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EFFECT OF NITROGEN AND POTASSIUM FERTILIZATION ON YIELD AND QUALITY OF SUGAR BEET IN SOHAG

A.M.A. EL-SHAFAI

Sugar Crops Res. Inst. Agric. Res. Center. Giza.

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Abstract

Two field trials were carried out at Shandaweel Rescarch Station (Sohag Governorate) in the two successive growing seasons of 1997/ 1998 and 1998/1999 to study the effect of nine treatments representing the combinations between three nitrogen levels (0,46 and 92 kg N/ fed) and three potassium levels (0,24 and 48 kg K_2O/fed) on yield and quality of sugar beet variety Del. 939. A complete randomized block design in four replications was used. The obtained results showed that increasing N-level up to 92 kg N/fed increased root fresh weight/plant. root and sugar yield significantly while sucrose percentage decreased. Increasing K-level from zero to 48 kg K_2O/fed positively increased root fresh weight/plant, sugar yield and sucrose percentage. Root yield insignificantly inceased as K-level increased up to 48 kg K_2O/fed. Purity percentage was not significantly affected by the applied levels of N and K fertilizers.

INTRODUCTION

It was observed that growers extremely apply nitrogen fertilizer to sugar beet because they deliver it to sugar factories on tonnage basis and sucrose% regardless of the reversible effect of nitrogen over doses on beet quality characteristics. Also. it was noticed that they are not aware of the importance of potassium for beet quality. Therefore, it was necessary to apply variable NK levels to find out the optimal combination resulting in the maximum yield and quality of sugar beet which was recently introduced to Sohag Governorate as a complementary sugar crop to narrow the gap between the consumed and produced sugar averaged 0.6 million ton/year. Many investigations proved that sugar beet yield and quality are greatly influenced by the applied levels of nitrogen and potassium fertilizers. Basha (1994) fertilized sugar beet with K fertilizer at rates of 25, 50, 75 and 100 K_2O/fed. He noticed that applying 100 kg K_2O/fed increased significantly root weight/plant, root yield, sucrose and purity percentages. Besheit et al. (1994) applied three N rates (100, 125 and 150 kg/fed) to sugar beet. They observed that the highest N rate significantly increased individual

root weight/plant, root and sugar yields/fed and reduced sucrose and purity percentages. Moustafa (1996) reported that root weight/plant, sugar yields/fed and sucrose percentage were not significantly affected by nitrogen levels. He added that the increase in K level up to 48 K_2O/fed significantly increased weight of root and root yield/fed. Ibrahim (1998) applied five N levels (0,25, 50,75 and 100 kg/fed) and three K levels (0, 24 and 48 kg K_2O/fed) to sugar beet. He found that increasing N-dose up to 100 kg/fed gave a significant increase in root fresh weight/plant, root and sugar yields while sucrose and purity percentages were significantly decreased. He added that root fresh weight, sucrose and purity percentages, root and sugar yields increased significantly with increasing K-level up to 48 K_2O/fed. El-Maghraby *et al.* (1998) found that increasing K-level from zero up to 48 kg K_2O/fed increased significantly root weight/plant, root and sugar yields while sucrose and purity percentages were significantly increased as K-level increased up to 24 kg K_2O/fed. They also revealed that increasing N-level from 30 to 60 and 90 kg N/fed caused a significant increase in root weight/plant, root and sugar yields/fed. They concluded that applying 48 kg K_2O/fed in combination with 90 kg N/fed had a superior effect on root and sugar yields. Shalaby (1998) found that root fresh weight/plant, root and sugar yields were gradually increased as the N-rate was increased from 60 to 75 and 90 kg/fed. However, purity percentage gradually decreased as N-level increased.

MATERIALS AND METHODS

Two field trials were carried out at Shandaweel Research Station (Sohag Governorate) in the two successive growing seasons of 1997/1998 and 1998/1999 to study the effect nine treatments representing three nitrogen levels (0, 46 and 92 kg N/fed) and three potassium levels (0, 24 and 48 kg K_2O/fed) on yield and quality of sugar beet. Treatments were randomly distributed in complete randomized block design in four replications. Nitrogen fertilizer was applied as Urea (46% N) in two equal doses; the first dose was added after thinning (45 days after sowing) and the second one was applied one month later. Potassium fertilizer was applied in the form of potassium sulphate (48% K_2O) as a single dose with the first nitrogen one. Sowing took place during the first week of November using sugar beet Del. 939 poly-germ variety while harvest was done 6 months later in both growing seasons. Sugar beet was sown on ridges of 60-cm apart with 20 cm between hills. The previous crop was seasame in both seaosons. The physical and chemical analysis of the upper 30-cm of soil of the experimental site showed that the soil was clay loam containing 27.8 ppm available N, 17.52 ppm P and 460 ppm K. Other agrcultural practices were done as followed by growers in the region.

