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Plant Distribution Patterns and Irrtgation Intervals Effects on Yield and Quality of Sugar Beet in North Delta

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ABSTRACT

Two field experiments were designed in a strip- plot with four replications were conducted in the Farm of Tag El-Ezz Research Station (latitude of 30.56^0 N and longitude of 31.35^0 E), Dakahlia Governorate during 2012/2013 and 2013/2014 seasons to study the effect of four plant spatial distributions and irrigation intervals on yield and quality of sugar beet preceded by rice crop. The present work included twelve treatments represent the combinations between four plant distribution patterns (D_1: planting on one side of ridges of 50-cm, D_2: planting on both sides of ridges of 50-cm width, D_3: planting on both sides of beds of 100-cm width and D_4: planting three rows on beds of 150-cm width, with hill spacing of 20 cm in case of D_1 and D_3 and D_4 as well as 40 cm in case of D_2) and three irrigation intervals [irrigation every 25 days (R_1), 35 days (R_2) and 45 days (R_1)]. The obtained results revealed that plant distribution patterns significantly influenced every studied traits in both seasons, except purity % in the 1st season. The highest values of all studied characters resulted from $D_{3,}$ while the maximum percentages of TSS, sucrose and purity resulted from D_1 in both seasons. Applying D_3 increased root yield by 21.7, 11.5 and 6.2 % t/fad in the 1st season, corresponding to 18.2, 10.4 and 4.2% t/fad in the 2nd one as compared with D_1, D_2 and D_4, respectively. Irrigation intervals had a significant effect on all studied characters except purity% in both seasons. The highest values of all studied characters produced from R_2 treatment, while the highest values of TSS%, sucrose% and purity% were recorded by R_1. Applying R_2 increased root yield by 3.9 and 8.2% t/fad in the 1st season and 4.9 and 9.3% t/fad in the 2nd one compared with R1 and R3, respectively. Planting on two sides of beds of 100-cm width and 20 cm between hills and irrigation every 35-days recorded the highest productivity and quality of sugar beet under the environmental conditions of North Delta.

INTRODUCTION

Sugar beet (*Beta vulgaris* variety *saccharifera* L.) is the second crop after sugarcane for sugar production in Egypt, which suffer from a gap in sugar commodity amounted to 700-900 thousand tons, imported every year to face the rapid increase in our population. So, Egyptian government expands sugar beet cultivation, as a national target, in order to increase the total sugar production in addition to its yield per unit area, using the best agricultural practices such as plant spatial distribution in fields and irrigation intervals.

The best distribution of sugar beet plants, grown in hills, depends on the optimum space assigned for individual plants, which decrease the intra competition among plants, enabling their foliage to receive an appropriate amount of solar radiation along with enough water and nutrients, which ensure a maximum photosynthesis rate, and consequently higher root fresh weight. In this context, El-Khattib (1991) and El-Douby *et al.* (2000) reported that ridge width plays a major role in plant distribution and productivity of sugar beet plants. It leads to optimum density for plants per unit area, minimum intra competition of plants for solar radiation utilized by sugar beet plants, and in turn high in the conversion of light energy to chemical energy and consequently high accumulation of dry matter. Farghaly *et al.* (2003), Gadallah *et al.* (2006), El-Bakary (2006), Attia *et al.*(2007), Sarhan *et al.* (2012) and Abdou and Badawy (2014) mentioned that the optimum distribution of sugar beet gave the highest return per unit area and total income to the farmer. Brar *et al.* (2015) found that better growth and higher yields of sugar beet can be achieved by planting two rows/bed, *i.e.*12 plants/m^2. Al-Jbawi *et al.* (2016) clarified that the distribution of 25 cm (hill spacing) × 50 cm (row width) resulted in the highest production traits, but to get a higher sucrose %, it is recommended to grow the beet roots at spacing of 30 × 60 cm. Malik *et al.* (2016) reported that the maximum sugar beet sugar yield/ha were recorded in case of planting sugar beet on 30 x 90 cm spacing paired row strips.

