Pak. J. Bot., 44(1): 131-134, 2012.

EFFICACY OF BIO-K FERTILIZER ON THE GROWTH AND SUGAR CONTENT OF SUGARCANE PLANTS

S. TAHIR ABBAS[1], RAHILA NAZLI[1]*, BUSHRA NAWAB[1] AND R.M. TARIQ[2]

[1]*Food and Marine Resources Research Centre, PCSIR Laboratories Complex, Karachi-75280, Pakistan*
[2]*M.A.H. Qadri Biological Research Centre, University of Karachi, E-mail: tariqbrc@yahoo.com*
[*]*E-mail: drrahilanazli@hotmail.com*

Abstract

Bio-K- fertilizer has been used as a source of potassium to enhance the concentration of sugar in sugarcane and prevent loss of resources and environmental damage. Potassium sulphate and murate of Potash are K fertilizers. The field experiments were done during 2009-2010 to see the increase of sugar contents in sugarcane by using –K- fertilizer. The use of bio-K-fertilizer has been found effective which resulted better yield in terms of both quantity and quality of sugarcane and found an increase in concentration of sucrose in sugarcane up to 28% calculated as 3-7%sugar content increase as a whole. The increase in crop production as whole was recorded as 74% due to Bio-K-fertilizer as compared to control plots. No chemical fertilizer was used during this experiment.

Introduction

Sugarcane is one of the important crop of Pakistan. Sugar crisis in Pakistan is directly related to sugarcane production. Pakistan has annually more than 10, lac hectares of land which is one of the largest area under sugarcane cultivation in the world. However, according to quantity, it is being ranked last. Production of sugar in Pakistan in the year 1999-2000 declined about 16%. Our average sugarcane production is 46-50 ton/ha ,whereas in the sugarcane producing countries like Indonesia, Egypt and Brazil, production is about 80-90 ton/ha (Bhambhro, 2002). Fertilizers play an important role in production of sugarcane crop. Nutrients application varies with soil types, seasons and conditions (Schroeder *et al.*, 1998; Ghaffar *et al*., 2011). In Pakistan 90% soils are deficient in nitrogen and phosphorus while 50% have insufficient potash (Bajwa, 1990). The use of chemical fertilizer leads to environmental problems (Yadava, 1977). Potassium is one of the major plant nutrients. It is not a part of plant or plant product, however it is very important for the life process of plant (Haji *et al*., 2011). It works as a catalyst in physiological process of plant, such as nitrogen metabolism and activation of enzymes (Yadava, 1966) .The application of potassium product result better yield of sucrose in sugarcane. Hybridization, induced mutation and biotechnological techniques play an important role in improved varieties of sugarcane. Bio-K fertilizer is friendly to the environment, low cost, easy to prepare and effective. The present studies on bio-K-fertilizer were carried out for the enhancement of sugarcane production and also to increase the concentration of sugar in sugarcane, at field level.

Materials and Methods:

Bio-K Fertilizer was prepared by PCSIR Labs Complex Karachi for field trial. Sugarcane was selected as a test crop because potassium requirement of sugarcane is high.

Plant material: Healthy sugarcanes (*Sacharum* officinarum) BL-4 with eyes were selected. They were cut into small pieces of 6"-8" in length with at least an eye in each piece. These pieces were soaked into benlate: water (1:200) solution for a period of 5-10 min., to prevent any fungal infection. Before sowing all the pieces were thoroughly dipped in slurry of bio-K-fertilizer and then these pieces after air-drying were sown in the experimental field.

Preparation of Experimental place: Experimental field was prepared by adding cow-dung and sweet earth; field was divided into six equal plots. Control and treated seeds (with and without Bio-K) were sown in alternate plots with replicates, 35 pieces were sown in each plot while distance between rows was 15"-18". Watering was done on alternate days. Experiment duration was kept one year.

Data collection: Sampling was done by selecting 10 plants randomly from each plot. Moisture was determined by drying the samples at 70^{o}C till constant weight.

