RESPONSE OF FOUR SUGARCANE VARIETIES TO POTASSIUM FERTILIZER

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Abstract

Field experiments were carried out in El-Mattana Agricultural Research Station at Qena Governorate during two harvest seasons 1998/2000 and 2000/2001, including plant crop and its first ratoon crop to study the response of some sugar cane varieties (G.T.54-9,G.87-37, G.87-55 and F.160) to different levels of K fertilizer (0,24,48 and 72 kg K_2O /fed.). Results obtained show that G.T. 54-9 variety surpassed the other three varieties in number of millable cane /m^2, length, diameter and yield of millable cane and sugar, while G.87-37 variety gave the highest values of T.S.S.% and sucrose % in both crops.

Concerning the K fertilizer, number of millable cane / m^2, millable cane diameter, cane yield, T.S.S.% sucrose % and sugar yield were significantly increased by K levels in plant crop and it first ratoon crop. In general all traits increased by increasing K fertilizer compared to control treatment. The highest theoretical sugar yield was obtained from G.T.54-9 with 72kg K_2O /fed in plant and its ratoon crop.

INTRODUCTION

Adequate nutrient availability in the soil, and varieties are the most essential requirement to be fulfilled for successful crop production. It is well known that potassium plays a direct effect on translocation of sugar and carbohydrates energy transformation and enzyme action in sugar crops. El-Geddawy *et al.* (1997), Ismail (1997), Ahmed (1998), Abo El-Ghait (2000), Gomaa (2000) and Mohamed (2001), reported that sugar cane varieties showed significant differences for number of millable came diameter, millable cane and sugar yields, also they found significant differences among sugar cane varieties for brix percentage, sucrose percentage and sugar yield/ fed. Many researchers elucedated the role of potassium for sugar cane. Rahman *et al.* (1990), reported that cane yield of plant and ratoon crops increased with increasing potassium level up to 300 kg K_2O /ha. Ismail (1991), found that juice quality was enhanced with the increase in potassium up to 75 kg K_2O /fed. Ricaud and Arceneaux (1994), found that using 80 lbs potash /ac. increased insignificantly stalk population, cane and sugar yields. Subramanian (1994), studied the effect of zero, 125, 187.5 kg K_2O / ha. as a soil application or spray of 1 % KCl at 30, 60 and 90 days after

planting with or without a soil application of 125 kg K_2O / ha. He reported that cane yield and sugar yield were highest with a combination of 125 kg K_2O / ha soil added to 1 % KCl foliar application. Nassar (1996) stated that K application significantly affected juice quality and sugar yield. Abd El-latif and Ismail (2000) reported that increasing K-level up to72 kg K_2O /fed. significantly increased the cane yield, sugar yield and quality of sugar cane.

The aim of this study was to determine the optimum K level for some sugar cane varieties.

MATERIAL AND METHODS

This study was carried out in El-Mattana Agricultural Research Station, Qena Governorate during 1998/2000 and 2000/2001 seasons including autumn plant cane and its first ratoon crop. Planting was carried out on October 1998 and sugar cane was preceded by fallow. The study includedn16 treatments which were the combination between 4 varieties (G.T.54-9, G.87-37, G.87-55 and F.160) and 4 potassium levels (0, 24, 48 and 72 Kg K_2O /fed)The experimental design was randomized complete block design with three replications.

Potassium fertilizer was added as potassium sulphate (48 % K_2O) and added to the soil with the first irrigation. Phosphorus fertilizer as calcium superphosphate (15.5 P_2O_5) was added at the rate of 50 Kg P2O5/fed during land preparation. The same amount of phosphorus was added before furrowing for ratoon crop. Nitrogen fertilizer at a rate of 180kg N/fed. for plant crop and 240 kg N/fed. for ratoon crop was applied as urea (46%N). The area of each sub-plot was 21m^2 containing three rows, seven meters in length and one meter in width. All agricultural practices for sugar cane were applied.

