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Effect of Plant Population and Distribution and Nitrogen Levels on Yield and Quality of Sugar Beet

Leilah, A. A.[1]; M. A. Abdel-Moneam[1]; G. A. Shalaby[2]; M. A. E. Abdou[2] and Heba M. AbdEl-Salam[1]

[1] **Aggrron. Dept., Fac. of Agric., Mansoura Univ., Egypt.**

[2] **Sugar Crops Inst., Agric. Res. Center, Egypt.**

ABSTRACT

Two series field experiments were done for the period of 2014/2015 and 2015/2016 seasons at Abo-Saied Village, Kafr El-Sheikh Center, Kafr El-Sheikh Governorate to study the effect of plant population and distribution and nitrogen levels on yield and quality of sugar beet, "CV. Zwan Poly". The studied plant distributions were 25, 30 and 35 cm on both sides of terrace (Mastaba) 80 cm width and 20, 24 and 28 cm on both sides of terrace (Mastaba) 100 cm width, which resulted in three plant populations of 30000, 35000 and 42000 plants/fad. The used design was split-plot with 4 replicates. Results showed that plant population and distribution had significant effects on all studied traits. Cultivating beet seeds at 35 cm distance between hills on both sides of mastaba 80 cm width (30000 plants/fad) resulting significant increases in number of leaves/plant, foliage fresh weight/plant, plant weight, root weight as well as sucrose percentage, total soluble solids(TSS) and purity percentages. Increasing N-levels from 69 to 92 and 115 kg N/fad significantly increased root weight, root diameter, root length, number of leaves, foliage fresh weight/ plant and plant weight in both years, while it significantly decreased sucrose, TSS and purity percentages in both years. Generally, it could be accomplished that cultivating sugar beet on both sides of mastaba 80 cm width and 25 cm between hills and fertilizing plants with 115.0 kg N/fad could be recommended for maximizing root yield under the ecological circumstances of this research.

INTRODUCTION

There is a general agreement that plant population and distribution plays important roles for sugar beet not only on productivity, but also on quality. For the effects of plant population and distribution, Hassanin (1991) indicated that sucrose and purity percentage tended to increase with the decrease in row or hill spacing. Bassal *et al.* (2001) showed that increasing the distance between rows led to significant increases in length and diameter of roots, top, fresh weight of plant and root/top ratio. Neamet-Alla *et al.* (2007) mentioned that planting sugar beet seeds in ridges of 50 cm and hill space of 20 cm caused significant increases in sucrose percentage, root diameter and root/top ratio in both years, but there were no significance effects on root length, total soluble solids and juice purity percentages. Bhullar *et al.* (2010) studied the effect of three planting densities, and found that plant population of 100 000 plants/ha (rows spaced at 50 cm and plants at 20 cm) produced the lowest beet root diameter and highest root length, root and sugar yields.

