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EFFECT OF NITROGEN AND POTASSIUM FERTILIZATION ON YIELD AND QUALITY OF TWO SUGAR CANE PROMISING VARIETIES

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Abstract

This investigation was carried out at Shandweel Research Station. Sohag Governorate in the two successive seasons of 1997/1998 and 1998/1999 to evaluate the effect of nitrogen (150.190 and 230 kg N/fed) and potassium (48 and 96 kg K_2O/fed) on yield and quality of two sugar cane promising varieties (G. 85/37 and G. 84/47). The results showed that sugar cane variety G.85-37 attained a superiority in plant height, cane and sugar yields over G. 84-47 variety. Increasing nitrogen level up to 230 kg N/fed increased stalk height, stalk diameter, cane and sugar yields of sugar cane varieties compared with the lowest dose (150 kg N/fed). Juice purity and sugar recovery percentages were adversely affected by increasing the applied N-level. Applying potassium fertilizer had no significant effect on stalk height, stalk diameter, purity and sugar recovery percentages. The results showed that increasing potassium level from 48 to 96 K_2O significantly affected cane and sugar yields in the 1st season.

INTRODUCTION

Nitrogen plays a role as important as that of carbon, hydrogen and oxygen which together form more than 90 percent of the dry matter. It is well known as a fact that nitrogen element plays an important role in the growth and productivity of sugar cane plants. Potassium plays an important role in physiological processes in the plant such as translocation of sugars and carbohydrates. Many investigations proved an evidence of the role of potassium in improving juice quality and recoverable sugar. Rahman *et al* (1990) found that cane yield of plant cane increased with increasing potassium level up to 300 kg K_2O/ha. Banger *et al* (1992) observed that sugar cane cv. Co. 6304. Co 7318 and Co 135 received nitrogen at the rates of 0,150,300 and 450 kg/ha increased plant height and girth. Also, they mentioned that there was a significant positive correlation between nitrogen levels and sugar yield. Abd El-Hadi, *et al* (1994) mentioned that juice quality in terms of purity and recovery were not clearly affected by adding nitrogen fertilizer at rates of 150, 175 and 200 kg N/fed. El-Geddawy et al (1997) found that both cane and sugar yields significantly increased by increasing ni-

trogen up to 210 kg/fed. they added that sugar cane variety G.T54-9 surpassed the two varieties in cane and sugar yields. Also, they demonstrated that sucrose, purity and recovery percentages showed a reverse relatioship due to nitrogen fertilizer application. Subramanian et al (1994) revealed that sugar cane variety Co 6304 fertilized with (0,125 and 187.5 kg K_2O /ha) produced the highest cane and sugar yields. Azzazy (1995) observed significant differences in stalk length and diameter of sugar cane varieties G.T. 54-9, F.153 and G. 74-96. Also he added that application of nitrogen fertilizer ranged from 150 to 210 kg/fed increased cane stalk and diameter. Abou-Salama (1995) found that application of potassium at rates of 50 and 100 kg K_2O/fed gave the highest cane and sugar yields. Nassar (1996) found that potassium application significantly affected juice quality and sugar yield. Ismail (1997) showed that potaassium application ate rates of 48 and 96 kg K_2O/fed had no significant effect on stalk dimension, juice quality, cane and sugar yields. This work was initiated to fined out the optimal N and K levels to obtain the maximum cane and sugar yields/fed of two promising cane varieties.

MATERIALS AND METHODS

The present work was conducted at Shandweel Research Station, Sohag Governorate in the two successive seasons of 1997/1998 and 1998/1999 to evaluate the effect of nitrogen and potassium fertilization on yield and quality of two sugar cane promising varieties. Each trial included twelve treatments represented the combination between two sugar cane varieties (G.85-37 and G. 84-47), three nitrogen levels (150, 190 and 230 kg N/fed) and two potassium levels (48 and 96 kg K_2O/fed). A split plot design with four replications was used. Sugar cane varieties were allocated in the main plots and the combination between nitrogen and potassium levels were randomly distributed in the sub-plots. Physical and chemical properties of the upper 30 cm of soil of the experimental site were clay loam, available N 27.8 ppm, P17.52 ppm and K 550 ppm. Sub-plot area was 42 m2 with 6 ridges of 7 meters in length and 1.0 m apart. Sugar cane varieties were planted in spring season (during the 1st week of April 1997). Nitrogen fertilizer was added as urea (46% N) into two equal doses; the first dose was applied after two months from planting (1st June) and the second one was added one month later (1st July). Potassium fertilizer was added as potassium sulphate (48% K_2O) as one dose with first nitrogen dose.

