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YIELD AND QUALITY OF SOME SUGAR BEET VARIETIES AS AFFECTED BY PLANTING DENSITIES AND NITROGEN FERTILIZATION

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ABSTRACT

Two field experiments were conducted at Kom-Osheem Agricultural Research Station, Fayoum Governorate during 2003/2004 and 2004/2005 growing seasons to evaluate the performance of four sugar beet varieties, Injermono and Helena (mono-germ) and Sultan and Baraca (multi-germ) grown under two planting populations (35000 and 46666 plants/fed) and three N levels (60, 80 and 100 kg N/fed). A split-plot design with three replications was used. The main plots were assigned to the two planting densities while the combinations of sugar beet varieties and N fertilization levels were randomly distributed in the sub-plots.

The results showed that sowing sugar beet at 46666 plants/fed significantly reduced root length (in the 1st season) and increased both of purity % and root yield/fed (in the 2nd season) and sugar yield/fed (in the 1st season). Root diameter, sucrose % and top yield/fed were insignificantly affected by plant densities in both seasons.

The examined sugar beet varieties significantly differed and Sultan variety showed the superiority in all studied traits in both seasons.

Increasing N doses from 60 up to 100 kg/fed increased significantly root length and diameter as well as root and top yields, while sucrose and purity percentages were significantly decreased.

INTRODUCTION

Increasing the planted area with sugar beet in new lands is considered the possible solution to minimize the gap between production and consumption of sugar commodity in Egypt. Many investigators showed that planting densities, beet variety and nitrogen fertilization level are considered major factors affecting yield and quality of sugar beet.

Hassanin (2001) stated that sowing sugar beet seeds at 20 cm between plants increased root and sugar yields/fed compared with 15 or 25 cm, while 25 cm hill spacing gave higher values of root length, diameter and top yield. On the other hand, the distance of 15-cm resulted in the best sucrose %, while purity % was insignificantly affected by hill spacing. Nassar (2001) found that increasing plant densities up to 42000 plants/fed (50 x 20 cm) significantly produced the highest root and sugar yields/fed. Increasing plant densities from 35000 (60 x 20 cm) to 70000 (40 x 15 cm) decreased root dimensions (length and diameter) and fresh weight of the individual roots, while sucrose and purity percentages increased. Ahmed (2003) found that narrowing planting distance between hills from 30 to 20 cm (increasing plant densities) significantly increased root, top and sugar yields/fed. Sogut and Aroglu (2004) sowed sugar beet at intra-row spacing of 15, 20, 25, 30 and 35 cm. They reported that 15 and 20 cm intra-row spacing produced higher root yield than the 35 cm intra-row spacing.

Concerning varietal effects, Saif (2000) recorded significant differences among sugar beet varieties (Marocpoly, M9680, M9681 and Mito) in sucrose and purity percentages and root yield. Al-Labbody (2003) tested fifteen sugar beet varieties under Fayoum Governorate conditions [ten multigerm varieties (Toro, Lados, Vital, Gloria, Pamela, Del.937, Del 938, Del.939, Kawemira and Athos poly) and five monogerm varieties (Aries, Helix, Tellus, Marathon and Rhopsodie)]. He recorded wide variations among varieties in growth and quality traits as well as root, sugar and top yields.

Regarding nitrogen effect, Gutmanski and Nowakowski (1994) fertlized sugarbeet with 0, 60, 120 or 180 kg N/ha. They observed that higher N rate increased root, sugar and leaf yields but reduced root sugar content. Abd-El-Hadi, *et al.* (2002) fertilized sugar beet with 60, 80 or 100 kg N/fed. They found that increasing nitrogen rates irrespective of the source increased root yield and decreased sugar yield. They obtained a negative correlation between nitrogen concentration in roots and sugar yield and juice purity. They added that applying 60 kg N/fed was recommended to produce the highest sugar yield and juice purity. Chikov, *et al.* (2003) added 75, 90 or 105 kg N/ha for sugar beet and found that the increase in the N rate enhanced the assimilate availability in roots which increased its biomass and root yield but reduced sugar content. The greatest increase in sugar yield over the control (30 %) was obtained with the lowest N rate. Jozefyova, *et al.* (2004) fertilized sugar beet with 0, 50, 100, 150 and 200 kg N/ha and found that sugar content diminished with the increasing N dose and that applying N at 50 kg N/ha was sufficient for high root yield and sugar content. El-Sayed (2005) obtained an increase in root length and diameter and root and sugar yields by increasing N fertilizer up to 125 kg N/fed.