Nitrogen is a limiting factor for sugar beet growth, yield and quality. Increasing nitrogen fertilizer rate is an important tool to increase sugar beet productivity through investigations. In this regard, Sorour *et al.* (1992) mentioned that raising N- rate from 60 to 120 kg N/fad. increased root length, root diameter, dry weight of plant and leaf area index. However, root/top ratio decreased with increment nitrogen rate. El-Kassaby and Leilah (1992) showed that root weight, root diameter, sucrose percentage as well as root and sugar yields/fad were significantly affected by nitrogen fertilizer levels. Toor and Bains (1994) fertilized sugar beet plants with different rates ranging from 0 to 180 kg N/ha. They showed that there were significant increases in root and sugar yields up to 120 kg N/ha. Azzazy (1998) in upper Egypt, showed that increment N rate up to 80 kg/fad led to significant improvements in root diameter and root yield, but it decreased sucrose percentage, whereas sugar yield was not significantly increased. EL-Maghraby *et al.* (1998) found that increasing rate of nitrogen to 90 kg N/fad caused significant increases in root length, root diameter and root weight per plant. Awinski and Greisz (2000) in Poland, mentioned that root and sugar yields were generally greatest with 120 kg N/ha. Also, the effect of nitrogen fertilizer on yield and quality were greater than that of all cultivation systems. Hilal (2000) in Egypt, stated that N fertilizer up to 80 kg N/fad could be recommend for optimum root and sugar yields per unit area at Kafr-ELsheikh Governorate. Bassal *et al.* (2001) found that bio-mineral N-fertilization had significant effects on all studied traits of sugar beet. Increasing mineral N-fertilization level up to 60 kg N/fad significantly increased top, root and sugar yields per faddan as well as root sucrose percentage. EL-Geddawy *et al.* (2001) cleared that raising nitrogen level from 60 to 100 Kg N/fad increased root diameter, root length and root fresh weight per plant. On the other hand, increasing nitrogen level had no statistical effects on sucrose and TSS percentages and sugar yield. Ismail and AboEL-Ghait (2005) stated that root diameter, root fresh weight and root yield were significantly increased by increment N-levels from 69 up to 119 kg N/fad, but sucrose parentage decreased. Zimny *et al.* (2005) in Poland, showed that there were significant increases in yield and its attributes with 135 and 150 kg N/ha. Ouda (2007) found that root diameter, root length, root and top weights as well as root, top and sugar yields/fad and TSS percentage were increment by raising N-levels up to 80 kg N/fad. Seadh (2008) found that using the highest N-level (150 kg N/fad) created the highest root and top yields/fad and its components in both years. Abdou (2013) studied the effect of N-levels under the newly reclaimed sandy soil conditions. He found that increasing nitrogen levels from 100 to 120 and 140 kg N/fad significantly reduced TSS, sucrose and purity percentages. Abdou and Badawy (2014) stated that increasing nitrogen fertilizer level from 70 to 90, 110 and 130 kg N/fad significantly increased root fresh

weight, root length and diameter as well as TSS, root and sugar yields/fad. On the other side, the same treatment significantly decreased both of sucrose and purity percentages in both years.

Therefore, the objective of this study was to determine the effect of plant population and distribution and nitrogen levels on yield and quality of sugar beet under the environmental conditions of this research.

MATERIALS AND METHODS

The present series field experiments were conducted at Abo-Saied Village, Center of Kafr El-Sheikh, Governorate of Kafr El-Sheikh, for the period of 2014/2015 and 2015/2016 studing the effect of three plant populations and six distributions; Planting on 25 30 and 35 cm between hills on the two sides of mastaba (Terrace), 80 cm widh and planting on 20, 24 and 28 cm between hills on the two sides of mastaba(Terrace), 100 cm width. Each three distances between hills on the two sides of mastabas gave 42000, 35000 and 30000 plants/fad. in that order, as well as three N – levels: 69, 92 ,115 kg N/fad. on yield and quality of sugar beet (*Beta vulgaris* L), Cv."Zwan Poly". The used design was the split-plot with 4 replicates. The main plots were assigned to six plant distributions. The sub-plots were devoted to three N - levels (69, 92, 115 kg N/fad).

Nitrogen fertilizer was applied in the from of Urea (46 % N), which was added in two equal doses, the once dose was post thinning and the second one was added at 30 days later.

The experimental unit contained 5 mastabas of 80 cm width or four mastabas of 100 cm width and five meters long in each, containing 20.0 square meters (1/210 fad). Maize was the preceding crop in the two years of experimentation. From the experimental field area, soil samples were randomly taken from the depth of 0-30 cm of soil surface to estimate mechanical and chemical properties, as shown in Table 1. Both Calcium Super Phosphate (12.5% P_2O_5) and Potassium Sulphate (48 % K_2O) were added during seedbed preparation, as recommended justly before the last ploughing.

Dry sugar beet balls were sown by hand on both sides of mastabas in hills at the rate of 3 – 4 balls per hill on 8th and 6th October in the two years, in that order. The field was irrigated immediately after cultivation immediately. At 30 days after sowing, plants were thinned to secure one plant/hill.