The mechanical and chemical analysis of soil of the experimental site showed that soil was clay loam, containing 61 ppm of the available nitrogen, 10 ppm P and 400 ppm K with a pH of 7.7. At harvesting, the following parameters were recorded:

1- Number of millable cane /m^2.
2- Stalk length, (cm.).
3- Stalk diameter ,(cm.).
4- Millable cane yield ,(tons/fed.).
5- T.S.S. % was determined in the laboratory using brix hydrometer.
6- Sucrose % of juice was determined using sacharemeter according to A.O.A.C. (1995).
7- Theoretical sugar yield /fed. (ton).

Where sugar yield = cane yield (ton/fed) x sugar recovery.

The collected data were subjected to the proper statistical analysis of randomized complete block design according to the procedure outlined by Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1- Yield and its components:

Data in Tables 1, 2, 3 and 4. show that the differences between the studied varieties were significant for number of millable cane, millabe cane diameter and cane yield /fed. In the plant and first ratoon crops. G.T. 54-9 variety was superior over the three other varieties, On the other hand G. 87-37 variety recorded the lowest value in both seasons. It is worthy to note that the differences between G.T. 54-9 variety and the other varieties were significant, also between F.160 variety and the two varieties i.e. G.87-37 and G.87-55. This result may be due to the relative importance of gene make-up effect on this trait. This result is in agreement with that obtained by Ahmed (1998) and Mohamed (2001), they reported significant differences between studied varieties in number of plant/ m2.

The available data in Table 2 and 3. reveal that G.T.54-9 variety surpassed the other varieties in stalk length and diameter, but the differences did not reach the level of significant in millable cane length. This observation was true in the two seasons.

Data given in Table 4. distinctly show that cane yield of the different varieties differed significantly in the plant and the first ratoon crops. Commercial sugar cane variety G.T.54-9 surpassed the other varieties in both seasons. The aforementioned results indicate that the plants of G.T.54-9 variety were more vigorous in number of plant/m^2, stalk diameter and length, consequently this variety gave the greatest cane yield/fed. This result is in line with that obtained by El-Geddawy *et al.*(1997) who reported that sugar cane variety G.T.54-9 recorded the highest cane yield, also Ismail (1997) and Abo El-Ghait (2000) found that cane yield differed between the studied varieties.

Data in Table 1 show that the effect of potassium fertilizer on the number of millable cane /m^2 was significant in plant and ratoon crop. The highest number of millbale cane /m^2 (12.06) and (13.45) was obtained by applying 48kg K2O / fed. This increase may be due to the role of potassium fertilizer in physiological processes in plants. Similar results were obtained by Ricaud and Arceneaux (1994).

The results in Table 2. cleare that length of millable cane was insignificantly affected by the potassium fertilizer levels in plant and ratoon crops. However 24 and 72 kg K_2O /fed. produced the tallest plants in plant and ratoon crops, respectively.

Data in Table 3. showed that millable cane diameter was significantly affected by potassium levels in the plant and ratoon crops. The highest values were obtained from plants received 48 kg K_2O /fed. in plant crop. while the highest values for ratoon crop was obtained by applying 72 kg K_2O /fed..

It is clearly from the results in Table 4 that the highest level of potassium (72 kg) gave the highest cane yield (47.900 ton/fed.) in plant crop, while the highest yield (48.175 ton/fed.) for ratoon crop was obtained by applying 48 kg K_2O /fed.. This result may be due to the favorable effect of potassium fertilizer on yield components, which in turn gave higher cane yield. Similar results were obtained by Rahman *et al.* (1990) and Subramanian (1994).

The results showed that number of millable cane, millable cane length, millable cane diameter and cane yield were significantly affected by the interaction between varieties and potassium fertilizer in plant and first ratoon crops.