Soil moisture availability is the main limiting factor for growing crops. Moisture stress affects plant growth, In this regard, El-Khattib (1991) found that water consumed by sugar beet to produce one ton of sugar was about 1300 m3, while sugar cane plant needs about 4000 m3 of water to produce the same quantity of sucrose. Kaffka *et al.* (1997) showed that near the end of growth stage, water stress have less impact on sugar beet yield. Jaggard *et al.* (1998) reported that water supply is the major factor affecting sugar beet growth and yield. Abdollahian (1999) found that throughout the early growing season of sugar beet, water deficit is the chief reason of yield shortage. Kirda *et al.* (1999) showed that during ripening stage of sugar beet, withholding water caused of saving nearly 22% of water without any significant reduction of yield. Moiller (2001) found that suitable irrigation system increasing yield. Zaid (2005) reported that increase soil organic matter content conservation of water which sufficient plants requirement for long time and slowing the release of macro- and micro- nutrients. Gouranga and Singh (2006) recorded that water irrigation is necessary to fulfill the need of reclamation and save water requirements of the different crops. Sohrabi and Heidari (2008) found that irrigation withholding at 40 days reduced root yield compare with 10, 20 and 30 day before harvest, but increased total and white sugar content. Selim *et al.* (2009) found that applying the irrigation 5 weeks before harvest time gave the lowest length of root, root fresh weight and the lowest yields of root and sugar. On the other hand, it gave the highest sucrose and purity percentages.

This investigation aimed to find out the best plant distribution and irrigation interval to get the highest yields of root and sugar and the best quality traits of sugar beet under the ecological conditions of North Delta.

MATERIALS AND METHODS

Two successive experiments was carried out at Tag El-Ezz Research Station (latitude of 30.56^0 N and longitude of 31.35^0 E), Dakahlia Governorate, during 2012/2013 and 2013/2014 seasons to evaluate the effect of plant spatial distribution and irrigation interval on productivity and quality of sugar beet cv. Oscar poly as the multi-germ cultivar. A strip-plot design with three replications was used. Horizontal plots were randomly occupied by the following plant distribution patterns:

D_1: Planting on one side of ridges of 50-cm width and 20 cm between hills.

D_2: Planting on both sides of ridges of 50-cm width and 40 cm between hills.

D_3: Planting on both sides of beds of 100-cm width and 20 cm between hills.

D_4: Planting three rows on beds of 150-cm width and 20 cm between hills.

In case of D_2, D_3 and D_4 hills were sown in reciprocal settings.

The vertical plots were devoted at random to the following three irrigation intervals:

R_1: Irrigation every 25-day interval (7 irrigation).

R_2: Irrigation every 35-day interval (5 irrigation).

R_3: Irrigation every 45-day interval (4 irrigation).

Irrigation treatments were separated by ditches of 1.5 m width to prevent seepage of water among them.

Agricultural practices:

Calcium super phosphate (15.5 % P_2O_5) was applied during soil preparation at the rate of 150 kg/fad. Thereafter, soil was leveled and divided into the experimental units of (21 m^2 = 1/200 fad), which included (12 ridges of 50-cm width), (6 beds of 100-cm width) and (4 beds of 150-cm width) and 3.5-m length. Nitrogen fertilizer was applied in the form of urea (46.5 % N) in three equal doses before the 1st, 2nd and 3rd irrigation. Potassium sulphate (48 % K_2O) was added at the rate of 50 kg/fad before the 3rd irrigation. Oscar poly sugar beet variety was sown in 1st week of October in both seasons. The preceding summer crop was rice in both seasons. All cultural practices were performed as recommended by Sugar Crops Research Institute.

Samples of soil were taken from 0-30 cm depth from the two sites before soil preparation, which analyses are given away in the following table.

Table 1. Mechanical and chemical analyses of the experimental soil during the two growing seasons.

Experiment site	2012/2013	2013/2014
Mechanical analysis		
Sand%	14.60	16.40
Silt%	29.10	28.60
Clay%	56.30	55.00
Texture class	Clayey	Clayey
Chemical analysis		
Organic matter %	1.96	2.04
Available N (ppm)	24.40	23.85
Available P (ppm)	10.50	11.30
Available K (ppm)	317	309
pH	7.7	7.9
EC (ds/cm)	2.9	3.4

*** Classification of soil salinity according to United States .**
1. EC = less than 1280 ppm (salinity free).
2. EC = 1280-2240 ppm (low salinity).
3. EC = 2240-4160 ppm (medium salinity).

The studied characters:

At harvest, a sample of 5 sugar beet plants were randomly collected from each plot to determine the following traits:

1. Root fresh weight/plant (g)
2. Foliage fresh weight/plant (g)
3. Root length (cm).
4. Root diameter (cm).
5. Total soluble solids percentage (TSS%) was measured in juice of fresh roots using "Hand Refractometer"
6. Sucrose percentage was determined polarimetrically in lead acetate extract of fresh macerated roots according to the method of Le-Docte (1972).
7. Purity percentage was determined as a ratio between sucrose % and TSS% of roots.