Data Recorded

At harvest, the following data were recorded

1. Root fresh weight (kg).

2. Sucrose % was determined as described by Le Docte (1927).

3. Purity % was calculated according to the following equation:

Purity % = Sucrose % x 100/TSS%

Where : Total soluble solids % (TSS%) was determined by Hand refractometer.

4. Root yield (tons/fed).

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

Sugar yield = Root yield x Sucrose % x Purity %.

The collected data were statistically analysed according to the method described by Snedecor and Cochran (1981).

RESULTS AND DISCUSSIONS

1. Root fresh weight/plant:

Data collected in Table (1) showed that root fresh weight of sugar beet plant was positively and significantly increased as the applied N-level increased from zero to 46 and 92 kg N/fed in both growig seasons. This result is probably due to the important role of nitrogen as an essential structural element in building up plant organs. This result is in accordance with that reported by (Besheit *et al.*, 1994; Moustafa, 1996 and Ibrahim, 1998).

Regarding potassium effect, it was noticed that root fresh weight/plant was appreciably increased with increasing the applied dose of K-fertilizer from zero up to 48 kg K_2O/fed in the 1st season. This result could be attributed to the important role of potassium in physiological processes in the plant such as translocation of sugars and carbohydrates. This result is in line with that reported by (Basha, 1994; Moustafa, 1996 and Ibrahim, 1998). The same trend was obtained in the 2nd season. However, the differences in this as affected by K-level were not significant. Root fresh weight of sugar beet plant was not statistically influenced by the interaction between N and K levels in both growing seasons.

Table 1. Root fresh weight/plant (kg) as affected by nitrogen and potassium levels and their interactions in 1997/1998 and 1998/1999 growing seasons.

Season Nitrogen (Kg N/fed)	1997/1998				1998/1999			
	Potassium (Kg K_2O/fed)			Average	Potassium (Kg K_2O/fed)			Average
	0	24	48		0	24	48	
0	0.794	0.927	0.983	0.902	0.950	1.317	1.276	1.181
46	1.184	1.171	1.427	1.261	1.253	1.460	1.836	1.516
92	1.254	1.349	1.467	1.357	1.953	1.760	1.803	1.839
Average	0.923	0.994	1.138	1.173	1.385	1.512	1.639	1.512

L.S.D. at 5% level for:		
Nitrogen (N)	0.166	0.353
Potassium (K)	0.166	N.S.
(N) x (K)	N.S.	N.S.

2. Sucrose percentage:

The results in Table (2) revealed that increasing N-level applied to sugar beet plants was accompanied with a reduction in sucrose percentage where the higher the N-level the lower the sucrose%. This result was fairly true in both growing seasons with a significant effect of the used N rates on this quality character in the 1st one. This result could be due to the fact that increasing the applied N-rate results in increasing water retention by the tap root and in turn decreases sucrose determined as a percentage of root fresh weight (Draycott, 1993). This result is in agreement with that reported by Besheith *et al* (1994).

Increasing the applied dose of potassium from zero to 24 and 48 kg K_2O/fed raised sucrose percentage gradually in both seasons. This result could be attributed to the important role of potassium in physiological processes in the plant such as translocation of sugars and carbohydrates. However, the differences in this quality character as affected by K-level were significant in the 1st season only. This result is in accordance with that reported by (Basha, 1994 and Ibrahim 1998).

Sucrose percentage was significantly influenced by the interaction between N and K in the 1st season where the highest value (17.05%) was obtained from beets received 48 kg K_2O/fed with no N application.

Table 2. Sucrose percentage as affected by nitrogen and potassium levels and their interactions in 1997/1998 and 1998/1999 growing seasons.

Season / Nitrogen (Kg N/fed)	1997/1998				1998/1999			
	Potassium (Kg K_2O/fed)			Average	Potassium (Kg K_2O/fed)			Average
	0	24	48		0	24	48	
0	14.54	16.64	17.05	16.07	13.00	13.74	12.99	13.24
46	14.54	14.90	14.84	14.76	12.05	12.83	13.77	12.88
92	14.44	14.40	14.93	14.59	11.15	12.47	12.77	12.13
Average	14.50	15.31	15.60	15.14	12.06	13.01	13.17	12.75

L.S.D. at 5% level for:

Nitrogen (N)	0.56	N.S.
Potassium (K)	0.56	N.S.
(N) x (K)	0.97	N.S.

3. Purity percentage:

The results illustrated in Table (3) showed that increasing N-dose applied to sugar beet insignificantly decreased purity percentage in the 1st and 2st seasons.