Pytlarz (2005) mentioned that raising nitrogen dose from 90 to 180 kg N/ha enhanced the increase of potassium and alpha amino-N in roots and hence lowered sugar content.

The present work aimed to find out the best combination of the studied factors to obtain the highest yield and quality of the grown sugar beet under conditions of Fayoum Governorate.

MATERIALS AND METHODS

Two field experiments were conducted at Kom-Osheem Agricultural Research Station, Fayoum Governorate in 2003/2004 and 2004/2005 growing seasons to evaluate the performance of four sugar beet varieties, Injermono and Helena (mono-germ) and Sultan and Baraca (multi-germ) grown under two planting populations (35000 and 46666 plants/fed) and fertilized with three N levels (60, 80 and 100 kg N/fed). The two planting densities were obtained by sowing sugar beet seeds in hills spaced at 20 cm on one side of ridges of 60-cm apart or both sides of 90-cm rows, respectively. Nitrogen fertilizer was added in the form of Urea (46% N) after thinning (30 days after sowing) and before the next irrigation. A split-plot design with three replications was used. The main plots were assigned to the two planting densities while the combinations of sugar beet varieties and N fertilization levels were randomly distributed in the sub-plots. Plot area was

27 m^2 including 15 or 10 ridges of 60 or 90 cm in width, respectively and 3 m in length. The previous crops were sesame and sunflower in the 1st and 2nd seasons, respectively. Soil analysis of the experimental site showed that the soil was sand clay_containing 74, 4 and 28 ppm of the available N, P and K with a pH of 8.1. Other agricultural recommendations for growing sugar beet were adopted.

Recorded data:

At harvest time, the following data were recorded:

1. Root length (cm).
2. Root diameter (cm).
3. Sucrose % was determined as described by Le Docte (1927).
4. Purity % was calculated according to the following equation:

Purity % = Sucrose % x 100 / TSS %

Total soluble solids % (TSS%) was determined using "Hand refractometer".

At harvest, the guarded ridges of sugar beet were harvested, topped and cleaned. Roots and tops were weighed to estimate:

5. Root yield (ton/fed).
6. Sugar yield (ton/fed) was calculated according to the following equation:

Sugar yield = Root yield x Sucrose %

7. Top yield (ton/fed).

The collected data were statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1. Root length:

Data in Table 1 showed that increasing planting densities from 35 to 46.666 thousand plants/fed reduced root length in the two growing seasons. However, this reduction was significant in the 1st season only. This effect was probably due to the competition among plants for growth factors such as water, nutrients and solar radiation. These results are in agreement with those reported by Hassanin (2001) and Nassar (2001).

Sugar beet variety Sultan showed a significant superiority over the other three varieties, while Helena variety had the shortest roots, in the 1st and 2nd season, respectively. The difference in growth characters as root length could be attributed to seed type. It is known that multi-germ varieties have greater growth vigor as compared with mono-germ ones. Differences among sugar beet varieties in this character were also detected by Al-Labbody (2003).

Results in Table 1 indicated that increasing the applied N levels to sugar beet plants caused a significant increase in root length in both seasons. These results are in agreement with those mentioned by El-Sayed (2005). Raising N-levels from 60 to 80 kg N/fed resulted in a pronounced increase of 4.3 and 5.1 cm in the 1st and 2nd seasons, respectively, corresponding to 2.9 and 2.3 cm only when N level was increased from 80 to 100 kg N/fed. The increase in root length as N fertilizer level increased could be attributed to the role of nitrogen in enhancing cell division and building up plant organs.

