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EFFECT OF NITROGEN; POTASSIUM FERTILIZER AND PLANT DISTRIBUTION PATTERNS ON YIELD AND QUALITY OF SUGAR BEET (*Beta vulgaris* l.)

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ABSTRACT

Two field experiments were planted during 2012/2013 and 2013/2014 growing seasons in the experimental farm of Sugar Crops Research Institute at sakha kafrelsheikh governorate, Egypt. Split plot design was used in both seasons, main plots were contained nitrogen and potassium fertilizers levels (75, 90 kg N and 24, 48 kg K_2O and combinations between them). Whereas, four plant distribution patterns were distributed in sub-plots (20 x 50 cm, 15 x 66 cm, 25 x 40 cm and 30 x 33 cm). Results obtained indicated that maximum root fresh weight, root and sugar yields were obtained when sugar beet was fertilized with high nitrogen and potassium levels (90 kg N and 48 kg K_2O/fed) and gave (2.430, 2.520 kg/plant; 36.41, 37.13 ton/fed and 6.47, 6.63 ton/fed) in both seasons, respectively. Whereas, the highest sucrose and total soluble solids and purity percentages were obtained with the lowest nitrogen level (75 kg N/fed.) and with the highest K levels (48 kg/fed.). On the other direction, all these best results were obtained with plant distribution patterns (20 x 50 cm), the space between hills and between ridges. These were true in both seasons. The highest nitrogen and potassium levels surprised the other levels because nitrogen and potassium encourage vegetative growth and increased sucrose accumulation in cells, whereas, patterns (20 x 50 cm) gave good growth by good leaf area which resulted from giving a good chance to plant to take sufficient sunlight which produced maximum carbohydrates and accumulation sucrose in roots.

INTRODUCTION

Several researches were carried out to determine the optimum dose from nitrogen and potassium because these two elements affected on yield and quality of sugar beet. If these two elements take over dose, quality of sugar beet well decrease and distribution of plants is very important to give maximum yield and quality. So, this work was carried out to determine the optimum levels of N and K with suitable plants distribution patterns of sugar beet to give a good yield and quality of sugar beet.

Several works were carried out by Ali (2012). He found that applying 140 kg N/fed. to sugar beet gave the highest root fresh weight, root yield, whereas adding 100 kg N/fed. gave the highest purity % in both seasons. Moustafa *et al*. (2011) concluded that increasing N rate to 100 kg/fed. significantly increased root and sugar yield per feddan.

Franzen (2003) reported that increasing nitrogen fertilizer reduced sucrose % but increased root yield and root impurities. Cai and Ge (2004) found that nitrogen content in root was positive correlated with nitrogen amount which used. Neameat Alla *et al*. (2002) concluded that increasing nitrogen soil application up to 90 kg/fed. as urea, significantly increased root, sugar yield/fed.

El-Hawary (1999) showed that increasing potassium fertilizer application up to 48 kg K_2O/fed. caused significant increase in root, sugar yield by 24.27 and 28.57% as well as 12.97 and 15.08% in both seasons, respectively. Neseim *et al*. (2014) reported that applications of 100 kg K_2O/fed. gave the highest root and sugar yields. Mohamed (2014) showed that increasing potassium levels from 0 to 12, 24, 36 and 48 K_2O/fed. as soil applications significantly increased root fresh weight, root and sugar yields. Fathy *et al*. (2009) concluded that increasing potassium fertilizer up to (114 kg/ha K_2O) caused a significant increase in sucrose content, sugar yield. Abo Shady *et al*. (2010) reported that application of 48 kg K_2O/fed. led to significant increase in sucrose percentage and sugar yield (ton/fed.). Mahdi *et al*. (2012) applied potassium fertilizer to sugar beet by 0, 50 and 100 kg K_2O/fed. They found that root and sugar yields as well as sucrose and purity percentages were significantly increased.

Plant density or plant distribution had important effective role for sugar beet. Abd El-Hafeez *et al*. (1984) concluded that hill space between plants (15 cm) gave significant differences in root, sugar yields and sucrose % compared to 20 cm between plants. Nassar (2001) concluded that increasing plant density from 35000 to 70000 plants/fed. was accompanied with reduction in sucrose content purity and root fresh weight. On the other direction, root and sugar yields were maximized with plant density of 42000 plants/fed. Kamel *et al*. (1981) reported that increasing distance between rows up to 60 cm significantly increased root fresh weight, root and sugar yields. On the other direction, sucrose and purity percentages were significantly decreased compared to other wide row (30 and 45 cm). Abo El-Wafa (2002) and Mahmoud *et al*. (1999) concluded that space between hills (30 and 20 cm) was very effective on root weight, root and sugar yields/fed., purity and TSS percentages.