Data Recorded

1. Stalk length (cm). 2. Stalk diameter (cm).

3. Cane yield (tons/fed).

4. Sugar recovery % was calculated according to the following equation :

Sugar recovery % = richness % x purity %

Where Richness = (sucrose in 100 grams x factor) / 100

Factor = 100 - [fiber % + (physical impurities % + percent water free from sugar)

5- Purity % was calculated according to the following equation:

Purity % = sucrose % / brix % x 100.

6. Sugar yield (tons/fed) was estimated according to the following equation:

Raw sugar production = cane yield (tons/fed) x sugar recovery %.

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

RESULTS AND DISCUSSIONS

1. Stalk height:

Data presented in Table 1 revealed that sugar cane variety G. 85-37 attained a superiority in plant height amounted to 4.39 and 4.42% over G. 84-47 variety in the 1st and 2nd season, respectively. However, the varietal effect on this trait was significant in the 1st season only. This finding is in line with that found by Azzazy (1995).

The results showed that increasing nitrogen fertilizer up to 230 kg N/fed increased stalk height of sugar cane varieties by 35.58 and 6.83 cm over the lowest dose (150 kg N/fed) in 1st the 2nd season, respectively. The increase in stalk height of sugar cane varieties due to N levels could be attributed to the important role of nitrogen fertilizer in encouraging the meristemic activity in plant in addition to cell elongation. However, this character was significantly affected by the applied nitrogen levels in the 1st season only. This result is in accordance with that found by Banager et al (1992). Applying of potassium fertilizer had no significant effect of stalk height in both seasons. This finding is in agreement with that obtained by Ismail (1997).

The interaction between the studied factors did not affect stalk height in both seasons.

2. Stalk diameter

Data illustrated in Table 2 showed that there was no significant difference between the tested varieties in their stalk diameter in both growing seasons.

The results cleared that stalk diameter was significantly affected by the applied doses of nitrogen fertilizer in both seasons. The increase in stalk thickness due to N levels could be attributed to the role of nitrogen element in enhancing cell division. This result is in line with that found by Azzazy (1995).

Potassium fertilizer had an insignificant effect on cane diameter in both growin seasons. This finding is in accordance with that reported by Ismail (1997).

Stalk diameter was not significantly affected by the interactions between the studied factors except that of nitrogen x potassium in the 2nd season only.

3. Cane yield

Data presented in Table (3) show that sugar cane variety G.85-37 attained a significant increase in cane yield amounted to 6.00 and 7.96 tons/fed over variety G.84-47 in the 1st and 2nd season, respectively. This finding is in accordance with that reported by El-Geddawy *et al* (1997).

Inereasing the appplied doses of nitrogen fertilizer from 150 to 190 and 230 kg N/fed attained a significant increase in cane yield amounted to 5.19 and 4.63 tons/fed in the 1st season corresponding to 2.28 and 4.43 tons/fed in the 2nd one, respectively. This finding is in accordance with that reported by Supramanian *et al* (1994) and El-Geddawy *et al* (1997).

The results showed that applying potassium fertilizer at rates of 48 and/or 96 K_2O significantly affected cane yield in the 1st season only. This result is in agreement with that shown by Abou-Salama (1995).

None of the interactions between the studied factors had a significant effect on cane yield in both growing seasons.

4. Sugar yield

Data illustrated in Table (4) showed that sugar cane variety G. 85-37 surpassed variety G. 84-47 in sugar yield by 8.30 and 13.06% in the 1st and 2nd season, respectively. The tested varieties differed significantly in sugar yield in the 1st season only. This finding is in agreement with that found by El-Geddawy *et al* (1997).

Increasing the applied nitrogen fertilizer from 150 to 190 and 230 kg N/fed significantly increased sugar yield by 0.436 and 0.593 ton/fed, respectively in the 1st season. However, sugar yield was not significantly affected by the applied nitrogen doses in the 2nd season. The increase in sugar yield is probably referred to the increase in cane yield as affected by increasing N-level. This result is in agreement with that reported by Subramanian *et al* (1994).