Table 1: Root length (cm) of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004 N levels, kg/fed (C) 60	80	100	Mean	2004/2005 N levels, kg/fed (C) 60	80	100	Mean
35000 plants/fed	Injermono	34.2	37.4	42.4	38.0	30.5	35.0	37.5	34.3
	Helena	30.6	37.0	41.1	36.2	31.0	36.0	36.5	34.5
	Sultan	38.2	40.6	43.7	40.8	36.0	40.0	42.5	39.5
	Baraca	36.3	40.0	42.3	39.5	31.0	36.5	40.0	35.8
Mean		34.87	38.7	42.4	38.7	32.1	36.8	39.1	36.1
46666 plants/fed	Injermono	31.7	37.7	39.2	36.2	28.5	31.0	37.0	32.1
	Helena	31.2	36.7	39.2	35.7	25.0	31.5	34.0	30.1
	Sultan	35.2	38.1	40.7	38.0	33.5	39.5	39.5	37.5
	Baraca	34.0	38.5	40.5	37.6	30.5	34.5	35.5	33.5
Mean		33.0	37.7	39.9	36.9	29.3	34.1	36.5	33.3
Interaction of (B) x (C)	Injermono	33.0	37.6	40.8	37.1	29.5	33.0	37.2	33.2
	Helena	30.9	36.9	40.2	36.0	28.0	33.7	35.2	32.3
	Sultan	36.7	39.3	42.2	39.4	34.7	39.7	41.0	38.5
	Baraca	35.1	39.2	41.4	38.6	30.7	35.5	37.7	34.6
Overall mean of N levels		33.9	38.2	41.1	37.8	30.7	35.5	37.8	34.6
LSD at 5% level (1st & 2nd season) for:	(A): 1.2 – NS			(A) x (B): NS - NS		(A) x (B) x (C): NS – NS			
	(B): 0.9 - 0.5			(A) x (C): NS - NS					
	(C): 0.8 - 0.4			(B) x (C): 1.6 - NS					

Among the possible interactions between the studied factors, root length was significantly affected by the interaction between sugar beet varieties and N-levels in the 1st season. It could be noted that fertilizing variety Sultan with 100 kg N/fed recorded the longest root amounted to 42.2 and 41.0 cm in the 1st and 2nd season, respectively. However, the combination between sugar beet variety Helena and 60 kg N/fed recorded the lowest root length amounted to 30.9 and 28.0 cm. This finding may be considered a good indication to the interaction between genetic structure and one of the production elements such as fertilization.

2. Root diameter:

Data in Table 2 show that sugar beet root diameter was insignificantly influenced by the studied sowing densities in both seasons. Sultan variety had the thickest roots while Injermono recorded the lowest value of this trait. The differences among varieties in root diameter were significant in the 1st season only. This effect may be due to their gene make-up. Al-Labbody (2003) also found differences among sugar beet varieties in root diameter.

Increasing N levels had an appreciable effect on root diameter in both seasons. This result is in agreement with that reported by El-Sayed (2005). Increasing N levels from 60 to 80 and from 80 to 100 kg N/fed increased root diameter by 2.0 and 1.1 cm in the 1st season, corresponding to 1.8 and 0.9 cm in the 2nd one. This result may be due to the role of nitrogen not only in cell division but also in enhancing plant growth.

Table 2: Root diameter (cm) of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004 N levels, kg/fed (C) 60	80	100	Mean	2004/2005 N levels, kg/fed (C) 60	80	100	Mean
35000 plants/fed	Injermono	10.1	12.2	13.2	11.8	12.0	13.9	14.6	13.5
	Helena	9.8	11.6	13.4	11.6	11.8	13.4	14.2	13.1
	Sultan	11.7	14.1	14.5	13.4	11.6	13.7	14.3	13.2
	Baraca	9.7	12.2	13.2	11.7	12.7	13.6	14.9	13.7
Mean		10.3	12.5	13.6	12.1	12.0	13.6	14.5	13.4
46666 plants/fed	Injermono	8.1	9.9	11.1	9.7	9.7	12.5	13.5	11.9
	Helena	9.1	10.9	12.7	10.9	10.8	12.2	13.5	12.2
	Sultan	10.9	12.5	13.4	12.2	11.5	13.0	13.8	12.7
	Baraca	10.2	11.8	13.0	11.7	11.5	13.5	13.9	12.9
Mean		9.5	11.3	12.5	11.1	10.9	12.8	13.7	12.4
Interaction of (B) x (C)	Injermono	9.1	11.0	12.1	10.7	10.8	13.2	14.0	12.7
	Helena	9.5	11.2	13.0	11.2	11.3	12.8	13.8	12.6
	Sultan	11.3	13.3	13.9	12.8	11.5	13.3	14.0	13.0
	Baraca	9.9	12.0	13.1	11.7	12.1	13.5	14.4	13.3
Overall mean of N levels		9.9	11.9	13.0	11.6	11.4	13.2	14.1	12.9

