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Effect of different sources and levels of sulphur on yield, quality and nutrient uptake of sugarcane ratoon crop

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Abstract
A field experiment was conducted to arrive the optimum dose of sulphur for sugarcane ratoon crop at sugarcane Research Station, Vuyyuru. Sulphur in the form of gypsum and elemental sulphur was applied in three levels *viz;* 30, 60 and 90 kg/ha along with recommended doses of nitrogen, phosphorus and potassium and were tested against no sulphur applied treatment. Thus seven treatments were replicated thrice in RBD design with the sugarcane variety 99 V 30. The treatments include T_1: Recommended doses of NPK only (RDF), T_2: RDF + 30 kg of 'S' per ha. Through elemental Sulphur, T_3: RDF + 60 kg of 'S' per ha. Through elemental Sulphur, T_4: RDF + 90 kg of 'S' per ha. Through elemental Sulphur, T_5: RDF + 30 kg of 'S' per ha. Through Gypsum, T_6: RDF + 60 kg of 'S' per ha. Through Gypsum and T_7: RDF + 90 kg of 'S' per ha. Through Gypsum. Application of sulphur resulted with the increase in shoot population at different stages of crop growth, cane yield, commercial cane sugar yield and nutrient uptake of nitrogen, phosphorus and potassium by sugarcane ratoon crop and were more at 90 kg sulphur per hectare. Among the sources tried, gypsum recorded highest cane and CCS yields and nutrient uptake and elemental sulphur was also significantly on par with gypsum. As the gypsum is economical in use than elemental sulphur, application of sulphur @ 90 kg/ha in the form of gypsum along with the recommended doses of nitrogen, phosphorus and potassium can be recommended for getting highest cane and CCS yields and nutrients uptake for ratoon crop of sugarcane.

Keywords: Sulphur, gypsum, elemental sulphur, sugarcane, ratoon crop, cane yield, CCS yield, juice sucrose, nutrient uptake

Introduction
Sulphur is one of the sixteen elements essential to crop production and it is essential for maximum crop yield and quality, often ranked behind only nitrogen, phosphorus and potassium in importance (Jeschke and Diedrick, 2010) [10]. Sulphur plays an important role in the plant's metabolism and required for amino acids, proteins and photosynthesis. Sulphur deficiencies are often confused with nitrogen deficiencies. Symptoms of Sulphur deficiency appear as stunted plant growth, general yellowing of leaves. In less severe sulphur deficiency situations, visual symptoms may not be apparent, but both yield and quality of crops will be affected (Ceccotti, 1996) [4]. Sulphur is becoming more of a limiting nutrient in crop production than in the past. The reasons for this increasing need include higher crop yields which require more sulphur, increased use of high analysis fertilizers containing little or no sulphur, reduced amounts of atmospheric sulphur fallout in rainfall and reduced soil sulphur reserves from organic matter losses due to mineralization and erosion (AW, PW *et al.*, 2005 [2]; Ceccotti, 1996) [4].
Sugarcane exhibits luxury consumption and removes a considerable quantity of sulphur from the soil. A hundred ton crop of cane contains about 47.6 kg SO_4 (Ali, 1986 [1]; Humbert, 1968 [8]). Intensive agriculture with use of high analysis and sulphur free fertilizers results in a decline in sulphur status of the soils, ultimately expressing sulphur deficiency in various crops. Imbalance in the use of fertilizer nutrients and depletion in the organic matter status of soils aggravated the problem of sulphur deficiency is soils and crops and became a serious constraint in the use efficiency of other nutrients. This condition implies to Krishna district soils where the sulphur deficiencies were noticed, finally leading to reduction in yield and quality of crops. The crops which produce higher biomass and the quality such as sugarcane removes higher amount of sulphur from soil which necessitates the replenishment. Hence the present study is proposed to know the best source and correct level or dose of sulphur for improving yield and quality of sugarcane crop.