The results showed that doubling the applied dose of potassium from 48 to 96 kg K_2O/fed attained an increase in sugar yield amounted to 0.406 and 0.605 ton/fed in the 1st and 2nd season, respectively. Meanwhile, the effect of K-level on sugar yield was significant in the 1st season only. This result is partially coincided with that revealed by Abou-Salama (1995).

No appreciable interaction effect of the studied factors on sugar yield was obtained in both growing seasons.

5. Sugar recovery percentage

Data collected in Table 5 indicated that there was no significant difference between the two sugarcane varieties (G.85-37 and G.84.47) in sugar recovery percentage in both growing seasons.

Sugar recovery percentage had a similar trend to that of juice purity percentage where it was adversely and significantly affected by increasing the applied N-level to sugar cane in the 1st and 2nd seasons. This result is in line with that found by El-Geddawy *et al.* (1997).

Increasing potassium application to sugarcane crop increased sugar recovery percentage in both seasons. However this effect was significant in the 2nd season only. This finding is in agreement with that reported by Nassar (1996).

Sugar recovery percentage was not significantly affected by the interaction between the studied factors in both seasons.

6. Purity percentage

The results in Table 6 cleared that the examined sugarcane varieties were insignificantly differed in juice purity percentage in the 1st and 2nd seasons.

It was found that increasing N-level from 150 to 190 and 230 kg N/fed was accompanied with a significant reduction in juice purity percentage in both seasons. This result is in line with that found by El-Geddawy *et al* (1997).

The results showed that the used levels of potassium fertilizer had no influence on purity in both seasons. This result is in agreement with that mentioned by Ismail (1997).

None of the interactions between the studied factors had a significant effect on purity percentage in both growing seasons.

Table 1: Effect of nitrogen and potassium fertilization on stalk diameter of two sugar cane varieties at harvest in 1997/1998 and 1998/1999 seasons.

Season		1997/1998				1998/1999			
		Stalk diameter				Stalk diameter			
Varieties	K_2Okg/fed	Nitrogen (kg N/fed.)			Average	Nitrogen (kg N/fed.)			Average
		150	190	230		150	190	230	
G. 85-37	48	284.66	303.33	331.00	306.33	328.66	332.66	342.66	334.66
	96	289.66	319.66	340.66	319.00	341.33	332.00	347.33	340.22
Average		287.16	311.50	335.83	316.66	335.00	332.33	345.00	337.41
G. 84-47	48	280.23	289.33	310.66	293.44	312.33	323.33	321.33	319.00
	96	300.33	294.66	322.00	305.66	332.00	326.33	330.33	329.55
Average		290.33	292.00	316.33	299.55	322.16	324.83	325.83	324.27
N x k	48	282.50	298.50	269.33	299.88	320.50	328.00	332.00	326.83
	96	307.16	320.83	331.33	312.33	336.66	332.66	338.83	336.05
Average of nitrogen		288.74	301.75	326.08	306.11	328.58	328.58	335.41	331.44

L.S.D. at 5% level for:		
Cane vreties (V)	NS	NS
Nitrogen level (N)	15.56	NS
Potassium level (P)	12.30	NS
V x N	NS	NS
V x K	NS	NS
N x K	NS	NS
V x N x K	NS	NS

Table 2 : Effect of nitrogen and potassium fertilization on stalk diameter of two sugar cane varieties at harvest in 1997/1998 and 1998/1999 seasons.

Season		1997/1998				1998/1999			
		Stalk diameter				Stalk diameter			
Varieties	K_2Okg/fed	Nitrogen (kg N/fed.)			Average	Nitrogen (kg N/fed.)			Average
		150	190	230		150	190	230	
G. 85-37	48	2.72	2.92	2.89	2.84	2.92	2.65	2.88	2.82
	96	2.81	2.81	2.94	2.87	2.82	2.88	3.00	2.90
Average		2.71	2.86	2.99	2.85	2.87	2.77	2.94	2.86
G. 84-47	48	2.68	2.63	2.99	2.77	2.82	2.55	2.61	2.66
	96	2.73	2.84	2.94	2.83	2.48	2.59	2.82	2.63
Average		2.70	2.73	2.97	2.80	2.65	2.57	2.71	2.64
Nxk	48	2.70	2.77	2.99	2.82	2.87	2.60	2.74	2.74
	96	2.77	2.82	2.97	2.85	2.65	2.74	2.91	2.76
Average of nitrogen		2.73	2.80	2.98	2.84	2.76	2.76	2.82	2.75

L.S.D. at 5% level for:		
Cane vreties (V)	NS	NS
Nitrogen level (N)	0.08	0.09
Potassium level (P)	NS	NS
V x N	NS	NS
V x K	NS	NS
N x K	NS	0.12
V x N x K	NS	NS

Table 3 : Effect of nitrogen and potassium fertilization on can yield of two sugar cane varieties at harvest in 1997/1998 and 1998/1999 seasons.

