing seasons and in the ٢nd season for K content and in the ١st season for sugar recovery % of sugar beet. Combined analysis show that increasing plant density of sugar beet from ٢٨ up to ٣٥ and ٤٦.٦٧ (١٠^{٣}) roots/fed. increased pol % by ١٥.١١ and ٢٣.٠٤٪, sugar recovery% by ٢٠.٦٥ and ٣٢.٣٥٪ and quality index by ٤.٨٢ and ٧.٥٨٪,while decreased Na content of beet root by ٧.٩٧ and ١٣.٧٤ % , K content of beet root by١٥.٤٧ and ٢٦.٩٨ % and α- N content of beet root by ٨.٥٣ and ١٨.٦٥٪, respectively . The present findings are in line with those reported by Kamel *et al*.(١٩٨٩) and Ramadan (١٩٩٩) who revealed that pol% , sugar recovery% and quality index significantly increased with the increase in plant density of sugar beet in both seasons.

Combined analysis show that beds planting increased pol % by ٢.١٨ and ٥.٦١ % , sugar recovery % by ٣.٥١ and ٨.٤٢٪ and quality index by ١.٣١ and ٢.٦٩٪, while decreased Na content by ٢.٩٦ and

٧.٤١٪ , K content by ٥.٥١ and ١١.٠٢٪ , α- N content by ٦.٥٧ and ١٢.١٢٪ compared with ridges and rows planting ,respectively . Similar trend was obtained by Hilal (٢٠٠٠) and El.Sheref (٢٠٠٧) who revealed significant differences among quality traits of beet roots between planting patterns , i.e. ridges , rows and platforms.

Table ٣ : Effect of plant density on pol%, Na and K contents (meq/١٠٠ gm) of beet roots.

Plant density	pol%			Na content (meq/١٠٠ gm)			K content (meq/١٠٠ gm)		
	١st	٢nd	combined	١st	٢nd	combined	١st	٢nd	combined
٢٨.٠٠(١٠٣)/fed at ridges	١٣.٢٠	١٣.٥٠	١٣.٣٥	١.٥٠	١.٤٨	١.٤٩	٤.٤٥	٤.١٥	٤.٣٠
٢٨.٠٠ (١٠٣)/fed at rows	١٣.١٠	١٣.١٠	١٣.١٠	١.٥٨	١.٥٢	١.٥٥	٤.٦٥	٤.٥٣	٤.٥٩
٢٨.٠٠ (١٠٣)/fed at beds	١٣.٥٠	١٣.٨٠	١٣.٦٥	١.٤٥	١.٤٣	١.٤٤	٤.٢٠	٤.٠٠	٤.١٠
Mean	١٣.٢٧	١٣.٤٧	١٣.٣٧	١.٥١	١.٤٧	١.٤٩	٤.٤٣	٤.٢٣	٤.٣٣
٣٥.٠٠(١٠٣)/fed at ridges	١٥.٤٠	١٥.٧٧	١٥.٥٨	١.٣٨	١.٣٧	١.٣٨	٣.٨٠	٣.٧٠	٣.٧٥
٣٥.٠٠ (١٠٣)/fed at rows	١٤.٨٠	١٥.٠٠	١٤.٩٠	١.٤٧	١.٤٣	١.٤٥	٤.٠٠	٣.٨٥	٣.٩٣
٣٥.٠٠ (١٠٣)/fed at beds	١٥.٦٠	١٥.٧٧	١٥.٦٨	١.٣٣	١.٣٢	١.٣٣	٣.٦٢	٣.٥٥	٣.٥٨
Mean	١٥.٢٧	١٥.٥١	١٥.٣٩	١.٣٩	١.٣٧	١.٣٨	٣.٨١	٣.٧٠	٣.٧٥
٤٦.٦٧(١٠٣)/fed at ridges	١٦.٢٧	١٦.٦٠	١٦.٤٣	١.٣٢	١.٢٨	١.٣٠	٣.٥٠	٣.٤٠	٣.٤٥
٤٦.٦٧ (١٠٣)/fed at rows	١٥.٨٠	١٦.٠٠	١٥.٩٠	١.٣٨	١.٣٣	١.٣٦	٣.٦٣	٣.٥٣	٣.٥٨
٤٦.٦٧ (١٠٣)/fed at beds	١٦.٨٣	١٧.٢٠	١٧.٠٢	١.٢٨	١.٢٧	١.٢٨	٣.٢٣	٣.١٧	٣.٢٠
Mean	١٦.٣٠	١٦.٦٠	١٦.٤٥	١.٣٣	١.٢٩	١.٣١	٣.٤٦	٣.٣٧	٣.٤١
Aveage of ridges	١٤.٩٦	١٥.٢٩	١٥.١٢	١.٤٠	١.٣٨	١.٣٩	٣.٩٢	٣.٧٥	٣.٨٣