Materials and Methods

A field experiment was conducted in sugarcane ratoon crop using the variety 99 V 30 at Sugarcane Research Station, Vuyyuru, Krishna district of Andhra Pradesh. The experiment was conducted in soil having pH value 7.63 and EC 0.42 d Sm^{-1} (Table 1). Soil is low in organic carbon (0.46%), medium in available nitrogen (376 kg/ha) high in phosphorus (36 kg/ha) potassium (452 kg/ha) and low in available sulphur (8 ppm). Recommended dose of nitrogen, phosphorus and potassium were applied @ 212, 100 and 168 kg/ha, respectively. Entire dose of phosphorus and potassium were applied as basal at the time of ratooning and nitrogen was applied in two equal splits at the time of ratooning and at 45 days after ratooning. Sulphur was applied in three different levels (30, 60 and 90 kg/ha) through two sources of sulphur (Elemental sulphur and gypsum). These sulphur applied treatments were tested against the control where recommended dose of N, P and K only applied without sulphur. Thus seven treatments were replicated thrice in R.B.D design.

Treatments include

T_1: Recommended doses of NPK only (RDF)
T_2: RDF + 30 kg of 'S' per ha. Through elemental Sulphur.
T_3: RDF + 60 kg of 'S' per ha. Through elemental Sulphur.
T_4: RDF + 90 kg of 'S' per ha. Through elemental Sulphur.
T_5: RDF + 30 kg of 'S' per ha. Through Gypsum.
T_6: RDF + 60 kg of 'S' per ha. Through Gypsum.
T_7: RDF + 90 kg of 'S' per ha. Through Gypsum

Data was collected on shoot population at different stages of crop growth, cane yield and juice quality. Whole cane plant samples were collected at grand growth period, cut into pieces, oven dried, powdered and analysed for nutrient contents of N, P & K using standard methods (Bremner and Mulvaney, 1982 [3], Jackson, 1973 [9] and Muhr *et al.*, 1963 [11], respectively). Uptake of nutrients was calculated using the following formula…

$$\text{Uptake of nutrient (kg/ha)} = \frac{\%\ \text{Conc. of nutrient} \times \text{Cane yield (t/ha)} \times 1000}{100}$$

Table 1: Initial soil analysis results in which experiment was conducted

S. No.	Parameter	Value
1.	pH	7.63
2	E.C.	0.42 dSm^{-1}
3	Available nitrogen	376 $kgha^{-1}$
4	Available phosphorus	36 $kgha^{-1}$
5	Available potassium	452 $kgha^{-1}$
6	Organic carbon	0.46%
7	Available sulphur	8 ppm

Results and Discussion

Shoot population at different stages of crop growth *i.e* at 90, 120, 160 and 180 days after ratooning was more with the application of sulphur compared to control and was more at 90 kg sulphur per ha in the form of gypsum followed by elemental sulphur. Cane yield and CCS (Commercial cane sugar) yield were also increased with the increase in the dose of the application of sulphur compared to control (T_1). Highest cane yield (91.71 t/ha) and CCS yield (13.61 t/ha) were recorded with the application of sulphur @ 90 kg/ha in the form of gypsum and were on par with T_4 (Application of sulphur @ 90 kg/ha in the form of elemental sulphur. Increase in cane yield might be due to increase in yield attributes such as number of millable canes, cane weight, cane girth and plant height with the application of sulphur along with recommended doses of nitrogen, phosphorus and potassium. These results are in confirmation with Singh *et al.* (2008) [16] reporting increase in the cane yield with the balanced application of N, P, K and S and Ghosh *et al.* (1990) [7].

Quality of sugarcane such as juice sucrose % and CCS % were increased with the application of sulphur but the increase was not significant (Table 2). 6.56% of juice sucrose and 7.22% of CCS were increased with application of sulphur at 90 kg/ha compared to no sulphur application. Similar results were also reported by Naga Madhuri *et al.* (2011) [12].