At harvest, sugar beet plants in each plot were up-rooted, separated into roots and leaves and weighed to estimate the following yields:

1. Root fresh yield (t/fad).
2. Top fresh weight (t/fad).
3. Sugar yield (t/fad) was calculated by multiplying root yield by sucrose percentage.

Statistical analysis:

Data were statistically analyzed according to the technique of analysis of variance for a strip-plot design by means of "MSTAT-C" computer software package. The LSD method was used to compare the differences among means of treatment at 5% probability level (Gomez and Gomez, 1984). The relationships among dependent and independent variables throughout the calculation of simple correlation coefficient were estimated by means of the correlation coefficient (r) between each of dependent and independent variable (Snedecor and Cochran, 1989). Multiple regression analysis was done to calculate the coefficient of determination (R^2) and to estimate relative contribution of independent variables for each dependent variable and to get the prediction equations (Draper and Smith, 1987). Stepwise multiple regression analysis was done to determine the variables accounting for the majority of the total variability independent character (Draper and Smith, 1987). Dependent variables for root yield/fad (Y) and the independent variables (X) are presented in Table 2.

Table 2. Independent variables related to root yield, t/fad (Y) of sugar beet

Independent variables	
- Root length (cm)	X1
- Root diameter (cm)	X2
- Foliage fresh weight/plant (kg)	X3
- Root fresh weight/plant (kg)	X4
- Top fresh weight (t/fad)	X5
- Root fresh weight (t/fad)	X6
- Sugar yield (t/fad)	X7
- Total soluble solids percentage (TSS%).	X8
- Sucrose percentage	X9
- Purity percentage	X10

RESULTS AND DISSCUTION

Effect of plant distribution:

Data in Tables 3, 4 and 5 showed that plant distribution pattern exhibited a significant effect on every one of studied traits in both seasons, except purity% in the 1st one.

Planting beet plants on both sides of beds of 100-cm width with 20-cm spacing among hills (D_3) attained the highest values in length of root, diameter and fresh weight/plant as well as foliage weight/plant. The same planting pattern (D_3) resulted in the highest top, root and sugar yields/fad. Root yield/fad increased markedly by 21.7, 11.5 and 6.2%, in the 1st season, corresponding to 18.2, 10.4 and 4.2%, in the 2nd one, when D_3 was used, compared with D_1, D_2 and D_4, respectively. The increment in root yield/fad associated with D_3 may be due to that pattern ensured better conditions concerning foliage light interception and decreased the intra-specific competition between sugar beet plants for growth factors, which positively contributed to higher photosynthesis rate and hence higher values of root length, diameter and fresh weight/plant, which participated in increasing root yield/fad. These results are in harmony with those reported by El-Bakary (2006) and Abdou and Badawy (2014).

Table 3. Length and diameter of root, root and foliage fresh weight/plant of sugar beet as affected by plant distribution, irrigation interval and their interactions

Characters	Root length (cm)		Root diameter (cm)		Root fresh weight/plant (g)		Foliage fresh weight/plant (g)	
Seasons	2012/13	2013/14	2012/13	2012/13	2012/13	2012/13	2012/13	2013/14
Treatments								
A. Plant distribution								
D_1	27.3	28.8	8.4	9.7	0.553	0.643	0.446	0.479
D_2	29.2	31.5	9.0	10.3	0.597	0.670	0.482	0.502
D_3	33.8	35.8	10.6	12.1	0.719	0.757	0.546	0.598
D_4	31.5	33.9	9.8	10.8	0.644	0.700	0.516	0.547
F-test	*	*	*	*	*	*	*	*
LSD at 5%	0.3	0.4	0.4	0.5	0.006	0.010	0.005	0.009
B. Irrigation intervals								
R_1	30.8	32.8	9.5	10.8	0.628	0.690	0.498	0.527
R_2	32.3	34.4	10.1	11.5	0.668	0.736	0.531	0.573
R_3	28.3	30.4	8.8	9.8	0.590	0.651	0.463	0.494
F-test	*	*	*	*	*	*	*	*
LSD at 5%	0.4	0.4	0.2	0.7	0.007	0.007	0.005	0.005
AB	*	NS	NS	NS	NS	NS	*	*

D_1: Planting on one side of ridges of 50-cm width and 20 cm among hills. D_2: Planting on both sides of ridges of 50-cm width and 40 cm among hills.
D_3: Planting on both sides of beds of 100-cm width and 20 cm among hills. D_4: Planting three rows on beds of 150-cm width and 20 cm among hills.
R_1: Irrigation every 25-day intervals (7 irrigation). R_2: Irrigation every 35-day intervals (5 irrigation).
R_3: Irrigation every 45-day intervals (4 irrigation).