Table 3. Purity percentage as affected by nitrogen and potassium levels and their interactions in 1997/1998 and 1998/1999 growing seasons.

Season / Nitrogen (Kg N/fed)	1997/1998				1998/1999			
	Potassium (Kg K_2O/fed)			Average	Potassium (Kg K_2O/fed)			Average
	0	24	48		0	24	48	
0	88.18	84.39	90.06	87.54	79.44	82.33	79.21	80.32
46	80.83	89.50	87.43	85.92	76.38	76.53	79.74	77.58
92	84.93	83.49	85.17	84.53	71.33	75.51	77.56	74.80
Average	84.65	85.79	87.55	86.00	75.71	78.15	78.84	77.57

L.S.D. at 5% level for:

Nitrogen (N)	N.S.	N.S.
Potassium (K)	N.S.	N.S.
(N) x (K)	N.S.	N.S.

It was noticed that purity percentage tended to increase as the applied K-level increased up to 48 kg K_2O/fed . However, the differences in this trait failed to reach the level of significance in both growing seasons.

No significant interaction effect of N X K was recorded on purity percentage in both seasons.

4. Root yield:

The results in Table (4) showed that increasing the applied dose of nitrogen fertilizer to 46 and 92 kg N/fed resulted in a significant increase in root yield amounted to 7.099 and 8.841 tons/fed compared with the unfertilized sugar beet, respectively, in the 1st season corresponding to 6.500 and 7.608 tons/fed in the 2nd one. The increase in root yield associated with increasing N-level is mainly due to the same effect of nitrogen on root fresh weight (Table 1). This result is in accordance with that reported by (Besheit *et al.*, 1994; Ibrahim, 1998 and Shalaby, 1998). It could be noticed that raising N-level from 0 to 46 was more beneficial than doubling the applied dose from 46 to 92 kg N/fed. This result may be due to that the highest N-rate enhanced the growth of leaves rather than translocation and storage of assimilates in roots.

Increasing the applied K-dose from zero to 24 and 48 kg K_2O/fed attained increases in root yield amounted to 1.358 and 3.368 tons/fed, successively in the 1st season, being 1.326 and 1.484 ton/fed, respectively in the 2nd one. However, The differences in root yield as affected by K-level were not significant in both seasons.

Root yield was significantly influenced by the interaction between N and K in the 2nd season where the maximum root yield (36.753 tons/fed) was obtained from beets fertilized with the highest levels of both elements. This result is in agreement with that reported by El-Maghraby et al. (1998).

Table 4. Root yield (tons/fed) as affected by nitrogen and potassium levels and their interactions in 1997/1998 and 1998/1999 growing seasons.

Season / Nitrogen (Kg N/fed)	1997/1998				1998/1999			
	Potassium (Kg K_2O/fed)			Average	Potassium (Kg K_2O/fed)			Average
	0	24	48		0	24	48	
0	21.832	20.745	24.460	22.346	25.773	28.555	23.951	26.093
46	27.785	29.258	31.292	29.445	31.693	32.761	33.325	32.593
92	28.735	32.423	32.703	31.287	32.111	32.238	36.753	33.701
Average	26.117	27.475	29.485	27.693	29.859	31.185	31.343	30.796

L.S.D. at 5% level for:

Nitrogen (N)	3.060	1.918
Potassium (K)	N.S.	N.S.
(N) x (K)	N.S.	N.S.

5. Sugar yield:

The results in Table (5) showed that fertilizing sugar beet plants with 46 or 92 kg N/fed incresed sugar yield by 0.522 and 0.652 ton/fed compared with the untreated ones, respectively, in the 1st season, being 0.558 and 0.351 in the 2nd one. Meanwhile, the differences in sugar yield as affected by the added N-doses were significant in the 1st season only. The positive influence of N-fertilizer levels could be mainly attributed to the same effect on root yield (Table 4). This result is in line with that found by (Besheit *et al.*, 1994; Ibrahim, 1998 and Shalaby, 1998).

Similarly, significant increases in sugar yield amounted to 0.360 and 0.847 ton/fed were recorded when the applied K-dose was raised from zero to 24 and 48 kg K_2O/fed, respectively, in the 1st season. The appreciable effect of increasing the appliped K-levels on sugar yield could be attributed to the beneficial influence of potassium on root fresh weight/plant, sucrose%, purity% and root yield (Tables 1,2,3, and 4). This result coincides with that obtained by (Basha, 1994; Moustafa, 1996 and Ibrahim, 1998). In the 2nd season, insignificant increases in sugar yield amounted to 0.440 and 0.535 ton/fed were obtained as K-level was increased to 24 and 48 kg K_2O/fed compared with the control (without K applicantion).

The interaction between N and K levels had no singificant effect on sugar yield in both growing seasons.