LSD at 5% level (1st & 2nd season) for:			
	(A): NS - NS	(A) x (B): 0.8 – NS	(A) x (B) x (C): NS – NS
	(B): 0.6 - NS	(A) x (C): NS – NS	
	(C): 0.5 – 0.2	(B) x (C): NS – NS	

Root diameter was significantly affected by the interaction between planting densities and sugar beet varieties in the 1st season. Sultan variety recorded the thickest root diameter under conditions of the two sowing densities, while the lowest value of this trait was recorded by Helena and Injermono when sugar beet was sown at 35000 and 46666 plants/fed, respectively.

3. Sucrose percentage:

Results in Table 3 show that sucrose percentage was insignificantly affected by the two studied sowing densities (35 and 46.666 thousand plants/fed) in both seasons. The tested sugar beet varieties differed significantly in sucrose %, where Sultan variety recorded the highest sucrose % compared with the three other beet varieties in both seasons. The lowest sucrose % was given by Baraca and Injermono varieties, in the 1st and 2nd seasons, respectively. The differences in this trait are mainly due to gene make-up effect. These results are in line with those of Saif (2000) and Al-Labbody (2003) who obtained differences among varieties in sucrose percentage.

Increasing N fertilization levels from 60 to 80 and 100 kg N/fed was accompanied with a significant and gradual reduction in sucrose % amounted to 0.78 and 1.76 %, respectively, in the 1st season, corresponding to 0.34 and 1.04 % in the 2nd one. This result could be due to that increasing the applied N levels resulted in increasing water retention by the tap root leading to a reduction in sucrose determined as a percentage of root fresh weight

(Draycott, 1993). These results are in agreement with those reported by Chikov, *et al.* (2003) and Jozefyova, *et al.* (2004). Moreover, Pytlarz (2005) explained that doubling N level increased impurities in terms of potassium, alpha amino-N in roots and hence, sugar content decreased.

Table 3: Sucrose percentage of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004 N levels, kg/fed (C) 60	80	100	Mean	2004/2005 N levels, kg/fed (C) 60	80	100	Mean
35000 plants/fed	Injermono	21.00	20.90	20.03	20.64	16.90	18.80	18.35	18.01
	Helena	21.00	20.08	19.49	20.19	18.75	17.85	17.60	18.06
	Sultan	21.93	20.64	19.76	20.78	20.10	19.00	18.25	19.11
	Baraca	20.00	19.03	18.47	19.16	19.40	18.45	17.90	18.58
Mean		20.98	20.16	19.44	20.19	18.78	18.52	18.02	18.44
46666 plants/fed	Injermono	22.28	21.58	20.24	21.36	18.87	18.52	17.60	18.33
	Helena	21.50	20.61	19.45	20.52	19.30	18.97	18.00	18.75
	Sultan	23.50	22.68	21.50	22.56	21.50	20.80	19.92	20.74
	Baraca	20.50	19.96	18.68	19.71	19.75	19.50	18.62	19.29
Mean		21.94	21.20	19.96	21.04	19.85	19.45	18.53	19.28
Interaction of (B) x (C)	Injermono	21.64	21.24	20.13	21.00	17.88	18.66	17.97	18.17
	Helena	21.25	20.34	19.47	20.35	19.02	18.41	17.80	18.41
	Sultan	22.71	21.66	20.63	21.67	20.80	19.90	19.08	19.92
	Baraca	20.25	19.49	18.57	19.44	19.57	18.97	18.26	18.93
Overall mean of N levels		21.46	20.68	19.70	20.61	19.32	18.98	18.28	18.86

LSD at 5% level (1st & 2nd season) for:			
	(A): NS – NS	(A) x (B): 0.73 - NS	(A) x (B) x (C): NS – NS
	(B): 0.51 - 0.68	(A) x (C): NS - NS	
	(C): 0.44 - 0.59	(B) x (C): NS - NS	

The interactions between the studied factors had no significant influence on sucrose %. Sowing Sultan variety at a population of 46666 plants/fed gave the highest sucrose %. This finding may be due to that the intensive population led to lower root size (Table 2) and low moisture content, consequently higher sugar content.