Table 4. Top, root and sugar yields of sugar beet as affected by plant distribution and irrigation interval and their interactions

Characters	Top yield (t/fad)		Root yield (t/fad)		Sugar yield (t/fad)	
Seasons	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
Treatments						
A. Plant distribution						
D_1	10.50	11.33	19.92	21.08	4.419	4.798
D_2	12.50	13.50	21.75	22.58	4.412	4.638
D_3	14.25	16.25	24.25	24.92	4.543	4.843
D_4	12.91	14.08	22.83	23.92	4.348	4.754
F-test	*	*	*	*	*	*
LSD at 5%	0.33	0.34	0.35	0.39	9.267	12.199
B. Irrigation intervals						
R_1	12.31	13.81	22.19	23.06	4.413	4.716
R_2	14.06	14.94	23.06	24.19	4.542	4.881
R_3	11.25	12.63	21.31	22.13	4.396	4.679
F- test	*	*	*	*	*	*
LSD at 5%	0.35	0.26	0.20	0.30	5.254	9.066
AB	*	NS	*	*	NS	NS

D_1: Planting on one side of ridges of 50-cm width and 20 cm among hills. D_2: Planting on both sides of ridges of 50-cm width and 40 cm among hills.
D_3: Planting on both sides of beds of 100-cm width and 20 cm among hills. D_4: Planting three rows on beds of 150-cm width and 20 cm among hills.
R_1: Irrigation every 25-day intervals (7 irrigation). R_2: Irrigation every 35-day intervals (5 irrigation).
R_3: Irrigation every 45-day intervals (4 irrigation).

Total soluble solids (TSS), sucrose and purity percentages recorded the highest values when sugar beet plants were sown on one side of ridges of 50-cm width with hill spacing of 20 cm (D_1) compared with D_2, D_3 and D_4. These results may be due to the decrease in root weight and diameter, low tissue water content, non-sucrose substances such as proteins and alpha-amino nitrogen, and hence increasing total soluble solid, sucrose and purity percentage, determined as per cents in the fresh samples. Similar results were obtained by El-Douby *et al.* (2000), Leilah *et al* (2005), Sarhan *et al.* (2012) and Seadh (2012).

Irrigation intervals effect:

Irrigation intervals had a significant effect on all studied characters in both seasons, except purity in the 1st season as shown in Tables 3, 4 and 5. The lowest values of foliage fresh weight/plant, root length and diameter were observed when the irrigation interval was prolonged to 45 days (R_3). These results are probably attributed to the negative effects of drought stress on the biological metabolic processes, *i.e.* ionic and hormone balance and water absorption, cell division and elongation, photosynthetic pigments, which decreased the translation and accumulation of assimilates from leaves to the roots (Leilah *et al.* (2005), Omar *et al.* (2013). Root yield/fad increased by 3.9 and 8.2% t/fad in the 1st season, corresponding to 4.9 and 9.3% t/fad in the 2nd one, when sugar beets were irrigated every 35 days (R_2), compared with those irrigated every 25 days (R_1) and/or 45 days (R_3), respectively.

The maximum percentages of TSS, sucrose and purity were attained by irrigating sugar beets every 45 days. These results may be due to decrease water content of the fresh tissues of roots, and hence increasing total soluble solid, sucrose and purity percentage, determined as per cents in the fresh samples. Similar results were stated by El-Bakary (2006), Sarhan *et al* (2012) and Seadh (2012).

Effect of the interaction:

The interaction between plant distribution and irrigation intervals (A x B) had a significant effect on root length and top yield/fad, in the 1st season and foliage fresh weight/plant and root yield/fad, in both seasons. The results in Table 6 and 7 clear that the combination between D_3 and R_2 resulted in the highest values of the previously mentioned traits.