Aveage of rows	١٤.٥٧	١٤.٧٠	١٤.٦٣	١.٤٨	١.٤٣	١.٤٥	٤.٠٩	٣.٩٧	٤.٠٣
Aveage of beds	١٥.٣١	١٥.٥٩	١٥.٤٥	١.٣٦	١.٣٤	١.٣٥	٣.٦٨	٣.٥٧	٣.٦٣
Overallmean	١٤.٩٤	١٥.١٩	١٥.٠٧	١.٤١	١.٣٨	١.٤٠	٣.٩٠	٣.٧٧	٣.٨٣
F value	**	**	**	Ns	Ns	Ns	Ns	**	*
LSD ٠.٠٥	٠.١٣	٠.٢٠	٠.١٤	-	-	-	-	٠.٠٩	٠.٠٨

Combined analysis showed that plant density at beds (٤٦.٦٧ ($١٠^{٣}$) plants/fed) achieved the highest values in both of pol% (١٧.٠٢٪), sugar recovery % (١٥.٠٢٪) and quality index (٨٨.٢٧٪) as well as the lowest values in both of K , Na and α-N contents (٣.٢٠, ١.٢٨ and ١.٨٣ meq/١٠٠ gm), while, low plant density at rows (٢٨.٠٠($١٠^{٣}$) plants/fed.) contained the lowest values in both of pol% and sugar recovery% (١٣.١٠ and ١٠.٤٤٪) and the highest values in both of K, Na and α-N contents (٤.٥٩, ١.٥٥ and ٢.٤٥ meq/١٠٠gm) ,respectively. Ramadan (١٩٩٩) Hilal (٢٠٠٠) and El.Sheref (٢٠٠٧) reported similar effects.

Table ٤: Effect of plant density on sugar recovery%, quality index and α- N content (meq/١٠٠ gm) of beet roots.

Plant density	**Sugar recovery %**			**quality index**			**α- N content (meq/١٠٠ gm)**		
	١st	**٢nd**	**combined**	**١st**	**٢nd**	**combined**	**١st**	**٢nd**	**combined**
٢٨.٠٠($١٠^{٣}$)/fed at ridges	١٠.٤٥	١١.٠٩	١٠.٨٧	٨٠.٦٨	٨٢.١٥	٨١.٤٢	٢.٣٣	٢.٢٣	٢.٢٨
٢٨.٠٠($١٠^{٣}$)/fed at rows	١٠.٣٨	١٠.٥٠	١٠.٤٤	٧٩.٢١	٨٠.١٥	٧٩.٦٨	٢.٤٢	٢.٤٨	٢.٤٥
٢٨.٠٠($١٠^{٣}$)/fed at beds	١١.٠١	١١.٤٥	١١.٢٣	٨١.٥٣	٨٢.٩٤	٨٢.٢٤	٢.١٧	٢.١٠	٢.١٣
Mean	١٠.٦٨	١١.٠١	١٠.٨٥	٨٠.٤٧	٨١.٧٥	٨١.١١	٢.٣١	٢.٢٧	٢.٢٩
٣٥.٠٠($١٠^{٣}$)/fed at ridges	١٣.١٣	١٣.٣٠	١٣.٢١	٨٥.٢٤	٨٤.٣٤	٨٤.٧٩	٢.١٧	٢.١٢	٢.١٤
٣٥.٠٠($١٠^{٣}$)/fed at rows	١٢.٣٥	١٢.٧٠	١٢.٥٢	٨٣.٤٣	٨٤.٦٤	٨٤.٠٤	٢.٢٣	٢.١٨	٢.٢١