4. Purity percentage:

Data in Table 4 showed that purity percentage tended to increase as planting population increased from 35000 to 46666 plants/fed in both seasons. However, the effect of planting densities on this trait was significant only in the 2nd season, where a significant increase of 5.11 % in purity percentage was detected when sugar beet was sown at 46666 plants/fed compared to that recorded at 35000 plants/fed. This result is in line with that reported by Nassar (2001). This result could be due to higher sucrose % recorded at the higher planting densities (Table 4).

The results cleared that the evaluated sugar beet varieties differed significantly in purity % in both seasons. Significant differences among varieties in purity % were also reported by Saif (2000) and Al-Labbody (2003). Sultan (multi-germ) variety showed the superiority over the other varieties in purity % probably due to higher sucrose % given by this variety, while Helena (mono-germ) gave the lowest values of this trait.

Table 4: Purity percentage of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004				2004/2005			
		N levels, kg/fed (C)			Mean	N levels, kg/fed (C)			Mean
		60	80	100		60	80	100	
35000 plants/fed	Injermono	92.31	87.26	78.58	86.05	78.90	81.79	76.61	79.10
	Helena	84.35	80.84	78.13	80.98	83.38	75.65	70.41	76.48
	Sultan	92.34	86.94	77.49	85.59	93.52	81.32	75.38	83.41
	Baraca	88.83	82.79	76.49	82.70	87.59	80.65	75.40	81.21
Mean		89.46	84.37	77.67	83.83	85.85	79.85	74.45	80.05
46666 plants/fed	Injermono	90.99	84.61	75.08	83.56	78.85	81.88	74.16	81.30
	Helena	91.43	86.93	79.39	85.90	89.78	85.30	77.04	84.04
	Sultan	92.15	88.59	84.30	88.35	91.48	88.19	84.83	88.17
	Baraca	91.10	85.87	76.22	84.40	94.04	86.19	81.24	87.17
Mean		91.43	86.48	78.75	85.55	90.79	85.39	79.32	85.16
Interaction of (B) x (C)	Injermono	91.65	85.93	76.83	84.80	83.37	81.84	75.39	80.20
	Helena	87.92	83.65	78.76	83.44	86.58	80.47	73.73	80.26
	Sultan	92.24	87.77	80.90	86.97	92.50	84.76	80.10	85.79
	Baraca	89.97	84.33	76.35	83.55	90.82	83.82	78.32	84.18
Overall mean of N levels		90.44	85.42	78.21	84.69	88.32	82.62	76.88	82.61

LSD at 5% level (1st & 2nd season) for:			
	(A): NS - 1.64	(A) x (B): 2.66 - N.S.	(A) x (B) x (C): NS – NS
	(B): 1.88 - 1.35	(A) x (C): NS - NS	
	(C): 1.63 - 1.18	(B) x (C): NS - NS	

Purity percentage was drastically and significantly decreased by 5.02 and 12.23 % in the 1st season corresponding to 5.70 and 11.44 % in the 2nd one as N level increased from 60 to 80 and from 80 to 100 kg N/fed, respectively. This result could be attributed to the reduction in sucrose accompanying to the increase in N level (Table 3). These results are in agreement with those reported by Abd-El-Hadi, *et al* (2002).

The interaction between planting densities and sugar beet varieties was the only interaction affecting purity % in the 1st season, where the highest value of this trait (88.35 %) was obtained by sowing Sultan variety at 46666 plants/fed.

5. Root yield:

Results collected in Table 5 clarified that sugar beet sown at 46666 plants/fed produced 1.733 and 2.570 tons/fed higher than that sown at 35000 plants/fed, in the 1st and 2nd seasons, respectively. However, the effect of planting densities on root yield reached the level of significance in the 2nd season only. These results are in agreement with those given by Ahmed (2003) and Sogut and Aroglu (2004).