Studied characters: At harvest, after 210 days from planting, ten guarded plants were randomly taken from each plot to decide the next characters:

A- Root yield components:

1- Plant weight (g), 2- Leaves number/plant. 3- Foliage fresh weight (g/plant), 4- Root fresh weight (g/plant), 5- Diameter of root (cm) and 6- Root length (cm).

***B- Root yield (t/fad)*:** At harvest, all plants of the four inner rows of each plot were harvested. Roots were carefully topped, cleaned and weighted to estimate root yield in tons per faddan (t/fad).

C- Quality parameters: 1- Sucrose %, 2- TSS % and 3- Purity %.

All collected data were statistically analyzed according to the procedures outlined by Gomez and Gomez (1984) using "MSTAT- C" computer program. BLSD method was used to evaluate the differences between means (at 5 % level of probability as mentioned by Waller and Duncan (1969).

Table 1. Some soil characteristics (mechanical and chemical) of the experimental sites (0 – 30 cm) through 2014/2015 and 2015/2016 years.

Soil analyses	2014/2015	2015/2016
A: Mechanical analysis:		
Sand (%)	23.81	23.51
Silt (%)	29.74	29.95
Clay (%)	46.45	46.54
Texture	Clay	Clay
B: Chemical analysis		
pH	7.86	7.95
EC (ds/m^2)	1.40	1.35
Organic matter (%)	1.09	1.12
Available N (ppm)	46.63	47.8
Available P (ppm)	1.36	1.15
Exchangeable K (ppm)	160.12	151.26

RESULTS AND DISCUSSIONS

A-Growth and yield components:

1- Number of leaves and foliage fresh weight/plant:

Results in Table 2 show the effect of plant population and distribution and nitrogen fertilizer level on number of leaves and foliage fresh weigh/plant. Results in Table 2 clear that plant population and distribution significantly affected number of leaves and foliage fresh weight/plant in both years. Cultivating sugar beet seeds on the sides of mastaba (Terrace) 80 cm width and 35 cm between hills (30000 plants/fad) recorded the highest values of both leaves number/plant (25.8, 26.6) and foliage fresh weight/plant (440 473.3 g) in the two years, in that order. Similar results were stated by EL-Khatib (1991) and Bassal *et al.* (2001).

Nitrogen fertilizer levels significantly affected the above mentioned characters (Table 2). These characteristics responded to the increase of the applied dose of nitrogen fertilizer. The highest nitrogen Level (115 kg N/ fad) recorded the highest values of number of levels/plant (25.4, 26.4) also the same rate gave the highest values of foliage fresh weight/plant(425.4, 451.7 g) in the two years, in that order. The increase in number of leaves and foliage fresh weight associated with the increase of N levels might be owing to the function of nitrogen in improving the vegetative growth, where leaves grow faster with large amounts of nitrogen as cells divided and expanded faster and increased in number and size. Rozbicki and kalinowska (1993) and Seadh (2012) obtained similar results.

Table 2. Number of leaves/plant, foliage fresh weight/plant and plant weight (g) as affected by plant population & distribution and N - levels in 2014/15 (I) and 2015/16 (II) years.

Character		Number of Leaves/ plant		Foliage fresh weight/plant (g)		Plant weight (g)	
	Season	(I)	(II)	(I)	(II)	(I)	(II)
A: Ridge width and hill spacing (cm):							
	25 Cm.	24.8	26.1	386.7	405.0	1052.0	1145.0
80 Cm.	30 Cm.	25.3	26.4	418.3	458.3	1113.3	1228.3
	35 Cm.	25.8	26.6	440	473.3	1206.7	1263.3
	20 Cm.	23.8	24.5	369.2	373.3	1070.0	1066.7
100 Cm.	24 Cm.	24.8	25.4	373.3	375	1076.7	1091.7
	28 Cm.	25.5	26.0	407.5	425	1144.2	1181.7
BLSD (0.05)		0.6	0.6	19.8	19.6	146.5	33.6
B: Nitrogen fertilizer levels:							
69 Kg N/Fad.		24.5	25.3	373.5	386.7	1071.5	1098.3
92 Kg N/Fad.		25.1	25.8	398.5	416.7	1127.3	1161.7
115 Kg N/Fad.		25.4	26.4	425.4	451.7	1132.7	1228.3
BLSD (0.05)		0.3	0.6	13.5	12.5	90.1	22.3

2- Plant weight (g): Data in Table 2 clear that plant population and distribution had marked effects on plant weight in both years. Cultivating beet plants on both sides of mastaba 80 cm width and 35 cm between hills (30000 plants/fad) produced the highest plant weight (1206.7, 1263.3 g) in the two years, in that order. These results are in agreement with that stated by Bassal *et al.* (2001).