El-Shafai (2000) used N rates (0, 46 and 92 kg N/fed.) and K_2O rates (0, 24, and 48 kg K_2O/fed.). He reported that nitrogen up to 92 kg/fed. increased root fresh weight, root, sugar yields, while sucrose % depleted. Increasing K levels due to increasing in sucrose %, while purity % and root yield not affected by N or K additions.

So, the object of this study was to study effect of nitrogen and potassium fertilizers and plant distribution patterns on sugar beet yield and quality,

MATERIALS AND METHODS

Two field experiments were carried out at Experimental Farm of Sugar crops Research Institute at sakha kafrelsheikh governorate during two successive seasons 2012/2013 and 2013/2014. A split-plot design was used in both seasons. Main plots were containing nitrogen and potassium fertilizer levels and their combinations as (0, 24, and 48 kg K_2O/fed. 75, 90 kg N/fed..); (75 kg N + 24 kg K_2O/fed.; 75 kg N + 48 K_2O kg/fed. + 90 kg N + 24 kg K_2O/fed. + 90 kg N + 48 kg K_2O/fed.). While four plant distributions patterns were arranged in sub plots as (plant space x wide ridge) (15 x 66; 20 x 50; 25 x 40 and 30 x 33 cm). We must take attention that every plant having equal land area mostly in all treatments but different in their distribution. Seeds of sugar beet were sown at the first two weeks from September at both seasons.

Sugar beet cultivar "Farida" was used in both seasons. Each experimental basic unit area containing five ridges. Potassium fertilizer levels were added before land preparation, whereas, nitrogen was applied at two equal doses; the first was added after thinning and the second half was giving to plants after one month later from the first one. Calcium super phosphate (15.5% P_2O_5) was applied at rate of 100 P_2O_5 kg/fed. during land preparation.

Plants were thinned at four leaf stages to one plant per hill. Nitrogen was added in the form of urea 46.5% N). All normal agricultural practices were done with exception of treatments under study. At harvest five roots were taking at randomly after 210 days from sowing to determine yield and quality parameters:

1. Root fresh weight (g/plant)
2. Root yield (ton/fed.)
3. Sucrose %
4. Sugar yield (ton/fed.)
5. Total soluble solids % T.S.S.
6. Purity % = Sucrose%/T.S.S x 100

Statistical analysis:

Data collected from experiments through two seasons were analyzed according to the technique of analysis of variance (A.O.V) of the split-plot design which recorded by Gomez and Gomez (1984) using of (MSTAT-C) computer software package. Least significant differences (LSD) was used to compare means of treatments at 5% levels of probability as described by Waller and Duncan (1969).

RESULTS AND DISCUSSION

Yield and yield attributes:

Root fresh weight (g/plant):

From Table (1), it can be noticed that in the first season, addition potassium from zero to 48 kg K_2O/fed. root fresh weight significantly increased until 932 g/plant, also, the same trend was found with application of nitrogen when increased it levels from 75 to 90 kg N/fed. with every one alone until 1670 g/plant, whereas, when they applied together with any level recorded significant increase more than every one alone. The highest value of root fresh weight were recorded in both seasons (2430 and 2520 g/plant) with application of (90 kg N + 48 kg K_2O/fed.). These results due to the role of both K and N for increase cell division and increase in growth rate in root and essential roles of potassium in increase photosynthesis and increase in water uptake and water content in root causing increase in root fresh weight. All of these data were found when sugar beet plants were distributed in patterns (20 x 50 cm) compared with other patterns which recorded low values. This was true in both seasons. The patterns of 20 x 50 cm advantaged than other patterns because plants not crowded and the competition for light and soil nutrients not strong compared to other patterns having narrow area between planting resulted from narrow space between hills or narrow ridges which increase the competition between plants and due to significant decrease in root fresh weight (Ali, 2012 and Moustafa *et al*., 2011). Concluded that N fertilizer had significant effect on increasing root fresh weight/plant. Nassar (2001) showed that high density reduced root fresh weight/plant. Kamel *et al*. (1981) and Abo El-Wafa (2002) found similar effect for density on root fresh weight.

Significant interaction effects were found between (nitrogen + potassium) and distribution patterns in both seasons. Sugar beet fertilized with high nitrogen dose (90 kg) and high potassium level (48 kg K_2O/fed.) and planted at distribution patterns (20 x 50 cm) gave the highest value for character under study and gave root fresh weight (2430 and 2520 g/plant in both seasons, respectively).