Table 1. Effect of varieties and K fertilizer on number of millable cane/m^2 in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	13.07	10.17	11.13	11.36	11.50	15.13	11.23	12.83	12.73	12.98
24 kg	13.10	15.53	11.27	11.63	11.63	14.27	11.83	12.87	12.90	12.97
48 kg	13.97	10.63	11.70	11.93	12.06	15.07	11.97	12.77	14.00	13.45
72 kg	13.17	10.37	11.57	11.67	11.70	14.27	11.90	12.57	12.93	12.92
Mean	13.33	10.43	11.42	11.72		14.68	11.73	12.76	12.14	

L.S.D.		
Variety (V)	0.53	0.40
K_2O (K)	0.53	0.40
VxK	1.06	0.81

Table 2. Effect of varieties and K fertilizer on millable cane length (cm) in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	309.10	289.43	297.77	306.67	300.74	283.33	280.33	281.32	284.67	282.42
24 kg	309.97	311.10	306.87	298.77	306.65	281.67	293.33	284.67	277.00	284.17
48 kg	276.43	297.33	307.53	300.20	295.37	292.33	275.67	285.33	283.33	284.17
72 kg	315.10	306.10	286.30	304.43	302.98	294.67	282.33	280.00	286.00	285.75
Mean	302.65	300.97	299.62	302.52		288.00	282.92	282.83	282.75	

L.S.D.

Variety (V)	N.S	N.S
K_2O (K)	N.S	N.S
VxK	28.03	14.15

Table 3. Effect of varieties and K fertilizer on millable cane diameter (cm) in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	2.817	2.680	2.713	2.890	2.775	2.963	2.920	2.823	2.787	2.873
24 kg	2.970	2.813	2.763	2.930	2.869	2.980	2.927	2.680	2.837	2.856
48 kg	3.100	2.933	3.050	2.933	3.004	3.030	2.727	2.876	2.843	2.867
72 kg	2.983	2.480	2.807	2.820	2.773	2.990	2.927	2.873	2.847	2.909
Mean	2.968	2.817	2.833	2.893		2.991	2.875	2.811	2.848	

L.S.D.

Variety (V)	0.075	0.046
K_2O (K)	0.075	0.046
VxK	0.149	0.091

Table 4. Effect of varieties and K fertilizer on cane yield (t/fed) in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	47.733	43.167	46.667	47.800	46.592	48.600	40.467	43.433	43.167	43.917
24 kg	49.167	43.933	47.167	47.367	46.909	49.000	43.800	46.600	43.467	45.717
48 kg	50.667	43.500	47.667	48.567	47.600	51.333	43.533	49.900	47.933	48.175
72 kg	51.233	43.400	48.367	48.600	47.900	49.267	39.267	40.333	47.200	44.017
Mean	49.950	43.500	47.467	48.084		49.550	41.767	45.067	45.442	

L.S.D.		
Variety (V)	0.498	2.784
K_2O (K)	0.498	2.784
VxK	0.996	5.569

2- Juice quality and sugar yield:

Data in Tables 5, 6 and 7 show that juice of G.87-37 had T.S.S. % and sucrose % more than those of other studied varieties in both crops, the differences between varieties were significant in plant and ratoon crop. On the other hand G.T. 54-9 variety surpassed the other varieties in sugar yield/fed. in plant and ratoon crops. This may be explained according to the negative association between yield and juice quality, also to the effect of gene make-up. This result is in accordance with those of Gomaa (2000) and Mohamed (2001).

Results presented in Table 5, 6 and 7 reveal that application of K fertilizer had a significant effect on T.S.S.%, sucrose %, and sugar yield in the plant and its first ratoon crops. The highest values were obtained by using 72 kg K2O /fed. where it gave (23.29 %, 20.88 % and 6.98 ton/fed.) in plant crop, and (21.21 %, 18.35 and 5.60 ton/fed.) in first ratoon for T.S.S. %, sucrose and sugar yield/fed., respectively. This result could be attributed to the important role of potassium in physiological processes in sugar cane plants such as translocation of sugar and carbohydrate synthesis. Similar results were obtained by Ismail (1991) who reported that juice quality was improved with increase in K up to 72 kg k_2o/fed.

The interaction between varieties and K fertilizer had a significant effect on all juice quality parameters in plant and first ratoon crops where G.T. 54-9 variety with 72 kg k_2O/fed. gave the highest sugar yield.