Table 5. Sugar yield (tons/fed) as affected by nitrogen and potassium levels and their interactions in 1997/1998 and 198/1999 growing seasons.

Season / Nitrogen (Kg N/fed)	1997/1998				1998/1999			
	Potassium (Kg K_2O/fed)			Average	Potassium (Kg K_2O/fed)			Average
	0	24	48		0	24	48	
0	2.802	2.907	3.914	3.208	2.596	3.160	2.403	2.720
46	3.265	3.857	4.068	3.730	2.943	3.222	3.669	3.278
92	3.525	3.907	4.149	3.860	2.554	3.034	3.627	3.071
Average	3.197	3.557	4.044	3.599	2.698	3.138	3.233	3.023

L.S.D. at 5% level for:

Nitrogen (N)	0.445	N.S.
Potassium (K)	0.445	N.S.
(N) x (K)	N.S.	N.S.

REFERENCES

1. Basha, H.A.(1994). Influence of potassium fertilizer level on yield and quality of some sugar beet cultivars in newly reclatimed sand soil. Zagazig J. Agric. Res. 21 (6):1631-1644.

2. Besheit, S.Y.; Mone, M.S. and Samia, S.E. (1994). The use of nitrogen for sugar beet grown in sandy soil of Egypt. Egypt.J. Appl.Sci., 9 (12): 225-231.

3. Draycott, A.P. (1993). Nutrition; 239-278. In D.A. Cooke and R.K. Scott, The Sugar Beet Crop. Chapman & Hall, 2-6 Boundary Row, london, SEI 8 HN, UK.

4. El-Maghraby, Samia, S., Mon

5. Ibrahim M.F.M. (1998). The effect of some fertilization elements on the yield and quality of sugar beet . Ph.D. Thesis, Agron, Dept., Fac. Agric. Moshtohor, Zagazig Univ., Egypt.

6. Le Docte, A. (1927). Commecial determintaion of sugar in beet root using the Sacks Le Docte. Int. Sugar J., 29:488-492.

7. Moustafa, M.M. (1996) The effect of N, P and K fertilizers on growth, yield and some physiological characters of sugar beet. M. Sc. Thesis, Agron. Dept., Fac. Agric. Moshtohor, Zagazig Univ., Egypt.

8. Shalaby N.M.E 91998) Effect of different nitrogen levels and the period of no irrigation befor harvesting on yield and quality of sugar beet. M.S.c. Thesis, Agron. Dept., Fac. Agric, Al-Azhar Univ., Egypt.

9. Snedecor, G.W. and W.G. Cochran. 1981. Statistical Methods. Seventh Ed. low State Univ. Press, Ames, Iowa, USA.

تأثير التسميد النيتروجيني والبوتاسي علي محصول وجودة بنجر السكر في سوهاج

عبد الله محمد عبد الله الشافعي

معهد بحوث المحاصيل السكرية - مركز البحوث الزراعية - الجيزة-مصر.

اقيمت تجربتان حقليتان في محطة بحوث شندويل بمحافظة سوهاج خلال موسمي الزراعة ١٩٩٧ / ١٩٩٨ و ١٩٩٨ / ١٩٩٩ لدراسة تأثير تسعة معاملات هي التوافق بين ثلاثة مستويات من السماد النيتروجيني (صفر و ٤٦ و ٩٢كجم ن / فدان) وثلاثة مستويات من السماد البوتاسي (صفر و ٢٤ و ٤٨ كجم بو ٢أ/فدان) . علي محصول وجوده صنف بنجر السكر Del. 939 استخدام تصميم قطاعات كاملة العشوائية في اربعة مكررات في الموسمين. وفيما يلي اهم النتائج المتحصل عليها:

* أدت زيادة السماد النيتروجيني حتي ٩٢ كجم ن / فدان الي زيادة الوزن الغض للجذر/ نبات ومحصول الجذور والسكر معنويا بينما انخفضت النسبة المئوية للسكروز.
* أدت زيادة السماد البوتاسي حتي ٤٨ كجم بو٢أ/فدان الي زيادة الوزن الغض للجذر/ نبات والنسبة المئوية للسكروز ومحصول السكر.
* ازداد محصول الجذور زيادة غير معنوية بزيادة السماد البوتاسي حتي ٤٨ كجم بو٢أ/ فدان.

أوضحت النتائج أن النسبة المئوية للنقاوة لم تتأثر معنويا بالمستويات المضافة من السماد النيتروجيني و البوتاسي.

تحت ظروف هذا البحث يوصي بتسميد بنجر السكر المنزرع في شندويل بمحافظة سوهاج باضافة ٩٢ كجم ، ٤٨ كجم بو٢ أ/فدان للحصول علي أعلي محصول جذور وسكر.