Data in Table 2 indicated that N - levels had significant effects on plant weight in both years. Increasing nitrogen fertilizer from69 up to 115 kg / fad resulted in markedly increase in plant weight from (1071.5 to 1132.7 g) in the first season and from 1098.3 to 1228.3 g in the second one. Similar results were obtained by EL-Sheref (2007, Ouda (2007), Abdel-Mostagally and Attia (2009), Omar and Mohamed (2013), Abdou (2013) and Abdou and Badawy (2014) .

3- Root weight (g) and dimensions: Results in Table 3 show the effect of plant population and distribution and nitrogen fertilizer level on sugar beet root traits in terms of root dimensions and root fresh weight. Plant population and distributions significantly affected sugar beet root weight, root length and root diameter in both years. Planting on both sides of mastaba of 80 cm width and 35 cm distance between hills(30000 plants/fad) recorded the highest root weight values (766.7, 790.0 g) and root diameter (8.9, 9.6 cm) in the first and second seasons, in that order. However, planting on the 2 sides of ridges 100 cm width and 28 cm between hills{30000 plants/fad.} produced the highest values of root length (29.7, 29.5 cm) in the two years, in that order. These results may be due to the facts that hill dimensions allow to high amounts of sun light to pass to plants which reflect on photosynthesis process consequently root weight. It also increase the soil volume which feeds plants (it decreases the competition among beet roots). Similar results were stated by Bassal *et al.* (2001), El-Maghrby *et al.* (2008) and Abdou (2013).

Table 3. Root length, diameter and weight as affected by plant population & distribution and N - levels in 2014/15 (I) and 2015/16 (II) years.

Character		Root length (cm)		Root diameter (cm)		Root weight (g)	
	Season	(I)	(II)	(I)	(II)	(I)	(II)
A: Ridge width and hill spacing (cm):							
	25 Cm.	27.0	27.6	8.3	9.1	726.6	740.0
80 Cm.	30 Cm.	27.3	28.2	8.7	9.4	726.8	770.0
	35 Cm.	28.0	28.6	8.9	9.6	766.7	790.0
	20 Cm.	28.3	28.8	8.0	8.6	700.8	693.3
100 Cm.	24 Cm.	29.0	29.1	8.3	9.0	703.3	716.7
	28 Cm.	29.7	29.5	8.7	9.4	736.7	756.7
BLSD (0.05)		1.2	0.9	0.4	0.4	33.3	22.6
B: Nitrogen fertilizer levels:							
69 Kg N/Fad.		27.2	27.6	7.8	8.7	697.9	711.7
92 Kg N/Fad.		28.3	28.7	8.7	9.2	734.2	745.0
115 Kg N/Fad.		29.2	29.6	9.1	9.7	748.3	776.7
BLSD (0.05)		0.6	0.6	0.3	0.2	28.3	16.6

Concerning nitrogen fertilizer level, results in Table 3 show that the above mentioned traits significantly affected with increasing in the applied dose of nitrogen fertilizer. The highest values of root weight (748.3, 776.7 g), root diameter (9.1 , 9.7 cm) and root length (29.2, 29.6 cm) were resulted with the increase of nitrogen level up to 115 kg/fad. These results may be indicating to the effect of nitrogen element on growth of sugar beet. These results are in agreement with those stated by Neamet-Alla (1997), Ouda *et al.* (1999), Abo El-Wafa (2002) and Abdou and Badawy (2014).