Table 5. Effect of varieties and k fertilizer on T.S.S% in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	19.98	20.15	18.98	19.04	19.54	17.87	18.30	16.88	17.28	17.58
24 kg	21.00	21.93	19.89	20.41	20.84	18.47	19.54	17.94	17.66	18.40
48 kg	22.00	22.73	20.62	21.83	21.80	20.03	20.47	18.69	19.96	19.79
72 kg	23.98	24.39	21.80	22.99	23.29	22.17	22.15	19.68	20.83	21.21
Mean	21.77	22.30	20.32	21.07		19.64	20.12	18.30	18.93	

L.S.D.		
Variety (V)	0.48	0.65
K_2O (K)	0.48	0.65
VxK	0.96	1.30

Table 6. Effect of varieties and k fertilizer on sucrose % in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	17.47	17.32	16.97	16.91	17.17	15.33	16.05	14.50	14.79	15.17
24 kg	18.66	19.78	17.33	17.58	18.34	15.98	16.77	15.47	15.36	15.90
48 kg	19.62	20.01	18.63	19.26	19.38	16.94	17.92	16.72	16.65	17.06
72 kg	20.84	21.99	19.75	20.93	20.88	18.66	19.21	17.38	18.17	18.36
Mean	21.77	19.78	18.17	18.67		16.73	17.49	16.02	16.24	

L.S.D.		
Variety (V)	0.58	0.52
K_2O (K)	0.45	0.52
VxK	1.15	1.04

Table 7. Effect of varieties and k fertilizer on sugar yield (t/fed) in plant crop and first ratoon.

K_2O/fed	Plant crop 1998/2000					Ratoon crop 2000/2001				
	GT54-9	G87/37	G87/55	F160	Mean	GT54-9	G87/37	G87/55	F160	Mean
0 kg	5.56	5.07	5.38	6.60	5.65	4.99	4.68	4.49	4.75	4.73
24 kg	6.35	6.07	5.62	5.69	5.93	5.36	4.76	4.80	4.57	4.87
48 kg	6.91	6.43	6.21	6.47	6.51	5.88	5.14	5.57	4.86	5.36
72 kg	7.33	6.66	6.77	7.18	6.98	6.57	5.17	4.83	5.82	5.60
Mean	6.54	6.06	5.99	6.49		5.70	4.94	4.92	5.00	

L.S.D.		
Variety (V)	0.28	0.34
K_2O (K)	0.428	0.34
VxK	1.56	0.67

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استجابة أربعة أصناف من قصب السكر للتسميد البوتاسي

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أجريت هذه الدراسة بمحطة البحوث الزراعية بالمطاعنة (محافظة قنا) خلال موسي ١٩٩٨-٢٠٠٠ و ٢٠٠٠-٢٠٠١ مشتملة على محصول الغرس الخريفي والخلفة الأولى له لدراسة إستجابة بعض أصناف قصب السكر (جيزة تايوان ٥٤-٩، جيزة ٨٧-٣٧، جيزة ٨٧-٥٥، ف.١٦٠) للتسميد الأرضي بالبوتاسيوم (صفر، ٢٤، ٤٨ و٧٢ كجم بو١/فدان) وقد أستخدم تصميم القطاعات كاملة العشوائية. وكانت أهم النتائج ما يلي:

١- تفوق الصنف التجاري جيزة تايوان ٥٤-٩ على الأصناف الأخرى في عدد العيدان للمتر المربع – طول الساق – سمك الساق – محصول العيدان – محصول السكر بينما تفوق الصنف جيزة ٨٧-٣٧ في صفات النسبةالمئوية للمواد الصلبة الذائبة الكلية – النسبة المئوية للسكروز في القصب الغرس والخلفة الأولى.

٢- أثر التسميد بالبوتاسيوم معنوياً على صفات عدد النباتات للمتر المربع – سمك الساق – محصول العيدان / الفدان – النسبة المئوية للمواد الصلبة الذائبة الكلية – النسبة المئوية للسكروز في العصير – محصول السكر في محصولي الغرس والخلفة الأولى حيث زادت بصفة عامة هذه الصفات بزيادة التسميد البوتاسي.

٣- يوصي هذا البحث بإضافة البوتاسيوم حتى معدل ٧٢ كم بو١ للفدان، وقد أعطى الصنف التجاري جيزة تايوان ٥٤-٩ بإستخدام هذا المعدل أعلى محصول سكر نظرى للفدان لمحصولي الغرس والخلفة الأولى.