Table (1): Average of root fresh weight/plant (g) as affected by plant distribution patterns and fertilization treatments as well as their interaction in 2012/2013 and 2013/2014 seasons.

Fertilization treatments (kg/fed.)	2012/2013					2013/2014				
	Plant distribution patterns					Plant distribution patterns				
	15x 66 cm	20 x50 cm	25x 40 cm	30x33 cm	Mean	15x 66 cm	20x 50 cm	25x 40 cm	30 x33 cm	Mean
Control	430	610	552	420	503	510	673	595	492	567
24 K_2O	752	852	763	714	772	693	867	689	579	707
48 K_2O	767	932	890	742	832	794	966	873	639	818
75N	995	1230	1131	963	1079	876	1311	1175	793	1038
90N	1260	1670	1530	1120	1395	1285	1720	1506	1101	1403
75N+24 K_2O	1220	1560	1473	1200	1363	1196	1591	1442	1099	1332
75N+48K_2O	1400	1931	1690	1370	1597	1366	1695	1614	1288	1490
90N+24 K_2O	1530	1996	1735	1480	1685	1601	2010	1830	1470	1727
90N+48 K_2O	1620	2430	2300	1595	1986	1713	2520	2410	1688	2082
Mean	1108	1468	1340	1067	1245	1114	1483	1348	1016	1240
L.S.D. for										
Plant distribution (A)	13.0					15.0				
Fertilization (B)	22.0					23.0				
Interaction (A x B)	41.0					44.0				

Root yield (ton/fed.):

Data tabulated in Table (2) showed that neither all nitrogen nor potassium levels alone gave the highest root yield (ton/fed.) but when they added together as (90 kg N + 48 kg K_2O/fed.) gave the highest root yield in both seasons (36.41 and 37.13 ton/fed.) compared to root yield of nitrogen alone (25.17 and 24.96 ton/fed.) and with potassium alone was (19.66 and 21.10 ton/fed.). Similar results were obtained by Fathy *et al*. (2009) and Abo-Shady *et al*. (2010). They concluded that with increasing potassium levels up to 48 kg K_2O/fed. caused a significant increase in root yield. In the same trend several investigators observed that with increasing nitrogen dose to sugar beet up to 100 kg N/fed. Gave a significant increase in root yield (ton/fed.) as Neseim *et al*. (2014), Ali (2012), and Franzen (2003).

Table (2): Average of root yield (ton/fed.) as affected by plant distribution patterns and fertilization treatments as well as their interaction in 2012/2013 and 2013/2014 seasons.

Fertilization treatments (kg/fed.)	2012/2013					2013/2014				
	Plant distribution patterns					Plant distribution patterns				
	15x 66 cm	20x 50 cm	25x 40 cm	30 x33 cm	Mean	15x 66 cm	20 x50 cm	25x 40 cm	30 x33 cm	Mean
Control	13.56	14.63	14.32	13.14	13.91	14.01	15.33	15.00	13.66	14.50
24 K_2O	17.23	18.52	17.95	16.11	17.45	16.32	19.10	18.22	14.95	17.14
48 K_2O	18.72	19.66	19.33	17.21	18.73	19.20	21.10	18.55	16.85	18.92
75N	19.75	22.35	21.16	18.15	20.35	20.66	23.14	22.70	19.33	21.45
90N	23.00	25.17	24.72	19.33	23.05	22.94	24.96	24.60	21.96	23.61
75N+24 K_2O	24.13	25.79	25.11	21.18	24.05	23.14	26.0	25.82	22.36	24.33
75N+48K_2O	26.00	27.44	26.76	23.14	25.83	26.15	28.00	27.18	24.17	26.37
90N+24 K_2O	26.77	30.15	29.81	25.73	28.11	27.51	31.71	30.66	26.31	29.04
90N+48 K_2O	32.51	36.41	35.16	26.99	32.76	33.10	37.13	36.80	30.61	34.41
Mean	22.40	24.45	23.81	20.10	22.69	22.55	25.16	24.39	21.13	23.30
L.S.D. for										
Plant distribution (A)	1.11					0.99				
Fertilization (B)	1.42					1.25				
Interaction (A x B)	2.13					2.51				

Regarding to root yield as affected by plant distribution patterns results in Table (2) showed that planting sugar beet by pattern 20 cm between plants and 50 cm width of ridges progressive than other patterns and gave the highest root yield (ton/fed.) in both seasons (36.41 and 37.13 ton/fed.). This was true in both seasons. Mahmoud *et al*. (1999) concluded that space hills between plants 20 cm gave the highest root yield.