Table 5. Sugar beet quality traits as affected by plant distribution, irrigation interval and their interactions

Characters	TSS%		Sucrose%		Purity%	
Seasons	2012 /13	2013 /14	2012 /13	2013 /14	2012 /13	2013 /14
Treatments						
A. Plant distribution						
D_1	24.8	25.9	20.9	22	86	85
D_2	23.9	25.2	20.3	21.3	85	84
D_3	22.8	24.0	19.3	20.3	84	84
D_4	21.9	23.2	19.1	19.1	85	83
F-test	*	*	*	*	NS	*
LSD at 5%	0.3	0.3	0.3	0.4	-	0.02
B. Irrigation interval						
R_1	22.4	23.6	19.1	20.3	85	84
R_2	23.1	24.7	19.8	20.5	85	83
R_3	24.6	25.4	20.8	21.2	85	86
F-test	*	*	*	*	NS	*
LSD at 5%	0.5	0.4	0.3	0.6	-	0.02
AB	NS	NS	NS	NS	NS	NS

D_1: Planting on one side of ridges of 50-cm width and 20 cm among hills.
D_2: Planting on both sides of ridges of 50-cm width and 40 cm among hills.
D_3: Planting on both sides of beds of 100-cm width and 20 cm among hills.
D_4: Planting three rows on beds of 150-cm width and 20 cm among hills.
R_1: Irrigation every 25-day intervals (7 irrigation).
R_2: Irrigation every 35-day intervals (5 irrigation).
R_3: Irrigation every 45-day intervals (4 irrigation).

Table 6. Root length and foliage fresh weight/plant as affected by the interaction between plant distribution and irrigation interval

Character	Root length (cm)				Foliage fresh weight/plant (g)							
Season	2012/2013				2012/2013				2013/2014			
Treatment	D_1	D_2	D_3	D_4	D_1	D_2	D_3	D_4	D_1	D_2	D_3	D_4
R_1	27.8	29.5	34.3	31.8	0.553	0.598	0.715	0.645	0.478	0.500	0.585	0.545
R_2	29.0	31.5	35.0	33.5	0.593	0.638	0.763	0.678	0.525	0.550	0.635	0.583
R_3	25.3	26.5	32.3	29.3	0.515	0.555	0.680	0.610	0.435	0.455	0.573	0.513
F-test	*				*				*			
LSD at 5%	0.2				0.837				0.709			

D_1: Planting on one side of ridges of 50-cm width and 20 cm among hills. D_2: Planting on both sides of ridges of 50-cm width and 40 cm among hills.
D_3: Planting on both sides of beds of 100-cm width and 20 cm among hills. D_4: Planting three rows on beds of 150-cm width and 20 cm among hills.
R_1: Irrigation every 25-day intervals (7 irrigation). R_2: Irrigation every 35-day intervals (5 irrigation).
R_3: Irrigation every 45-day intervals (4 irrigation).

Table 7. Top and root yields (t/fad) as affected by the interaction between plant distribution and irrigation interval

Characters	Top yield (t/fad)				Root yield (t/fad)							
Seasons	2012/2013				2012/2013				2013/2014			
Treatment	D_1	D_2	D_3	D_4	D_1	D_2	D_3	D_4	D_1	D_2	D_3	D_4
R_1	10.50	12.25	13.75	12.75	20.00	21.75	24.25	22.75	21.00	22.50	24.50	24.25
R_2	11.50	14.00	16.30	14.50	20.50	22.75	25.25	23.75	21.75	23.50	26.50	25.00
R_3	09.50	11.30	12.80	11.50	19.25	20.75	23.25	22.00	20.50	21.75	23.75	22.50
F-test	*				*				*			
LSD at 5%	0.22				0.19				0.26			

D_1: Planting on one side of ridges of 50-cm width and 20 cm among hills. D_2: Planting on both sides of ridges of 50-cm width and 40 cm among hills.
D_3: Planting on both sides of beds of 100-cm width and 20 cm among hills. D_4: Planting three rows on beds of 150-cm width and 20 cm among hills.
R_1: Irrigation every 25-day intervals (7 irrigation). R_2: Irrigation every 35-day intervals (5 irrigation).
R_3: Irrigation every 45-day intervals (4 irrigation).

The relationship between root yield and its attributing variables:

The relationships between root yield and its attributing variables were done. Three statistical procedures, viz; simple correlation, multiple linear regression and stepwise regression were used in this study.