Results and Discussion

Potassium is one of the major plant nutrients. The major role of potassium is energy transfer and carbohydrates metabolism. Sugar content in fruits decreases by potassium deficiency and insufficient supply of potash adversely affect on size, shape, color, form and sugar content of fruits. Sugarcane crop requires more potassium than nitrogen and phosphate. These amounts are much less than nitrogen and phosphorus uptake, which are 168-276 kg/ha and 18-29 kg/ha, respectively. Previously 100 field experiments with K-fertilizer resulted in significant effect on sugarcane crop (Wood *et al.*, 1990). Significant response to K application by sugarcane in Peshawar has been reported. Present studies are the use of bacterial bio-K-fertilizer without applying any chemical fertilizers.

The results obtained (Tables 1-13) revealed that bio-K fertilizer has a positive effect on both growth and sugar production as also reported by Khan *et al., (*2005) conducted an experiment to study the effect of NPK on yield of sugar at NIA, Tando Jam, Pakistan and reported a significant increase in sugar with K application @ 150 kg/ha. Bio-K-fertilizer can be used as a replacement for potash fertilizers, because bio-K fertilizer does not affect soil conditions and also reduces pollution. Besides chemical fertilizers increase the soil EC values and decrease pH, which results in inhibition of soil nitrogenous activity. Application of balance NPK

fertilizers, the potential yield has been obtained up to 165-176 ton/ha (Sharif & Chaudhry, 1988). Studies on bio- K-fertilizer showed increase of 10-15% in grain crop, 20-30% in vegetable and 15-25% in general. Besides these enhancements, the use of bio-K-fertilizer improved soil rhizosphere population and decreases resistance capacity. Bio-K treated plants produced much better in size, color, quality and quantity with an increase of 3-7% in sugar content. The height of plants was also increased by the application of bio-K-fertilizer. In control plots average height of plants were 334.97 cm as completed to treated plots it was observed 352.67 cm. Similarly average length of canes was 177.6 cm in control plots while incorporated by bio-K-fertilizer had an average length of cane 186.16 cm. Bio-K fertilizer resulted approximately 74% increased crop production. All physical and significant increase represented in Tables 1-13.

Table 1. Effect of Bio-K fertilizer on height of sugarcane.

Replicates	Control plots			Treated plots		
	1	5	9	2	6	10
1	373.38	431.18	401.32	449.58	370.84	421.64
2	391.78	398.78	355.6	396.24	373.38	383.54
3	378.46	416.56	388.62	396.24	381.0	381.
4	340.36	416.56	370.84	439.2	396.24	375.92
5	335.28	373.38	386.08	421.64	378.46	457.2
6	320.04	353.06	215.9	292.1	325.12	271.78
7	312.42	309.88	236.22	353.06	317.5	259.08
8	307.34	332.74	241.3	309.88	307.34	266.7
9	223.52	307.34	292.1	317.5	312.42	256.54
10	281.94	302.26	254	304.8	330.2	233.68
Average	326.452	364.174	314.198	368.046	349.25	330.708

Table 2. Effect of Bio-K fertilizer on length of sugarcane.

Replicates	Control plots			Treated plots		
	1	5	9	2	6	10
1	226.06	246.38	215.9	276.86	223.52	223.52
2	203.2	203.2	203.2	238.76	208.28	238.76
3	208.28	231.14	238.76	243.84	213.36	213.36
4	198.12	220.98	23.2	261.62	208.28	238.76
5	182.88	238.76	238.76	215.9	203.2	279.4
6	177.8	175.26	83.82	142.24	167.64	91.44
7	165.1	121.92	129.46	195.58	154.94	109.22
8	160.02	172.72	91.44	152.4	149.86	91.4
9	121.92	172.72	137.16	157.48	154.4	109.22
10	129.54	109.22	121.92	162.56	172.72	86.36
Average	177.292	189.23	166.362	204.724	185.62	168.144

Table 3. Effect of Bio-K fertilizer on yield (kg) of sugarcane plants.

Replicate	Control	Treated
1	96.00	195.00
2	91.00	96.50
3	96.50	149.00

Table 4. Effect of Bio-K fertilizer on circumference of stem of sugarcane plants.