The interaction between nitrogen and potassium fertilizer levels and plant distribution patterns was significant in both seasons. Maximum root yields were obtained (36.41 and 37.13 ton/fed.) resulted from the interaction between (90 kg N + 48 kg K_2O/fed.) x (20 x 50 cm) plant pattern. This was true in both seasons.

Sugar yield (ton/fed.):

Regarding the effect of nitrogen and potassium on root yield (ton/fed.) data presented in Table (3) cleared that maximum values were obtained from high level of potassium and nitrogen alone (3.97 and 4.27 ton/fed.) and (4.02 and 4.13 ton sugar/fed.) in both seasons, respectively. On the other hand, when all of potassium and nitrogen was added together at the highest levels (90 kg N + 48 kg K_2O/fed.) gave the highest sugar yield in both seasons (6.47 and 6.63 ton/fed.). These results attributed to the highest root yield with suitable sucrose content. Similar observations were found by Moustafa *et al*. (2011) and Neameatalla *et al*. (2002).

Table (3): Average of sugar yield (ton/fed.) as affected by plant distribution patterns and fertilization treatments as well as their interaction in 2012/2013 and 2013/2014 seasons.

Fertilization treatments (kg/fed.)	2012/2013					2013/2014				
	Plant distribution patterns					Plant distribution patterns				
	15x 66 cm	20 x50 cm	25x40 cm	30x33 cm	Mean	15x 66 cm	20 x 50 cm	25x 40 cm	30 x33 cm	Mean
Control	2.34	2.54	2.48	2.17	2.38	2.37	2.56	2.47	2.22	2.40
24 K_2O	3.33	3.55	3.42	2.95	3.31	3.15	3.68	3.47	2.78	3.27
48 K_2O	3.77	3.97	3.88	3.39	3.75	3.88	4.27	3.72	3.33	3.80
75N	3.39	3.84	3.58	3.00	3.44	3.55	3.98	3.85	3.27	3.66
90N	3.70	4.02	3.91	3.02	3.66	3.90	4.13	3.99	3.55	3.89
75N+24 K_2O	4.25	4.52	4.35	3.53	4.16	4.11	4.55	4.45	3.86	4.24
75N+48K_2O	4.48	4.87	4.67	3.96	4.49	4.72	5.03	4.79	4.23	4.69
90N+24 K_2O	4.77	5.31	5.16	4.38	4.90	4.92	5.64	5.44	4.63	5.15
90N+48 K_2O	5.88	6.47	6.17	4.67	5.79	5.94	6.63	6.56	5.42	6.13
Mean	3.99	4.32	4.17	3.45	3.99	4.06	4.49	4.30	3.69	4.14
L.S.D. for										
Plant distribution (A)	0.21					0.14				
Fertilization (B)	0.40					0.49				
Interaction (A x B)	0.70					0.62				

Planting sugar beet at pattern 20 cm between hills and wide ridge 50 cm was a good pattern for planting sugar beet compared to other three patterns which gave the highest sugar yield in both seasons. These pattern enhancing sugar beet to become vigour and reduced the competition between plants in Table (3).

These results are in harmony with those obtained by Nassar (2001) and Kamel *et al*. (1981). They showed that planting sugar beet at space hills 20 cm between plants gave maximum sugar yield compared to other space hills.

There was significant effect due to the interaction between two factors under study on sugar yield (ton/fed) in both seasons. The highest sugar yield was obtained (6.47 and 6.63 ton/fed.) when potassium at rate 48 kg/fed. was mixed with 90 kg N/fed. and planting at hill space 20 cm on wide ridge 50 cm compared with other potassium, nitrogen fertilizers and distribution patterns under study.

Quality:

Sucrose percentage:

With respect to effect of nitrogen and potassium fertilizers on sucrose percentage, the results in Table (4) clearly indicated that all of two fertilizers having reflected effect on sucrose %. Increasing nitrogen level up to 90 kg/fed. gave the lowest values (15.22 and 16.17%) in both seasons, respectively. On the other direction increasing potassium fertilizer up to 48 kg/fed. recorded the highest sucrose % in both seasons (20.21 and 20.27%). Whereas, with addition potassium and nitrogen with any rate from two fertilizers failed to gave the highest sucrose% in both seasons. These results due to the differences between mode of action for two elements, the high rate of growth root and water content resulted from nitrogen fertilizer is more than rate of sucrose accumulation by potassium. The above mentioned results are in agreement with those obtained by Franzen (2003), and Cai and Ge (2004). They stated that increasing nitrogen rate caused a decrease sucrose %. Whereas, El-Hawary (1999) reported that with increasing K_2O/fed. up to 48 kg K_2O/fed. significantly sucrose % was increased.