B- Root yield (t/fad.): Data in Table 4 show the effect of plant populations and distributions and nitrogen fertilizer level on root yield (t/fad) for the period of 2014/2015 and 2015/2016 years. Averages of root yield (t/fad) were significantly affected by plant population and distribution in both years. Planting sugar beet on both sides of mastaba 80 cm width and 25 cm between hills (42000 plants/fad.) recorded the highest root yield (31.900, 31.889 t/fad.) in the two years, in that order.

This improvement that obtained with changing the width of mastaba from 100 to 80 cm may be due to the increase in number of plants per unit area. Similar results were stated by Ramadan (1999) and Nemeat-Alla (2009).

Table 4. Averages of root yield (t/fad) as affected by plant population & distribution and N - levels in 2014/15 (I) and 2015/16 (II) years.

Season		(I)	(II)
A: Ridge width and hill spacing (cm):			
	25 Cm.	31.900	31.889
80 Cm.	30 Cm.	28.328	28.096
	35 Cm.	23.054	23.742
	20 Cm.	26.374	24.882
100 Cm.	24 Cm.	23.340	21.656
	28 Cm.	20.871	19.783
BLSD (0.05)		1.400	2.569
B: Nitrogen fertilizer levels:			
69 Kg N/Fad.		22.160	21.609
92 Kg N/Fad.		25.359	24.712
115 Kg N/Fad.		29.416	28.702
BLSD (0.05)		0.907	1.030
C: Interaction (F. test):		*	*

Table 5. Averages of root yield (t/fad) as affected by the interaction between plant population & distribution and N - levels in 2014/15 (I) and 2015/16 (II) seasons.

Treatments		Season	(I)	(II)
	25 Cm.	69 Kg N/Fad	28.140	28.875
		92 Kg N/Fad	30.398	30.240
		115 Kg N/Fad	37.164	36.553
	30 Cm.	69 Kg N/Fad	23.520	23.951
80 cm		92 Kg N/Fad	28.547	28.862
		115 Kg N/Fad	32.918	31.474
	35 Cm.	69 Kg N/Fad	19.683	20.601
		92 Kg N/Fad	24.069	24.452
		115 Kg N/Fad	25.410	26.171
	20 Cm.	69 Kg N/Fad	23.478	19.871
		92 Kg N/Fad	25.064	23.405
		115 Kg N/Fad	30.581	31.369
	24 Cm.	69 Kg N/Fad	20.071	18.323
100 cm		92 Kg N/Fad	22.990	21.978
		115 Kg N/Fad	26.959	24.668
	28 Cm.	69 Kg N/Fad	18.065	18.034
		92 Kg N/Fad	21.086	19.336
		115 Kg N/Fad	23.461	21.978
BLSD (0.05)			1.571	2.013

Data in Table 4 clear that nitrogen fertilizer levels had significant effects on root yield/fad. in both years. Increasing nitrogen level from 69 to 115 kgN/fad. resulted in an increase in the average of root yield from

22.160 to 25.359 and 29.416 t/ fad. in the first season and from 21.609 to 24.712 and 28.702 t/ fad. in the second season. The increase in root yield associated with increasing nitrogen level up to 115 kgN/fad may be due to the role of nitrogen element on growth of sugar beet. These results are in agreement with that stated by Hilal (2000) Badr (2004) and Seadh (2008).

Effect of the interaction: The interaction between planting patterns and nitrogen fertilizer on root yield was significant in both years. The highest root yield (37.164 and 36.553 t/fad., in the first and second seasons) was obtained by cultivating sugar beet seeds on both sides of mastaba 80 cm width and 25 cm between hills and fertilizing with 115.0 kg N/ fad as shown in Table (5). Similar results were stated by Leilah *et al.* (2005) and Abdou (2013).

C-Quality parameters

1- Sucrose percentage: Data collected in Table 6 show the effect of plant population and distribution and nitrogen fertilization on sucrose % for the period of 2014 / 2015 and 2015 / 2016 years. Planting patterns had significant effects on sucrose % in both years. The highest sucrose percentage (19.32, 19.27%) in the first and second years were resulted from planting sugar beet in two sides of mastaba 80 cm width and 35 cm between hills (30000 plants/fad.) The increase in sucrose content associated with the decrease in plant population may be due to the decrease in competition between plants. Similar results were stated by Obead (1980), Bee (1994) as well as Abdou and Badawy (2014).