Replicates	Control plots			Treated plots		
	1	5	9	2	6	10
1	13.97	12.70	11.43	13.97	12.7	13.97
2	13.97	11.43	11.43	12.7	11.43	12.70
3	12.70	11.43	10.37	13.97	12.70	13.33
4	12.70	11.43	10.16	12.70	12.95	13.33
5	11.43	12.7	11.43	12.70	14.22	13.97
6	11.43	10.16	7.62	11.43	12.70	11.43
7	10.16	9.65	11.43	11.43	11.93	11.43
8	7.62	10.16	11.43	11.43	10.16	10.16
9	11.43	10.43	12.70	11.43	12.19	11.43
10	11.43	9.65	12.70	10.16	10.92	10.16
Average	11.684	10.974	11.07	12.192	12.19	12.191

Table 5. Effect of Bio-K fertilizer on total weight of sugarcane plants.

Replicates	Control plots			Treated plots		
	1	5	9	2	6	10
1	2.45	1.62	1.01	1.3	1.29	1.56
2	1.04	2.02	1.9	2.72	1.98	2.80
3	1.25	1.84	1.00	1.46	1.2	1.2
4	1.51	1.75	1.45	2.11	1.59	2.00
5	1.96	1.07	1.53	1.72	1.86	1.73
6	1.14	1.6	1.21	1.22	1.09	2.3
7	2.50	1.02	1.70	2.80	2.10	1.70
8	1.10	2.04	1.2	1.57	1.28	1.25
9	1.81	1.05	1.28	2.00	1.65	2.70
10	1.66	1.07	1.50	1.72	1.80	1.61
Average	1.642	1.378	1.378	1.862	1.584	1.585

Table 6. Effect of Bio-K fertilizer on weight of cane of sugar cane plants.

Replicates	Control plots			Treated plots		
	1	5	9	2	6	10
1	0.845	1.28	0.824	1.08	0.955	1.21
2	1.20	1.9	1.50	2.10	1.600	1.80
3	0.8	0.70	0.70	1.00	0.90	1.45
4	1.25	1.30	1.1	1.55	1.25	1.26
5	1.16	1.88	1.09	1.34	1.40	1.08
6	1.25	1.10	1.25	1.20	1.50	1.13
7	1.50	1.23	1.074	1.69	1.05	1.90
8	1.1	1.10	0.90	1.10	1.00	1.25
9	1.2	0.93	0.99	2.08	1.15	1.46
10	1.21	1.20	1.00	1.00	1.40	1.10
Average	1.151	1.282	1.043	1.414	1.22	1.364

ANOVA Tables 7. Effect of Bio-K fertilizer on height of sugarcane.

		Sum of square	df	Mean square	F-value	Sig.
Treated*control	Between (combined)	100045.629	26	3847.909	4.359	0.125
	Within group	2648.382	3	882.794		
	Total	102694.011	29			
Control*treated	Between (combined)	99996.683	24	4166.528	2.956	0.115
	Within group	747.681	5	1409.536		
	Total	107044.364	29			

ANOVA Tables 8. Effect of Bio-K fertilizer on length of sugarcane.

		Sum of square	df	Mean square	F-value	Sig.
Treated*control	Between (combined)	81392.209	21	3875.819	4.198	0.021
	Within group	7386.635	8	923.329		
	Total	88778.845	29			
Control*treated	Between (combined)	64918.854	23	2822.559	25.082	0.000
	Within group	675.209	6	112.535		
	Total	65594.066	29			

ANOVA Table 9. Effect of Bio-K fertilizer on circumference of stem of sugarcane plants.

		Sum of square	df	Mean square	F-value	Sig.
Treated*control	Between (combined)	7.396	7	1.057	0.625	0.730
	Within group	37.181	22	1.690		
	Total	44.577	29			
Control*treated	Between (combined)	23.572	9	2.619	1.250	0.321
	Within group	41.900	20	2.095		
	Total	65.472	29			

ANOVA Table 10. Effect of Bio-K fertilizer on total weight of sugarcane plants.

		Sum of square	df	Mean square	F-value	Sig.
Treated*control	Between (combined)	7.422	28	0.265	147.253	0.065
	Within group	0.002	1	0.002		
	Total	7.423	29			
Control*treated	Between (combined)	4.638	25	0.186	1.155	0.502
	Within group	0.643	4	0.161		
	Total	5.280	29			

ANOVA Table 11. Effect of Bio-K fertilizer on weight of cane of sugar cane plant.