With concern the effect of plant distribution patterns on sucrose %, the results in Table (4) illustrated that pattern having 20 cm between hills and 50 cm width ridge gave a good chance to plants to synthetic sucrose with high content more than any treatmen had increased competition between plants which led to decrease sucrose accumulation in roots. This was true under any nitrogen or potassium levels in both seasons. The positive effect of space hills and wide ridges on sucrose % was demonstrated by Abd El-Hafeez (1984) and Kamel *et al*. (1981).

Table (4): Average of sucrose percentage as affected by plant distribution patterns and fertilization treatments as well as their interaction in 2012/2013 and 2013/2014 seasons.

Fertilization treatments (kg/fed.)	2012/2013					2013/2014				
	Plant distribution patterns					Plant distribution patterns				
	15x66 cm	20x50 cm	25x40 cm	30x33 cm	Mean	15x66 cm	20x50 cm	25x40 cm	30x33 cm	Mean
Control	17.33	17.38	17.36	16.56	17.15	16.95	16.76	16.47	16.31	16.62
24 K_2O	19.33	19.21	19.10	18.33	18.99	19.36	19.31	19.07	18.66	19.10
48 K_2O	20.14	20.21	20.11	19.73	20.04	20.21	20.27	20.10	19.79	20.09
75N	17.13	17.19	16.72	16.53	16.89	17.33	17.21	17.00	16.93	17.11
90N	16.13	15.99	15.22	15.66	15.90	17.02	16.55	16.23	16.17	16.49
75N+24 K_2O	17.63	17.55	17.36	16.71	17.31	17.77	17.52	17.27	16.96	17.38
75N+48K_2O	17.95	17.76	17.47	17.13	17.57	18.05	17.79	17.63	17.51	17.79
90N+24 K_2O	17.83	17.64	17.31	17.05	17.45	17.91	17.81	17.76	17.61	17.77
90N+48 K_2O	18.01	17.77	17.56	17.33	17.71	17.96	17.87	17.83	17.71	17.84
Mean	17.94	17.85	17.64	17.22	17.66	18.06	17.91	17.71	17.52	17.80
L.S.D. for										
Plant distribution (A)	0.13					0.11				
Fertilization (B)	0.30					0.27				
Interaction (A x B)	0.63					0.54				

Regarding the interaction effect for two factors under study. Table (4) indicated that significant interaction effect on sucrose % was found in both seasons. Fertilization sugar beet with 48 kg K_2O gave the highest sucrose percentage (20.21 and 20.27%), which cultivated with hill space 20 cm wide ridge 50 cm compared to other treatments under this study.

Total soluble solids (TSS):

Averages of total soluble solids as affected by nitrogen and potassium rates were presented in Table (5) which showed that this trait correlated with sucrose % and take the same trend because sucrose is one of ingredients of TSS. Potassium fertilizer playing the major role for increasing total soluble solids resulted from increasing sucrose content. Mixing potassium and nitrogen fertilizers take the second grade for effective on TSS. While, nitrogen alone take the last grade for effective on TSS. Abo El-Wafa (2002) showed that increasing nitrogen rate from 60 to 80 kg/fed. significantly decrease total soluble solids%. On the other direction, Ouda (2000) found that no significant effect on TSS from nitrogen rate. Nemeat Alla *et al.* (2002) found similar results. El-Shafai (2000) found that TSS percentage not affected by K application.

Table (5): Average of total soluble solids percentage as affected by plant distribution patterns and fertilization treatments as well as their interaction in 2012/2013 and 2013/2014 seasons.