٣٥.٠٠(١٠٣)/fed at beds	١٣.٤٢	١٣.٦٢	١٣.٥٢	٨٦.٠٥	٨٦.٤٠	٨٦.٢٣	٢.٠٠	١.٩٥	١.٩٨
Mean	١٢.٩٧	١٣.٢١	١٣.٠٩	٨٤.٩٠	٨٥.١٣	٨٥.٠٢	٢.١٣	٢.٠٨	٢.١١
٤٦.٦٧(١٠٣)/fed at ridges	١٤.١٤	١٤.٥٢	١٤.٣٣	٨٥.٢٤	٨٧.٤٩	٨٧.٢٢	١.٩٥	١.٩٥	١.٩٥
٤٦.٦٧(١٠٣)/fed at rows	١٣.٥٩	١٣.٨٥	١٣.٧٢	٨٣.٤٣	٨٦.٥٨	٨٦.٣٠	٢.٠٣	١.٩٨	٢.٠١
٤٦.٦٧(١٠٣)/fed at beds	١٤.٨٢	١٥.٢٢	١٥.٠٢	٨٦.٠٥	٨٨.٤٧	٨٨.٢٧	١.٨٥	١.٨٢	١.٨٣
Mean	١٤.١٩	١٤.٥٣	١٤.٣٦	٨٤.٩٠	٨٧.٥١	٨٧.٢٦	١.٩٤	١.٩٢	١.٩٣
Aveage of ridges	١٢.٦٤	١٢.٩٧	١٢.٨١	٨٤.٢٩	٨٤.٦٦	٨٤.٤٧	٢.١٥	٢.١٠	٢.١١
Aveage of rows	١٢.١٠	١٢.٣٥	١٢.٢٣	٨٢.٨٨	٨٣.٧٩	٨٣.٣٤	٢.٢٣	٢.٢٢	٢.٢٢
Aveage of beds	١٣.٠٨	١٣.٤٣	١٣.٢٦	٨٥.٢١	٨٥.٩٤	٨٥.٥٨	٢.٠١	١.٩٦	١.٩٨
Overallmean	١٢.٦١	١٢.٩٢	١٢.٧٦	٨٤.١٣	٨٤.٨٠	٨٤.٤٦	٢.١٣	٢.٠٩	٢.١١
F value	**	Ns	**	Ns	Ns	Ns	**	**	**
LSD ٠.٠٥	٠.١٢	-	٠.١٨	-	-	-	٠.٠٤	٠.٠٨	٠.٠٥

Productivity traits :

Results in Table ٥ show highly significant differences among plant densities with regard to root yield of sugar beet in the ٢nd season. It could be noticed from combined analysis that increasing plant density of sugar beet from ٢٨ up to ٣٥and ٤٦.٦٧ (١٠٣) roots/fed. led to an increase in root yield (ton/fed) by ٤.١٠ and ٢.٠٥٪, and sugar yield by ٢٤.١٧ and ٣٧.٥٠٪ ,respectively. The results could be due to the increase in number of roots/ fed at harvest and pol% of sugar beet with increasing the plant density (Tables ٢ and٣). These findings are in harmony with the findings of Lauer (١٩٩٥) and Ramadan (١٩٩٩) .

It could be noted from combined analysis (Table ٥) that beds and ridges recorded the highest values of root yield(ton/fed) of sugar beet by ١٢.١٠ and ١٢.١٠ % and recoverable sugar yield(ton/fed) by ١٩.٩٥ and ١٧.١٠ %compared with rows, respectively . This is possibility due to the increase in number of roots / fed. and pol % under beds and ridges planting . These findings are in agreement with those obtained by Hilal (٢٠٠٠) and El.Sheref (٢٠٠٧) who revealed that planting systems (ridges, rows and beds) had significant effect on root and recoverable sugar yield of sugar beet.