Season		1997/1998			Average	1998/1999			Average
Varieties	K_2Okg/fed	Stalk diameter Nitrogen (kg N/fed.)				Stalk diameter Nitrogen (kg N/fed.)			
		150	190	230		150	190	230	
G. 85-37	48	48.80	53.98	58.60	53.79	60.63	67.22	69.72	65.86
	96	51.53	56.66	36.90	57.36	64.13	64.60	63.10	93.94
Average		50.16	55.32	61.25	55.57	62.38	65.91	66.41	64.90
G. 84-47	48	45.20	50.76	53.80	49.92	51.48	54.34	32.11	55.97
	96	48.20	53.06	56.70	52.65	55.45	54.65	63.61	57.90
Average		46.70	51.91	55.25	51.28	53.46	54.49	62.86	56.94
Nxk	48	47.00	52.37	65.20	51.85	56.05	60.78	65.91	60.91
	96	49.86	54.86	60.30	55.05	59.79	59.62	63.35	60.92
Average of nitrogen		48.43	53.62	58.25	53.43	57.92	60.20	64.63	60.92

L.S.D. at 5% level for:		
Cane vreties (V)	3.91	7.79
Nitrogen level (N)	1.81	4.93
Potassium level (P)	1.46	NS
V x N	NS	NS
V x K	NS	NS
N x K	NS	0.12
V x N x K	NS	NS

Table 4 : Effect of nitrogen and potassium fertilization on sugar yield of two sugar cane varieties at harvest in 1997/1998 and 1998/1999 seasons.

Season		1997/1998				1998/1999			
Varieties	K_2Okg/fed	Stalk diameter Nitrogen (kg N/fed.) 150	190	230	Average	Stalk diameter Nitrogen (kg N/fed.) 150	190	230	Average
G. 85-37	48	5.606	6.001	6.212	5.940	6.424	7.171	6.893	6.829
	96	6.013	6.373	6.735	6.374	6.723	7.317	7.733	7.258
Average		5.809	6.187	6.474	6.157	6.573	7.244	7.313	7.044
G. 84-47	48	5.118	5.686	5.683	5.496	6.326	5.864	5.646	5.945
	96	5.614	5.913	6.094	5.874	6.633	6.254	6.698	6.528
Average		5.366	5.800	5.889	5.685	6.479	6.059	6.172	6.237
Nxk	48	5.362	5.844	5.948	5.718	6.375	6.517	6.270	6.387
	96	5.814	6.143	6.414	6.124	6.678	6.785	7.216	6.893
Average of nitrogen		5.588	5.994	6.181	5.921	6.526	6.651	6.743	6.640

L.S.D. at 5% level for:		
Cane vreties (V)	NS	NS
Nitrogen level (N)	0.146	NS
Potassium level (P)	0.116	NS
V x N	NS	NS
V x K	NS	NS
N x K	NS	NS
V x N x K	NS	NS

Table 5 : Effect of nitrogen and potassium fertilization on sugar recovery % of two sugar cane varieties at harvest in 1997/1998 and 1998/1999 seasons.