Date recorded in Table 4 clear that nitrogen fertilizer levels had a significant effect on sucrose % in

the first and second years. The highest values of sucrose (18.01, 18.19%) in both years, in that order were produced by adding the lowest N-level (69 kg N/fad).

Table 6. Sucrose, total soluble solids (TSS) and purity percentages as affected by plant population and distribution and N - levels in 2014/15 (I) and 2015/16 (II) years.

Character		Sucrose (%)		TSS (%)		Purity (%)	
Season		(I)	(II)	(I)	(II)	(I)	(II)
A: Ridge width and hill spacing (cm):							
80 Cm.	25 Cm.	17.11	17.30	23.17	23.01	73.99	75.18
	30 Cm.	18.80	18.97	23.63	23.95	79.24	75.89
	35 Cm.	19.32	19.27	24.33	24.12	79.41	79.86
100 Cm.	20 Cm.	16.50	16.83	22.30	22.79	73.88	73.85
	24 Cm.	17.10	17.02	23.13	22.73	73.97	74.90
	28 Cm.	17.30	17.50	23.33	23.06	74.34	79.21
BLSD (0.05)		0.37	0.31	0.50	0.28	0.62	1.08
B: Nitrogen fertilizer levels:							
69 Kg N/Fad.		18.01	18.19	23.60	23.70	76.28	76.73
92 Kg N/Fad.		17.67	17.83	23.33	23.25	75.70	76.66
115 Kg N/Fad.		17.35	17.42	23.01	22.89	75.43	76.06
BLSD (0.05)		0.22	0.19	0.44	0.21	2.03	1.08

The increase in sucrose percentage caused by the decrease of nitrogen level might be due to the decrease the other soluble solids according to the fact that nitrogen uptake and alfa amino N content of the sugar beet juice increase with increasing N fertilizer levels. Similar results were stated by Nemeat-Alla *et al.* (2002), Nemeat-Alla (2004), Ismail and Abo EL-Ghait (2005) and Allam (2008).

2- **Total soluble solids percentage** (TSS%): Results in Table 6 show effects of plant population and distribution and nitrogen fertilizer levels on TSS (%) in the first and second years. Results revealed that plant population and distribution significantly affected on TSS % in both years. Planting sugar beet on the two sides of mastaba 80 cm width and 35 cm between hills{30000 plants/fad.} gave the highest TSS values (24.33, 24.12%) in the two years, in that order. The gradually increase in TSS% that was accompanied with the decrease in plant populations in both years may be due to the fac that the increase in plant population results in the decrease of sucrose content in sugar beet roots (sucrose generally forms more than 70% of T.S.S in sugar beet roots). Similar results were stated by Obead (1980).

Results in Table 6 clear that nitrogen levels had a significant effect on TSS %. Fertilizing beet plants with 69 kg N/fad. resulted in the highest values of T.S.S% (23.60, 23.70%) in both years. The decrease in TSS% associated with raising N - levels may be due to role of nitrogen that causes the increase of cells size and its water content. Similar results were obtained by Leilah *et al.* (2007).

3- Purity percentage: Results in Table 6 reveal the effect of plant population and distribution and nitrogen fertilizer on purity percentage in the first and second years. Results recorded in Table (6) clear that plant population and distribution had a significant effect on purity % in both years. Cultivating sugar beet seeds on the two sides of mastaba 80 cm width and 35 cm between hills{30000 plants/fad.} resulted in the highest values of purity % (79.41 , 79.86%), in that order in both years. These results may be due to that the decrease in T.S.S % of sugar beet roots resulted with increasing plant density was more than the reduction in sucrose percentage in sugar beet roots resulted from the same reason. Similar results were obtained by Nemeat-Alla *et al.* (2007).