1. Correlation coefficient:

The result of correlation coefficient (r) among root yield/fad and each of its attributing variables in Table 8 show that root yield/fad was positively and significantly associated with root length, root diameter, foliage fresh weight/plant, root fresh weight/plant and top yield (t/fad). Sugar yield/fad was negatively and significantly associated with TSS%. Also, there were associated with correlation among all characters that were studied and each of other as previously mentioned.

2. Multiple regression:

Results of multiple regression analysis recorded in Table 9, cleared that the relative contribution (R^2) for all variables in the total variation of root yield was 91.67%. On the other hand, the residual value was 8.33%' which indicates that the most characters were included in this study.

3. Stepwise regression analysis:

Data in Table 9 show that four variables out of the eleven were accepted as significantly contributing variables to the variation in root yield. These accepted variables were root yield/plant, top yield (t/fad), flag leaf area, sugar yield (t/fad) and sucrose % with R^2 being 6.36%, 85.80, 0.29 and 6.29% according stepwise analysis, respectively. The results indicated that stepwise analysis develops a sequence of multiple regression equation by removing 6 from the full model equation with relative contribution of 0.97%. In conclusion, it can be stated that root yield/p, top yield (t/fad), sugar yield (t/fad) and sucrose% were the most important characters, Since did not have only highly significant positively associated with root yield/fad, but also had highly relative contributing towards root yield/fad in the prediction equation. Therefore, maximum effort should be given to these characters for the improvement of sugar beet yield by selection through breeding programs.

Table 8. Simple correlation coefficient among sugar beet characters (average of the two seasons)

Character	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X1- Length of root (cm)										
X2- Diameter of root (cm)	.868*									
X3- Fresh weight of foliage /plant (g)	.982*	.864*								
X4- Fresh weight of root /plant (g)	.980*	.980*	.984*							
X5- Top yield (t/fad)	.961*	.847*	.963*	.962*						
X6- Root yield (t/fad)	.967*	.855*	.956*	.962*	-.252ns					
X7- Sugar yield (t/fad)	.585*	.775*	.578*	.602*	.039ns	.595*				
X8- TSS%	-.678*	-.322*	-.675*	-.643*	.378*	-.672*	-.672*			
X9- Sucrose %	-.697*	-.372*	-.685	.668*	.304*	-.680*	.702*	.120ns	.	
X10- Purity%	.022*	-.104ns	.039ns	.001ns	-.205ns	.043ns	.015 ns	.075ns	-.273ns	0.07

Table 9. Multiple and stepwise regression analyses for root yield t/fad (Y) as affected by all studied characters of sugar beet

Prediction equation according to multiple regression	
Y=a+bx1+bx2+bx3+bx4+bx5+bx6+bx7+bx8+bx9	
Y = 23.51 - 0.0803 x1+0.0160 x2+ 3.50 x3+ 0.85 x4+ 1.59 x5 + 0.0230 x6 + 0.04861x7- 0.118x8 - 0.964x9.	
Relative contribution (R^2) for all variables according to full model regression	99.71%
Prediction equation according to stepwise	
Y= a + bx5 + bx6+ bx9 + bx10	
Y= 20.241 + 1.255x5 +0.0498 x6+0.04764 x9-1.0688 x10	
Relative contribution (R^2) for each of accepted variables according to stepwise regression	
X4 root yield/p.	6.36%
X6 top yield/fad	85.80%
X9 sugar yield/fad	0.29%
X10 sucrose%	6.29%
The total relative contribution (R^2) for all accepted variables according to stepwise regression	98.74
The relative contribution (R^2) for all removed variables according to stepwise regression	0.97
The relative contribution (R^2) for residual variables according to stepwise regression	0.29
Total effect (accepted, removed and residual)	100%

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تأثير نُظُم توزيع النباتات وفترات الرى على حاصل وجودة بنجر السكر فى شمال الدلتا