Season		1997/1998				1998/1999			
		Stalk diameter				Stalk diameter			
Varieties	K_2Okg/fed	Nitrogen (kg N/fed.)			Average	Nitrogen (kg N/fed.)			Average
		150	190	230		150	190	230	
G. 85-37	48	11.49	11.12	10.60	11.07	11.35	10.67	9.22	10.41
	96	11.66	11.25	1.55	11.15	12.05	11.31	10.57	11.31
Average		11.58	11.18	10.57	11.11	11.70	10.99	9.89	10.86
G. 84-47	48	11.32	11.23	10.56	11.03	10.96	10.76	10.15	10.62
	96	11.65	11.15	10.75	11.18	12.11	11.39	10.43	11.31
Average		11.48	11.19	10.65	11.10	11.53	11.08	10.29	10.97
Nxk	48	11.40	11.16	10.58	11.05	11.15	10.71	9.69	10.52
	96	11.65	11.20	10.65	11.16	12.08	11.35	10.50	11.31
Average of nitrogen		11.53	11.18	10.61	11.1	11.62	11.03	10.09	10.91

L.S.D. at 5% level for:		
Cane vreties (V)	NS	NS
Nitrogen level (N)	0.20	0.67
Potassium level (P)	NS	0.55
V x N	NS	NS
V x K	NS	NS
N x K	NS	NS
V x N x K	NS	NS

Table 6 : Effect of nitrogen and potassium fertilization on stalk purity % of two sugar cane varieties at harvest in 1997/1998 and 1998/1999 seasons.

Season		1997/1998				1998/1999			
		Stalk diameter				Stalk diameter			
Varieties	K_2Okg/fed	Nitrogen (kg N/fed.)			Average	Nitrogen (kg N/fed.)			Average
		150	190	230		150	190	230	
G. 85-37	48	82.52	79.62	74.63	78.92	91.84	85.56	72.98	81.7
	96	82.22	78.84	75.46	78.84	91.90	82.70	71.07	81.89
Average		82.37	79.23	75.04	78.88	91.87	81.63	72.02	81.84
G. 84-47	48	85.01	79.99	75.91	80.30	83.38	77.60	73.75	78.24
	96	83.98	78.66	75.31	79.32	87.47	82.12	73.67	81.08
Average		84.49	79.33	75.61	79.81	85.42	79.86	73.71	79.66
Nxk	48	83.77	79.81	75.26	79.61	87.61	79.08	73.56	80.02
	96	83.10	78.75	75.38	79.08	89.68	72.41	72.37	81.49
Average of nitrogen		83.40	79.28	75.32	79.35	88.65	80.71	72.87	80.75

L.S.D. at 5% level for:		
Cane vreties (V)	NS	NS
Nitrogen level (N)	3.12	4.08
Potassium level (P)	NS	NS
V x N	NS	NS
V x K	NS	NS
N x K	NS	NS
V x N x K	NS	NS

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تأثير التسميد الازوتى والبوتاسى على المحصول وجودة صنفين مبشرين من قصب السكر

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اقيم هذا البحث فى محطة البحوث الزراعية بشندويل محافظة سوهاج خلال موسمى الزراعة ١٩٩٧ / ١٩٩٨ و ١٩٩٨ / ١٩٩٩ بغرض دراسة تاثير التسميد الازوتى (١٥٠ ، ١٩٠ و ٢٣٠ كجم ن/ فدان) ومعدلين من السماد البوتاسى (٤٨ و ٩٦ كجم بو ٢ ا / فدان) على محصول وجودة صنفين من قصب السكر المبشرة (جيزة ٨٥ / ٣٧ وجيزة ٨٤ / ٤٧) وفيما يلى اهم النتائج المتحصل عليها .

تفوق الصنف جيزة ٨٥ /٣٧ على صنف جيزة ٨٤ / ٤٧ فى صفة ارتفاع العود ومحصول العيدان والسكر .

ادت زيادة التسميد الازوتى ٢٣٠ كجم ن/ فدان الى زيادة ارتفاع وسمك العيدان وكذلك محصول العيدان والسكر مقارنة باضافة ١٥٠ كجم ن / فدان .

وجدت علاقة عكسية بين زيادة التسميد الازوتى والنسبة المؤية لناتج السكر وجودة العصير .

لم تؤثر اضافة التسميد البوتاسى معنويا على صفة ارتفاع وسمك العيدان وكذلك النسبة المؤية لناتج السكر وجودة العصير .

ادت زيادة معدلات التسميد البوتاسى من ٤٨ حتى ٩٦ كجم ٢ا/ فدان الى زيادة معنوية فى محصول العيدان والسكر فى الموسم الاول فقط.

ويوصى هذا البحث بزراعة الصنف جيزة ٨٥ /٣٧ وتسميده ب ٢٣٠ نيتروجين و ٩٦ كجم بو ٢ا / فدان وذلك للحصول على اعلى محصول من العيدان والسكر .