The results showed that the tested sugar beet varieties varied significantly in root yield in both seasons. These results are in agreement with those reported by Saif (2000) and Al-Labbody (2003). Sugar beet variety Sultan produced the highest root yield/fed in comparison to the other varieties. It out-yielded Injermono, Helena and Baraca by 4.236, 2.435 and 1.969 tons/fed, in the 1st season, corresponding to 7.854, 6.762 and 7.220 tons/fed, in the 2nd one, respectively.

Table 5: Root yield (ton/fed) of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004				2004/2005			
		N levels, kg/fed (C)			Mean	N levels, kg/fed (C)			Mean
		60	80	100		60	80	100	
35000 plants/fed	Injermono	16.800	17.675	19.100	17.858	17.025	18.750	21.000	19.925
	Helena	15.275	17.725	19.500	17.500	17.150	19.000	20.000	19.717
	Sultan	18.100	18.375	21.180	19.218	19.650	22.225	27.350	23.075
	Baraca	16.500	18.710	19.420	18.210	17.400	18.975	21.000	19.125
Mean		16.669	18.121	19.800	18.197	17.806	19.738	22.337	19.960
46666 plants/fed	Injermono	15.040	17.310	16.000	16.117	16.600	19.225	20.500	18.775
	Helena	19.000	20.230	21.000	20.077	18.750	21.000	23.750	21.167
	Sultan	20.680	25.000	24.000	23.227	26.500	31.000	33.500	30.333
	Baraca	18.500	20.165	22.230	20.298	18.500	20.030	21.000	19.843
Mean		18.305	20.676	20.807	19.930	20.088	22.814	24.688	22.530
Interaction of (B) x (C)	Injermono	15.920	17.492	17.550	16.987	16.813	18.988	20.750	18.850
	Helena	17.137	18.977	20.250	18.788	17.950	20.000	21.875	19.942
	Sultan	19.390	21.688	22.590	21.223	23.075	26.613	30.425	26.704
	Baraca	17.500	19.438	20.825	19.254	17.950	19.503	21.000	19.484
Overall mean of N levels		17.487	19.399	20.304	19.063	18.947	21.276	23.512	21.245
LSD at 5% level (1st & 2nd season) for:		(A): NS - 1.354		(A) x (B): 2.087 - 1.049		(A) x (B) x (C): NS – NS			
		(B): 1.446 - 0.742		(A) x (C): NS - NS					
		(C): 1.278 - 0.642		(B) x (C): NS - 1.285					

This result could be due to higher values of root length and diameter recorded by Sultan variety (Tables, 1 and 2). The difference in growth characters as root length could be attributed to their gene make-up. Also, it is known that multi-germ varieties have greater growth vigor as compared with mono-germ ones. Also, no significant difference in root yield was detected between Baraca and Helena varieties, in the 2nd season.

Root yield was gradually and significantly increased by the applied N levels in both seasons. These results are in agreement with those reported by Chikov, *et al.* (2003). Raising N levels from 60 to 80 and from 80 to 100 kg N/fed increased root yield by 1.912 and 0.905 tons/fed, in the 1st season, corresponding to 2.329 and 2.236 tons/fed in the 2nd one, respectively. This result could be due to the increase in both root length and diameter (Tables, 1 and 2). In addition, insignificant difference in root yield could be noticed in case of applying 80 or 100 kg N/fed, in the 1st season.

Root yield was significantly affected by the interaction between planting densities and sugar beet varieties in both seasons. Sowing 46666 plants/fed of Sultan variety resulted in the highest root yield.

Root yield was significantly influenced by the interaction between sugar beet varieties and N levels in the 2nd season, where the highest root yield was produced by Sultan variety when it was fertilized with 100 kg N/fed.

6. Sugar yield:

Data in Table 6 showed that sowing sugar beet at 46666 plants/fed produced higher sugar yield/fed compared with 35000 plants/fed in both seasons. Sowing sugar beet at the higher densities increased sugar yield by 0.525 and 0.787 ton/fed, in the 1st and 2nd seasons, respectively, compared with the lower density. However, the effect of plant densities on sugar yield was significant in the 1st season only. These results are in agreement with those found by Ahmed (2003). This result could be due to higher values of sucrose %, purity % and root yield obtained at the higher planting densities (Tables 3, 4 and 5, respectively).