It could be noticed from combined that high plant density at beds (٤٦.٦٧ ($١٠^{٣}$)roots/fed) achieved the highest values of root and recoverable sugar yields (٣٥.٤٦ and ٥.٣٣ tons/fed, respectively), while low plant density at rows (٢٨.٠٠ ($١٠^{٣}$)roots/fed) scored the lowest values of of root and recoverable sugar yields (٢٩.٩٤ and ٣.١٣ tons/fed, respectively). Such data are in agreement with those reported by Ramadan (١٩٩٩) Hilal (٢٠٠٠) and El.Sheref (٢٠٠٧).

The present study recommended the use of high plant density at beds (٤٦.٦٧ ($١٠^{٣}$)roots/fed at beds) Middle Egypt conditions. These will results in because the highest values of root and recoverable sugar yields (٣٥.٤٦ and ٥.٣٣ ton/fed, respectively) , increasing income value of grower and sugar production for the factory, and increase the efficiency of water use. Also, reducing the vast gap between sugar consumption and production on the national level .

Table ٥: Effect of plant density on root and recoverable sugar yields(ton/fed) of beet roots.

Plant density	Root yield(ton/fed)			Sugar yield(ton/fed)		
	١st	٢nd	combined	١st	٢nd	combined
٢٨.٠٠(١٠٣)/fed at ridges	٣٤.٦٥	٣٥.٠٦	٣٤.٨٦	٣.٦٧	٣.٨٩	٣.٧٨
٢٨.٠٠ (١٠٣)/fed at rows	٢٩.٤١	٣٠.٤٨	٢٩.٩٤	٣.٠٥	٣.٢٠	٣.١٣
٢٨.٠٠ (١٠٣)/fed at beds	٣٣.٤٥	٣٦.٠٢	٣٤.٧٣	٣.٦٨	٤.١٣	٣.٩١
Mean	٣٢.٥٠	٣٣.٨٥	٣٣.١٧	٣.٤٧	٣.٧٤	٣.٦٠
٣٥.٠٠(١٠٣)/fed at ridges	٣٥.٤٠	٣٥.٤٨	٣٥.٤٤	٤.٦٥	٤.٧٢	٤.٦٨
٣٥.٠٠ (١٠٣)/fed at rows	٣١.٦٤	٣٣.٢٤	٣٢.٤٤	٣.٩١	٤.٢٢	٤.٠٧
٣٥.٠٠ (١٠٣)/fed at beds	٣٤.٩١	٣٦.٤٩	٣٥.٧٠	٤.٣٥	٤.٩٧	٤.٦٦
Mean	٣٣.٩٨	٣٥.٠٧	٣٤.٥٣	٤.٣٠	٤.٦٤	٤.٤٧
٤٦.٦٧(١٠٣)/fed at ridges	٣٥.٩٧	٣٥.٢٥	٣٥.٦١	٥.٠٩	٥.١٢	٥.١٠
٤٦.٦٧ (١٠٣)/fed at rows	٣١.٢٢	٣٢.٩٧	٣٢.١٠	٤.٢٤	٤.٥٧	٤.٤١
٤٦.٦٧ (١٠٣)/fed at beds	٣٤.٣٢	٣٦.٠٠	٣٥.٤٦	٥.٠٩	٥.٥٧	٥.٣٣
Mean	٣٣.٨٤	٣٤.٩٤	٣٤.٣٩	٤.٨١	٥.٠٩	٤.٩٥
Average of ridges	٣٥.٣٤	٣٥.٢٦	٣٥.٣٠	٤.٤٧	٤.٥٨	٤.٥٢
Average of rows	٣٠.٧٦	٣٢.٢٣	٣١.٤٩	٣.٧٣	٤.٠٠	٣.٨٦
Average of beds	٣٤.٢٢	٣٦.٣٧	٣٥.٣٠	٤.٣٧	٤.٨٩	٤.٦٣
Overallmean	٣٣.٤٤	٣٤.٦٢	٣٤.٠٣	٤.١٩	٤.٤٩	٤.٣٤
alue	Ns	*	*	Ns	Ns	Ns
٠.٠٥	-	١.٢٥	٠.٩١	-	-	-