Results in Table 6 show that nitrogen fertilizer levels had significant effects on purity percentage. Fertilizing sugar beet plants with 69 kg N/fad. produced the highest values of purity % (76.28 , 76.73%), in that order in both years. Increasing nitrogen rates from 69 to 115 kg N/fad decreased juice purity % from 76.28 to 75.43%, in the first season and from 76.73 to 76.06% in the second season. These results may be due to that the decrease in TSS % associated with raising nitrogen fertilizer rate which was less than the decrease in sucrose percentage caused by the same reason. Similar results were stated by Barta and Drco (1983), Badawy (1985), Mustafa and Darwish (2001) and Leilah *et al.* (2007).

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تأثير كثافة وتوزيع النباتات ومستويات النيتروجين على المحصول والجودة فى بنجر السكر

عبد الرحيم عبد الرحيم ليله[١]، مأمون أحمد عبد المنعم[١]، جمال عبد الجواد شلبى[٢]، محمد علي الدسوقى عبده[٢] و هبة مصطفى عبد السلام[١].

[١] قسم المحاصيل، كلية الزراعة، جامعة المنصورة، مصر.

[٢] معهد بحوث المحاصيل السكرية، مركز البحوث الزراعية، مصر.

أقيمت تجربتان حقليتان خلال موسمى الزراعة ٢٠١٤ / ٢٠١٥ و ٢٠١٥/ ٢٠١٦ م فى قرية أبو سعيد ، مركز كفر الشيخ ، محافظة كفر الشيخ لدراسة تأثير كثافة وتوزيع نباتات بنجر السكر من خلال زراعته على مسافة ٢٥ ، ٣٠ و٣٥ سم بين الجور على جانبى خطوط (مصاطب) بعرض ٨٠ سم وكذلك الزراعة على مسافة ٢٠، ٢٤ و٢٨ سم بين الجورعلى جانبى مصاطب بعرض ١٠٠ سم مؤدية لثلاث كثافات نباتية (٤٢، ٣٥ و٣٠ ألف نبات/فدان، على التوالى) وثلاث مستويات من التسميد النيتروجين (٦٩ و٩٢ و١١٥ كجم نيتروجين / فدان) على المحصول والجودة فى بنجر السكر " صنف زوان بولى ". نفذت التجارب بنظام تصميم القطع المنشقة مرة واحدة ذو أربع مكررات، حيث وزعت عشوائيا نظم الزراعة (كثافة وتوزيع النباتات) على القطع الرئيسية، بينما وزعت مستويات السماد النيتروجينى عشوائيا على القطع الشقية. ويمكن تلخيص النتائج المتحصل عليها فيما يلى: ١- كان لتغير كثافة وتوزيع نباتات بنجر السكر أثرا معنوبا على جميع الصفات المدروسة فى كلا الموسمين. وأدت زراعة بذور بنجر السكر على جانبى المصاطب بعرض ٨٠ سم ومسافة ٣٥ سم بين الجور (٣٠ ألف نبات / فدان) إلى زيادة معنوية فى عدد الأوراق ووزن العرش الغض/نبات ووزن الجذر، وزن النبات، نسبة السكر، نسبة النقاوة ونسبة المواد الصلبة الذائبة الكلية فى كلا الموسمين. ٢- أدت زيادة مستويات التسميد النيترجينى من ٦٩ إلى ٩٢ و ١١٥ كجم ن/فدان إلى زيادة معنوية فى وزن الجذر، قطر الجذر، طول الجذر، عدد الأوراق ووزن العرش الغض لكل نبات ووزن النبات فى كلا الموسمين، الا أنها أدت إلى احداث نقص معنوى فى نسبة السكروز والنقاوة والمواد الصلبة الذائبة الكلية فى كلا الموسمين.ومن نتائج الدراسة، يمكن أن ننصح بزراعة بنجر السكر على كلا الجانبين لمصاطب بعرض ٨٠ سم ومسافة زراعة ٢٥ سم بين الجور والتسميد النيتروجينى بمعدل ١١٥ كجم ن/فدان للحصول على أعلى إنتاجية وجودة للجذور تحت ظروف هذا البحث.