Fertilization treatments (kg/fed.)	2012/2013					2013/2014				
	Plant distribution patterns					Plant distribution patterns				
	15x 66 cm	20x 50 cm	25x 40 cm	30 x33 cm	Mean	15x 66 cm	20x 50 cm	25x 40 cm	30 x33 cm	Mean
Control	21.75	21.45	21.56	21.66	21.60	21.57	21.17	21.33	21.47	21.38
24 K_2O	23.99	23.66	23.77	23.81	23.80	23.93	23.73	23.84	23.62	23.78
48 K_2O	24.86	24.41	24.46	24.66	24.59	24.51	24.20	24.45	24.61	24.44
75N	22.67	22.33	22.42	22.56	22.49	22.51	22.11	22.43	22.60	22.41
90N	21.76	21.37	21.53	21.70	21.59	22.17	21.41	21.66	21.85	21.77
75N+24 K_2O	22.95	22.19	22.61	22.83	22.64	22.76	22.09	22.66	22.71	22.55
75N+48K_2O	23.14	22.36	22.53	22.71	22.68	23.05	22.60	22.72	22.80	22.79
90N+24 K_2O	22.33	22.01	22.26	22.30	22.22	22.94	22.53	22.91	22.95	22.83
90N+48 K_2O	22.53	22.16	22.40	22.51	22.46	22.95	22.55	22.81	22.83	22.78
Mean	22.89	22.43	22.61	22.75	22.67	22.93	22.49	22.76	22.83	22.75
L.S.D. for										
Plant distribution (A)	0.15					0.25				
Fertilization (B)	0.73					0.67				
Interaction (A x B)	0.96					0.99				

The interaction between nitrogen + potassium fertilizers and plant distribution patterns had significant effect on total soluble solids in both seasons as shown in Table (5). The highest values in both seasons were (24.66 and 24.61%) resulted from addition high potassium rate (48 kg K_2O/fed.) with planting distribution pattern of (30 x 33 cm).

Purity percentage:

Purity percentage as affected by nitrogen and potassium fertilizers during growing seasons 2012/2013 and 2013/2014 are shown in Table (6). Significant differences were observed between mean values of purity percentage in both seasons due to effect of application of 48 kg K_2O/fed. These were true in both seasons and gave the highest values (82.79 and 83.76%), whereas, nitrogen effects on this trait were less than effect of potassium in both seasons. The combination between N + K gave the highest values more than effect of nitrogen alone. These results are similar to that found by Basha (1994) who reported that applied 100 kg K_2O increased purity %. On the other hand, El-Shafai (2000) found that neither N nor K fertilizer affected on purity %.

Table (6): Average of purity percentage as affected by plant distribution patterns and fertilization treatments as well as their interaction in 2012/2013 and 2013/2014 seasons.

Fertilization treatments (kg/fed.)	2012/2013					2013/2014				
	Plant distribution patterns					Plant distribution patterns				
	15x 66 cm	20x 50 cm	25x 40 cm	30 x33 cm	Mean	15x 66 cm	20x 50 cm	25x 40 cm	30 x33 cm	Mean
Control	79.96	81.00	80.51	76.45	79.48	78.58	79.16	77.21	75.96	77.72
24 K_2O	80.57	81.19	80.35	76.85	79.74	80.90	81.37	79.99	79.00	80.33
48 K_2O	81.01	82.79	82.21	80.00	81.50	82.45	83.76	82.20	80.41	82.20
75N	75.56	76.98	74.64	73.27	75.11	76.98	77.83	75.79	74.91	76.37
90N	74.12	74.82	73.47	72.16	73.64	76.77	77.30	74.93	74.00	75.75
75N+24 K_2O	76.81	79.08	76.78	73.19	76.46	78.07	79.31	76.21	74.68	77.06
75N+48K_2O	77.57	79.42	77.54	75.44	77.49	78.30	79.50	77.59	76.79	77.99
90N+24 K_2O	79.88	80.01	77.76	76.45	78.52	78.07	79.05	77.52	76.73	77.84
90N+48 K_2O	79.93	80.18	78.39	76.98	78.87	78.25	79.24	78.16	77.57	78.30
Mean	78.39	79.49	77.96	75.64	77.86	78.71	79.61	77.73	76.67	78.17
L.S.D. for										
Plant distribution (A)	0.43					0.23				
Fertilization (B)	1.09					0.85				
Interaction (A x B)	1.20					0.98				

Regarding to effect of planting distribution patterns on purity%, pattern having 20 x 50 cm between hills and wide ridge, respectively gave the highest values of purity under potassium or nitrogen alone or the combinations between them. In this connection, Kamel *et al*. (1981) reported that significant decrease in purity % was found with increasing row spacing up to 60 cm.

Respecting the interaction effect between two factors under study (fertilization x plant distribution patterns) on purity percentage, significant effects were found in both seasons on purity%. Potassium fertilizer level 48 kg/fed. with planting by pattern 20 x 50 cm (hill space x wide ridge) gave the highest purity percentage in both seasons (82.79 and 83.76%). On the other direction, nitrogen fertilizer with planting distribution patterns to 20 x 50 and 25 x 40, respectively gave the lowest values (74.82 and 74.93%). Whereas, the combination between potassium and nitrogen fertilizers gave middle values between maximum and lowest values because potassium intered in this combined than nitrogen alone which gave the lowest ones.