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أُقيمت تجربتان حقليتان بمحطة البحوث الزراعية بتاج العز (دائرة عرض 30.56° شمالاً وخط الطول 31.35 ° شرقاً) بمحافظة الدقهلية خلال الموسمين 2013/2012 و 2014/2013 لدراسة تأثير أربعة نظم لتوزيع النباتات بالحقل وهى 1- الزراعة على جانب واحد على خطوط عرضها 50 سم على مسافة 20 سم بين الجور ، 2- الزراعة على جانبى خطوط عرضها 50 سم على مسافة 40 سم بين الجور المتبادلة (رجل غراب) ، 3- الزراعة على جانبى مصاطب عرضها 100 سم على مسافة 20 سم بين الجور و 4- زراعة ثلاثة صفوف على مصاطب عرضها 150 سم فى على مسافة 20 سم بين الجور المتبادلة (رجل غراب) ، وثلاث فترات رى (الرى كل 25 ، 35 و45 يوماً) على إنتاجية وجودة بنجر السكر "صنف أوسكار بولى". نفذت التجربة بنظام الشرائح المتعامدة فى أربع مكررات. تتلخص أهم النتائج فيما يلى: - أثرت نظم توزيع النباتات معنوياً على الصفات المدروسة عدا النسبة المئوية للنقاوة فى الموسم الأول . تفوقت الزراعة على جانبى مصاطب عرضها 100 سم ومسافة 20 سم بين الجور المتبادلة فى جميع الصفات عدا صفات النسبة المئوية للمواد الصلبة الذائبة الكلية ، السكروز و النقاوة والتى إزدادت بالزراعة على جانب واحد لخطوط عرضها 50 سم ومسافة 20 سم بين الجور . إزداد حاصل الجذور/فدان بزراعة ثلاثة صفوف من بنجر السكر على مصاطب عرضها 150 سم بمسافة 20 سم بين الجور المُتبادَلة (النظام الرابع) بنحو 10.5 ،20 و 5.2 % كمتوسط للموسمين ، مقارنة بالنظام الأول ، الثانى والثالث لتوزيع النباتات ، على التوالى. - أثرت فترات الرى معنوياً على جميع الصفات خلال موسمى الدراسة عدا النسبة المئوية للنقاوة فى الموسم الأول. تفوقت فترة الرى كل 35 يوماً فى جميع الصفات المدروسة خلال موسمى الدراسة عدا النسبة المئوية للمواد الصلبة الذائبة الكلية ، السكروز والنقاوة والتى إزدادت بإطالة الفترة بين الريات إلى 45 يوماً. إزداد حاصل الجذور/فدان برى البنجر كل 35 يوماً بحوالى 4.4 و 8.8 % كمتوسط للموسمين مقارنة بالرى كل 25 و/أو 45 يوماً ، على الترتيب. - أوضحت النتائج أن التفاعل بين عاملى الدراسة قد أثَّر معنوياً على طول الجذر فى الموسم الأول ، وزن الأوراق الطازج/نبات فى الموسمين الأول والثانى ، حاصل العرش/فدان فى الموسم الأول و حاصل الجذور فى الموسمين الأول والثانى ، وتم الحصول على أعلى القيم لتلك الصفات عند زراعة بنجر السكر على جانبى مصاطب بعرض 100 سم ومسافة 20 سم بين الجور المتبادلة والرى كل 35 يوماً.- أظهرت النتائج المُتحصَّل عليها وجود إرتباط معنوى موجب بين الحاصل وجميع الصفات المدروسة عدا النسبة المئوية للمواد الصلبة الذائبة الكلية حيث كان الإرتباط معنوياً سالباً ، وغير معنوى للنسبة المئوية للنقاوة . - أظهرت نتيجة تحليل الإنحدار المتعدد أن المساهمة النسبية لكل الصفات كمتغيرات مستقلة مجتمعة كانت 99.71% فى تباين الحاصل (طن/فدان) - كما بيَّنت نتيجة تحليل الإنحدار المتعدد المرحلى أن أربع صفات من عشرة تساهم بنسبة 98.94% فى التباين الكلى للحاصل (طن/فدان) وهذه الصفات هى وزن الجذر/نبات و حاصل الأوراق (طن/فدان) ، حاصل السكر (طن/فدان) و نسبة السكروز ، وذلك بنسبة مساهمة قدرها 6.36 ؛ 85.80 ؛ 0.29 و 6.29 % على الترتيب ، مما يوضح أن هذه الصفات الأربع لها إرتباطٌ موجب عالى المعنوية بينها و بين الحاصل ، وساهمت بنسبة عالية فى التباين الكلى للحاصل بلغت 98.94 %. توصى الدراسة بزراعة بنجرالسكر على جانبى مصاطب عرضها 100 سم بمسافة 20 سم بين الجور المُتبادلة و الرى كل 35 يوماً (5 ريات فى الموسم) للحصول على أعلى إنتاجية للفدان من الجذور والسكر فى شمال الدلتا.