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Importing productivity and quality of sugar beet

تأثير اختلاف الكثافة النباتية على إنتاجية و جودة بنجر السكر تحت ظروف مصر الوسطي

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قسمي بحوث تكنولوجيا السكر والمعاملات ، معهد بحوث المحاصيل السكرية ، مركز البحوث الزراعية ،جمهورية مصر العربية

لا يزال هناك حاجة لإجراء العديد من الدراسات لإيجاد التوصيات الفنية لتحسين إنتاجية و جودة بنجر السكر تحت ظروف مصر الوسطي . لهذا الشأن أقيمت تجربتين حقليتين بمحطة البحوث الزراعية بملوي ،محافظة المنيا ،مصر خلال موسمى٢٠٠٧ /٢٠٠٨، ٢٠٠٨/٢٠٠٩ لدراسة تأثير تسع كثافات نباتية مختلفة هى ٢٨ ،٣٥ و ٤٦.٦٧ ألف نبات /ف على الخطوط ، الصفوف و المصاطب في تصميم قطع كاملة العشوائية لعدد أربع مكررات على الصفات الخضرية وكذلك صفات الجودة و المحصول لجذور بنجر السكر .

أوضحت النتائج المتحصل عليها الأتي :

١- حققت الكثافة النباتية ٤٦.٦٧ ألف نبات /فدان على المصاطب أعلى القيم لعدد الجذور / ف عند الحصاد (٣٥.٨ إلف نبات / ف) وطول الجذر (٤٤.٨٥ سم)، فى المقابل سجل القيم الأقل لعدد الجذور/ف عند الحصاد (٢٣.٠٣ ألف نبات/ ف) وطول الجذر (٢٩.٢٥ سم) للكثافة النباتية ٢٨ ألف نبات /ف على صفوف .

٢- حققت الكثافة النباتية ٤٦.٦٧ ألف نبات /فدان على المصاطب أعلى القيم لنسبة الحلاوة في جذور البنجر(١٧.٠٢%) ، نسبة استخراج السكر(١٥.٠٢ %) و معامل الجودة (٨٨.٢٧ %) وكذلك القيم الأقل لكميات ألفا أمنيو نتروجين ، البوتاسيوم و الصوديوم (١.٨٣ ، ٣.٢٠ و ١.٢٨ ملليمكافئ / ١٠٠ جم بنجر على التوالى) ، فى المقابل حققت الكثافة النباتية ٢٨ ألف نبات /ف على صفوف اقل القيم لنسبة الحلاوة في جذور البنجر(١٣.١٠%) و نسبة استخراج السكر(١٠.٤٢ %) وكذلك

القيم الأعلى لكميات ألفا أمنيو نتروجين ، البوتاسيوم و الصوديوم (٢.٤٥ ، ٤.٥٩ و ٢.٤٥ ملليمكافئ / ١٠٠ جم بنجر على التوالى) .

٣- بناء على تقدم فأن الكثافة النباتية المناسبة لبنجر السكر تحت ظروف مصر الوسطي هى ٤٦.٦٧ ألف نبات/ف على مصاطب ويمكن التوصية بها حيث حققت أعلى القيم لنواتج الجذور النظيفة والسكر القابل للاستخراج (٣٥.٤٦ و ٥.٣٣ طن/ ف على التوالي) وتحقق زيادة دخل المزارع و أنتاج السكر للمصنع ، وهذا بالإضافة يساعد في خفض الفجوة الضخمة بين أنتاج و استهلاك السكر على مستوى الوطن.