REFERENCES

Abd El-Hafeez, A.A.; H.S. Osman; N.F. Dawla and A.F. Abdalla (1984). Effect of population on some sugar beet varieties. Bull. Fac. of Agric., Univ. of Cairo, Vol. 35, No. 1 (1984).

Abo-El-Wafa, A.M. (2002). Effect of plant spacing, nitrogen rates and its quality on yield and quality of Kawemira sugar beet variety under Egypt conditions. J. Agric. Sci., Mansoura Univ., 27(2): 707-716.

Abo-Shady, K.A.; S.M.M. Hilal; E.M. El-Sheref and M.F.M. Ibraheim (2010). Yield and quality of sugar beet crop as affected by irrigation intervals, cultivars and potassium fertilization in North Delta. J. Agric. Res., Kafr El-Sheikh Univ., 36(4): 361-376.

Ali, A.A. Al-Mekdad (2012). Response of yield and quality of some sugar beet varieties (*Beta vulgaris*, L.) to plant density and nitrogen fertilizer under new reclaimed soil conditions. M.Sc. Agron. Dept., Fayoum Univ.

Basha, M.A. (1999). Response of two sugar beet cultivars to level and method of nitrogen application in sandy soil. Zagazig. J. Agric. Res., 26(1): 1-26.

Cai Baiyan and Ge Jingping (2004). The effect of nitrogen level on main nutrient of sugar beet. Nature and Science, 2(4): 79-83.

El-Hawary, M.A. (1999). Influence of nitrogen, potassium and boron fertilizer levels on sugar beet under saline soils condition. J. Agric. Sci., Mansoura Univ., 24(4): 1573-1581.

El-Shafai, A.M.A. (2000). Effect of nitrogen and potassium fertilization on yield and quality of sugar beet in Sohag. Egypt. J. Agric. Res., 78(2): 759-767.

Fathy, M.F.; A. Motagally and K.K. Attia (2009). Response of sugar beet plants to nitrogen and potassium fertilization in sandy calcareous soil. Int. J. Agric. Biol., 11: 695-700.

Franzen, A.H. (2003). Fertilizing sugar beet. North Dakota State University Fargo, North Dakota, 58105.

Gomez, K.N. and A.A. Gomez (1984). Statistical procedures for agricultural research. John Wiley and Sons, New York, 2nd ed., 68.

Kamel, M.S.; M.M.F. Abdalla; E.A. Mahmoud and I.K. Obead (1981). Growth, yield and quality of two sugar beet cultivars as affected by row and hills spacing. Bull. Fac. of Agric., Cairo Univ., Vol. 32.499-519

Mahdi, M.; M.J. Moeini and Armin (2012). Sugar beet (*Beta vulgaris* L.) response to potassium application under full and deficit irrigation. Euro. J. Exb. Bio., 2(6): 2113-2119.

Mahmoud, E.A.; M.A. El-Metwally and M.E.M. Gobarh (1999). Yield and quality of some nitrogen sugar beet as affected by plant densities and nitrogen levels. J. Agric. Sci. Mansoura Univ., 24(9): 4499-4516.

Moustafa, Z.R.; A.M.K. Soudi and E.M. Kalil, (2011). Productivity and quality of sugar beet as influence by nitrogen fertilizer and some micronutrients. Egypt. J. Agric. Res., 89(3): 320-331.

Nassar, A.M. (2001). Effect of plant density on the productivity of some sugar beet varieties. J. Agric. Sci. Mansoura Univ., 26(12): 7533-7546.

Nemeat Alla, E.A.E.; A.A.E. Mohamad and S.S. Zalat (2002). Effect of soil and foliar application of nitrogen fertilization on sugar beet. J. Agric. Sci. Mansoura Univ., 27(3): 1343-1351.

Neseim, M.R.; A.Y. Amin and M.M.S. El-Mohamady (2014). Effect of potassium applied with foliar spray yeast on sugar beet growth and yield under drought stress. Global Advantage Res. J. of Agric. Sci., 3(8): 211-222.

Ouda, Soheir, M. (2000). Effect of nitrogen fertilization with micronutrients on yield and quality of sugar beet in yield and quality of sugar beet in newly reclaimed land. Zagazig J. Agric. Res., 27(I): 1-12.