		Sum of square	df	Mean square	F-value	Sig.
Treated*control	Between (combined)	2.398	21	0.114	1.289	0.372
	Within group	0.709	8	0.089		
	Total	3.106	29			
Control*treated	Between (combined)	1.895	23	0.082	1.133	0.477
	Within group	0.436	6	0.073		
	Total	2.331	29			

Table 12. ANOVA Appendix one - sample statistics.

	N	Mean	Std. deviation	Std. error mean
Control	30	334.9667	60.7551	11.0923
Treated	30	352.668	59.5078	10.8646
Control	30	177.6560	47.5591	8.6831
Treated	30	186.1627	55.3294	10.1017
Control	3	94.5000	3.0414	1.7559
Treated	3	33.3133	54.7217	31.5936
Control	30	11.2427	1.5025	0.2743
Treated	30	12.1910	1.2398	.2264
Control	30	1.5093	0.4267	7.790E-02
Treated	30	1.7347	0.5059	9.237E-02
Control	30	1.1519	0.2835	5.177E-02
Treated	30	1.3330	0.3273	5.976E-02

Table13. ANOVA Appendix one sample test.

	t	df	Sig. (2.tailed)	Mean difference	95% confidence interval of the difference	
					Lower	Upper
Control 1	30.198	29	0.000	334.9667	312.2803	357.6530
Treated 1	32.460	29	0.000	352.6680	330.4474	374.8886
Control 2	20.460	29	0.000	177.6560	159.8972	195.4148
Treated 2	18.429	29	0.000	186.1627	165.5023	206.8230
Control 3	L53.817	2	0.000	94.5000	86.9448	102.0552
Treated 3	1.054	2	0.402	33.3133	102.6230	169.2497
Control 4	40.983	29	0.000	11.2427	10.6816	11.8037
Treated 4	53.857	29	0.000	12.1910	11.7280	12.6540
Control 5	19.374	29	0.000	1.5093	1.3500	1.6687
Treated 5	18.779	29	0.000	1.7347	1.5457	1.9236
Control 6	22.252	29	0.000	1.1519	1.461	1.2578
Treated 6	22.308	29	0.000	1.3330	1.2108	1.4550

Test value=0

References

Bajwa, M.I. 1990. Soil fertility management for sustainable agriculture. Proc. 3rd National**.** Congress of Soil Science**,** held at Lahore from 20th to 22nd March 1990. pp. 7-25.

Bhambhro, S.N. Daily Dawn, Pakistan December 25, 2002.

Ghaffar, A., E.N. Akbar and S.H. Khan. 2011. Influence of zinc and iron on yield and quality of sugarcane planted under various trench spacings. *Pak. J. Agri. Sci*., 48: 25-33.

Haji, M.A.A., A. Bukhsh, R. Ahmad, J. Iqbal, S. Hussain, A. Rehman and M. Ishaque. 2011. Potassium application reduces bareness in different maize hybrids under crowding stress Conditions. *Pak. J. Agri. Sci*., 48: 41-48.

Khan, I.A., G.S. Khatri, M.A. Nizamani, S. Siddiqui, Raza and N.A. Dahar. 2005. Effect of NPK fertilizer on the growth of sugar cane clone AEC86-347 developed at NIA, Tandojam, Pakistan. *Pak. J. Bot.*, 37(2): 355-360.

Schroeder, B.L., A.W. Wood and G. Kingston. 1998. The evolution on the bases for fertilizer recommendation in the Australia Sugar Industry. In: *Proc. Aust. Sugarcane Technol*., 21: 239-247.

Sharif, M. and T.M. Chaudhry. 1988. Role of potash and profitability of NPK application to sugarcane under Sindh condition. In: *Proc. 1st Natl. Congr. Soil Sci. Lahore*, Oct. 1985, pp. 327-333.

Wood, R.A. J.H. Meyer and R.A. Donaldson. 1990. Response to potassium by sugarcane, grown on base saturated pale soil in the Eastern Transvall Lowe led land. In: *Proc. S. Afr. Sug. Technol. Ass*., 64:17-21

Yadava, S.N. 1977. Dynamic optimization nitrogen use when ground water contamination in internalized at the standard at the long run. *Am. J. Agri. Eco.*, 79: 931-945.

Yadava, S.S.N. 1966. Soil fertility and fertilizers" 3rd Edition, Macmillan Publisher, London.

(Received for publication 25 August 2010)