Table 6: Sugar yield (ton/fed) of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004 N levels, kg/fed (C) 60	80	100	Mean	2004/2005 N levels, kg/fed (C) 60	80	100	Mean
35000 plants/fed	Injermono	3.255	3.230	3.010	3.165	2.355	2.888	2.962	2.735
	Helena	2.731	2.864	2.976	2.857	2.689	2.570	2.471	2.577
	Sultan	3.665	3.300	3.238	3.401	3.693	3.438	3.757	3.629
	Baraca	3.956	2.955	2.749	2.887	2.957	2.825	2.833	2.872
Mean		3.152	3.088	2.993	3.077	2.924	2.930	3.006	2.953
46666 plants/fed	Injermono	3.043	3.165	2.447	2.885	2.757	2.925	2.679	2.787
	Helena	3.742	3.619	3.240	3.534	3.250	3.406	3.301	3.319
	Sultan	4.472	5.024	4.370	4.622	5.210	5.700	5.661	5.523
	Baraca	3.458	3.467	3.180	3.368	3.439	3.368	3.182	3.330
Mean		3.679	3.819	3.309	3.602	3.664	3.850	3.706	3.740
Interaction of (B) x (C)	Injermono	3.149	3.198	2.729	3.025	2.556	2.906	2.821	2.761
	Helena	3.236	3.241	3.108	3.195	2.969	2.988	2.886	2.948
	Sultan	4.068	4.162	3.408	4.012	4.451	4.569	4.709	4.576
	Baraca	3.207	3.211	3.965	3.128	3.198	3.096	3.008	3.101
Overall mean of N levels		3.415	3.453	3.151	3.340	3.294	3.390	3.356	3.346
LSD at 5% level (1st & 2nd season) for:	(A): 0.344 - NS		(A)x (B): 0.457 - 0.217			(A) x (B) x (C): NS – NS			
	(B): 0.323 - 0.182		(A) x (C): NS – NS						
	(C): NS - NS		(B) x (C): NS – NS						

Results cleared that sugar beet varieties differed significantly in sugar yield/fed in both seasons. These findings are in agreement with those found by Al-Labbody (2003). The sugar beet variety namely Sultan produced 1.077, 0.817 and 0.814 ton of sugar/fed higher than that of Injermono, Helena and Baraca varieties, in the 1st season and 1.815, 1.628 and 1.475 in the 2nd one, respectively. This result is probably due to its superiority with respect to sucrose %, purity % and root yield/fed (Tables 3, 4 and 5, respectively). Meantime, insignificant difference in sugar yield was found among Injermono, Helena and Baraca varieties, in the 1st season and/or between Helena and Baraca, in the 2nd one.

Sugar yield was insignificantly affected by the applied N levels in both seasons.

Among the possible interactions of the studied factors, sugar yield was significantly affected by the interaction between planting densities and sugar beet varieties, where the highest sugar yield was obtained from Sultan variety planted at 46666 plants/fed in both seasons.

7. Top yield:

Results in Table 7 showed that top yield was not significantly affected by the two plant densities in both seasons. Meanwhile, it could be noticed that sowing sugar beet at 46666 plants/fed resulted in higher top yield/fed than that of 35000 plants/fed.

The tested sugar beet varieties varied significantly in top yield/fed in both seasons. Sultan variety gave the highest top yield in both seasons, while Injermono and Baraca recorded the lowest top yield in the 1st and 2nd season, respectively. These results are in agreement with those reported by Al-Labbody (2003).

Table 7: Top yield (ton/fed) of the tested sugar beet varieties as affected by nitrogen levels and planting densities in 2003/2004 and 2004/2005 seasons.