Waller, R.A. and D.B. Duncan (1969). A bays role for the symmetrical multiple comparison problem. Ann. State Assoc. J. December, 1496-1503.

تـأثير السـماد النتروجينـى والبوتاسـى ونظـم توزيـع النباتـات علـى محصـول وجـودة بنجر السكر

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أقيمت تجربتـان حقليتـان فـى الموسـمين الزراعيين (٢٠١٢/٢٠١٣ ، ٢٠١٣/٢٠١٤) فـى المزرعـة البحثية لمعهد بحوث المحاصيل السكرية فى محطة بحوث سخا كفر الشيخ ـ ج.م.ع وذلك بهدف دراسـة تـاثير السماد النتروجينى والبوتاسى وكذلك نظم توزيع النباتات داخل مساحة واحدة لكل نبات على محصول وجودة بنجر السكر. وقد استخدم التصميم الاحصائى القطع المنشقة مرة واحدة فى هذا البحث حيث تم إختبار معدلين من السماد النتروجينى (٩٠،٧٥ كجم ن/ف) وكذلك ثلاث معاملات من السماد البوتاسى (صفر ـ ٢٤ ـ ٤٨ كجم بو٢أ/ف) وتوليفات بينهم بينما تم وضع أربعة نظم توزيع النباتـات فـى القطـع الشقية وهـى (١٥ × ٦٦ سم ، ٢٠ × ٥٠ سم ، ٢٥ × ٤٠ سم ، ٣٠ × ٣٣سم).

وكان من أهم النتائج المتحصل عليها الآتى:

١- أدت زيادة معدل السماد النتروجينى بمعدلات مرتفعة حتى ٩٠ كجم/ف وكذلك السماد البوتاسى من صفر حتـى ٤٨ كجـم بـو٢أ/ف إلـى زيـادة معنويـة فـى وزن الجـذور الغـض ومحصـول الجـذور والسـكر عنـد مقارنتهم بالمعاملات الأخرى فى كل من الموسمين ، كما كان لنظام توزيع النباتات المستخدم ٢٠سم بين الجور × ٥٠ سم عرض الخط إلى زيادة معنوية فى محصول الجذور والسكر فى كل من الموسمين. وكان هناك تفاعلا معنويا بين عاملى الدراسة مع الوزن الغض للجذور (جم/نبات) ومحصول الجذور بالطن/ف وكذلك محصول السكر بالطن/ف.

٢- كان لإضافة السماد النتروجينى لمحصول بنجر السكر بمعدلات مرتفعة حتى ٩٠ كجم ن للفدان تأثيرا سلبيا على نسبة السكروز بالنقص ونسبة المواد الصلبة الذائبة الكلية وكذلك النقاوة بينما كان لإضافة السماد البوتاسى تأثيرا موجبا فى زيادة نسبة السكر وذلك بزيادة معدل الإضافة من صفر حتى ٤٨ كجم بو٢أ/ف وكذلك زيادة معنوية فى كل من نسبة المواد الصلبة الذائبة الكلية والنقاوة للعصير فى كل من الموسمين.

٣- أدى نظام توزيع النباتات إلى تأثير معنوى موجب فى زيادة نسبة السكروز وكذلك نسبة المواد الصلبة الذائبة الكلية ونقاوة العصير وذلك عندما استخدم نظام توزيع النباتات فى الحقل بنظام كانت المسافة بين النباتات ٢٠ سم وعرض الخط المنزرع عليه البنجر ٥٠ سم إذا ماقورنت نتائج هذا النظام بنتائج النظم الأخرى المستخدمة فى هذه الدراسة وذلك من خلال موسمى الزراعة.

٤- أما التفاعل بين عاملى الدراسة وتأثيره على نسبة السكروز والمواد الصلبة الذائبة الكلية وكذلك النقاوة فقد كان هناك تفاعلا معنويا موجبا ناتجا عن تأثير إضافة السماد البوتاسى بمعدل ٤٨ كجم بو٢أ/ف ونظام توزيع النباتات ٢٠ × ٥٠ سم على زيادة معنوية فى نسبة السكروز والمواد الصلبة الذائبة وكذلك نقاوة العصير فى موسمى الزراعة.

٥- كان التفاعل موجبا عندما تم إضافة السماد النتروجينى مع البوتاسى معا والزراعة بين النباتات على مسافة ٢٠ سم وعرض الخط ٥٠ سم فى معظم الصفات تحت الدراسة إذا ما قورنت بإضافة أى من السمادين النتروجينى أو البوتاسى منفردا وبقية نظم توزيع النباتات الأخرى تحت الدراسة.