Planting densities (A)	Sugar beet varieties (B)	2003/2004 N levels, kg/fed (C) 60	80	100	Mean	2004/2005 N levels, kg/fed (C) 60	80	100	Mean
35000 plants/fed	Injermono	6.900	8.250	8.700	7.950	5.050	6.300	6.900	6.083
	Helena	6.500	7.950	8.350	7.600	5.800	6.800	6.700	6.433
	Sultan	8.650	9.800	9.900	9.450	7.100	8.700	9.575	8.458
	Baraca	7.950	8.900	9.800	8.883	4.950	5.080	6.850	5.627
Mean		7.500	8.725	9.188	8.471	5.725	6.720	7.506	6.650
46666 plants/fed	Injermono	8.600	9.600	9.900	9.367	6.475	7.550	7.950	7.325
	Helena	6.900	8.625	9.600	8.375	6.100	7.525	7.950	7.192
	Sultan	9.050	10.225	10.800	10.025	8.100	8.550	9.925	8.858
	Baraca	8.930	10.025	10.500	9.818	7.050	7.500	8.150	7.567
Mean		8.370	9.619	10.200	9.396	6.931	7.781	8.494	7.735
Interaction of (B) x (C)	Injermono	7.750	8.925	9.300	8.658	5.763	6.925	7.425	6.704
	Helena	6.700	8.288	8.975	7.988	5.950	7.163	7.325	6.813
	Sultan	8.850	10.013	10.350	9.738	7.600	8.625	9.750	8.658
	Baraca	8.440	9.463	10.150	9.351	6.000	6.290	7.500	6.597
Overall mean of N levels		7.935	9.172	9.694	8.934	6.328	7.251	8.000	7.193
LSD at 5% level (1st & 2nd season) for:		(A): NS - NS			(A) x (B): NS - 0.239		(A) x (B) x (C): NS – NS		
		(B): 0.536 - 0.692			(A) x (C): NS – NS				
		(C): 0.464 - 0.185			(B) x (C): NS - 0.271				

Increasing N levels was accompanied with gradual and significant increase in top yield in both seasons. These results are in agreement with those reported by Gutmanski and Nowakowski (1994).

Concerning the various combinations between the studied factors, it could be observed that increasing N-level increased top yield/fed under the different examined varieties, meanwhile, this effect was significant in the 2nd season only.

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تأثر محصول وجودة بعض أصناف بنجر السكر بكثافة الزراعة والتسميد النيتروجيني

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اقيمت تجربتان حقليتان في محطة بحوث كوم اوشيم بمحافظة الفيوم خلال موسمي الزراعة ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥ لتقييم اربعة اصناف من بنجر السكر اثنين وحيدا الأجنة (انجرمونو وهيلينا) واخران عديدا الأجنة (سلطان وبركة) منزرعة بكثافتين (٣٥٠٠٠ و ٤٦٦٦٦ نبات/فدان) ومسمدة بثلاثة مستويات من النيتروجين (٦٠ ، ٨٠ و ١٠٠ كجم ن/فدان). استخدم تصميم قطع منشقة مرة واحدة في ثلاثة مكررات حيث خصصت القطع الرئيسية لكثافتي الزراعة في حين وزعت التوافقات بين أصناف بنجر السكر ومستويات التسميد النيتروجيني عشوائيا في القطع الشقية.

أوضحت النتائج أن زراعة بنجر السكر بكثافة ٤٦٦٦٦ نبات/فدان أدى الى نقص معنوى في طول الجذر (فى الموسم الأول) وزيادة معنوية لكل من النسبة المئوية للنقاوة ومحصول الجذور/فدان (في الموسم الثانى) ومحصول السكر (فى الموسم الأول) – فى حين لم يتأثر قطر الجذر و النسبة المئوية للسكروز ومحصول العرش بكثافة الزراعة في الموسمين.

تباينت الأصناف المختبرة معنويا واظهر الصنف سلطان تفوقا على الأصناف الاخرى في كل الصفات المدروسة في الموسمين.

ادت زيادة جرعة النيتروجين من ٦٠ وحتى ١٠٠ كجم ن/فدان الى زيادة معنوية في طول وقطر الجذر ومحصول الجذور و العرش – في حين انخفضت النسبة المئوية لكل من السكروز والنقاوة.

توصى الدراسة بزراعة بنجر السكر صنف سلطان بكثافة نباتية ٤٦٦٦٦ نبات/فدان مع اضافة ١٠٠ كجم ن/فدان للحصول على اعلى محصول وجودة وذلك تحت الظروف التى أجرى بها الدراسة.