Table 2: Effect of different sources and levels of sulphur on yield and quality of sugarcane

Treatments	Shoot population ('000 /ha)				Cane Yield (t/ha)	Juice sucrose (%)	CCS %	CCS Yield (t/ha)
	90 DAP	120 DAP	160 DAP	180 DAP				
T_1	50.78	50.78	50.78	47.05	62.02	19.21	13.84	8.57
T_2	54.77	54.77	55.21	49.56	71.83	19.55	13.95	10.02
T_3	54.86	56.68	58.85	54.68	74.35	19.96	14.48	10.80
T_4	68.49	59.89	61.02	55.12	81.55	20.31	14.21	11.58
T_5	59.37	55.82	55.73	50.78	72.70	19.87	14.22	10.35
T_6	62.85	57.12	58.85	58.25	75.69	19.70	14.22	10.77
T_7	71.70	66.84	68.49	60.16	91.71	20.47	14.84	13.61
C.D @5%	12.24	6.54	6.417	NS	14.09	NS	NS	2.41
C.V (%)	11.4	6.4	6.2	9.2	10.5	4.2	4.8	12.5

Table 3: Effect of different sources and levels of sulphur on nutrient uptake by sugarcane

Treatments	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
T_1	225.57	18.45	190.97
T_2	292.08	52.32	331.94
T_3	333.69	59.75	327.57
T_4	373.43	81.29	410.61
T_5	331.66	57.79	293.43
T_6	329.43	74.15	382.23
T_7	457.67	96.81	500.32

C.D 5%	84.91	31.43	169.54
C.V (%)	14.3	28.1	27.4

Application of sulphur also increased the whole plant nutrient uptake of nitrogen, phosphorus and potassium by sugarcane ratoon crop and was more at 90 kg S/ha. Among the sources tried, gypsum recorded highest uptake of nutrients and elemental sulphur was also on par with the gypsum. The significant increase of nitrogen uptake with sulphur application was might be due to the cumulative effect of higher yield along with higher content. A profuse vegetative growth and higher yield due to sulphur application might increased nitrogen uptake.

Increased uptake of phosphorus by plants was because of increased phosphorus absorption in the presence of sulphur. The favourable effect of sulphur on the absorption of phosphorus can be due to the ability of sulphur to mobilise phosphorus in to available form. More uptake of phosphorus resulted from enhanced mobilisation of soil phosphorus thereby enhanced efficiency of native and applied phosphorus due to decrease in pH and its utilisation by crops was reported by Raikhy *et al.* (1985) [13] and Tiwari *et al.* (1984) [17].

Increased uptake of potassium was mainly because of increase in potassium concentration and cane yield which shows the synergistic effect of sulphur and potassium in increasing cane yield and CCS yield. Similar results of increase in uptake of nitrogen, phosphorus and potassium with sulphur application were also reported by Gangwar and Parameswaran (1977) [6] and Sagare *et al.* (1990) [14] in sunflower, Singh and Bairathi (1980) [15] in mustard, Das and Das (1994) [5] in rapeseed and Raikhy *et al.* (1985) [13] in cowpea.

Among the sources tried, gypsum recorded highest nutrient uptake of N, P and K at 90 kg S/ha and elemental sulphur was on par with it. This was because of easily available sulphate sulphur in gypsum than elemental sulphur which helped in increasing nutrient uptake and yield attributes and thereby resulting in increase in cane yield and CCS yield finally.

Conclusion

From this study it was proved that the application of sulphur along with the application of recommended doses of nitrogen, phosphorus and potassium increased the cane yield, CCS yield and nutrient uptake of nitrogen, phosphorus and potassium by whole plant of sugarcane ratoon crop irrespective of the sources tried. Among the sources tried, gypsum recorded highest cane yield, commercial cane sugar yield and nutrient uptake and elemental sulphur was on par with gypsum and the gypsum is economical in use than elemental sulphur. Hence, it can be concluded that application of sulphur @ 90 kg/ha in the form of gypsum along with the recommended doses of nitrogen, phosphorus and potassium can be recommended for ratoon crop of sugarcane for getting highest cane and CCS yields and nutrients uptake of sugarcane.

References

1. Ali OA. Sugarcane Response to Applied Potassium at Different Potassium Levels at Kenana Sugar Company Ltd. University of Khartoum 1986.
2. AW W, PW M, JH P. Sustainable nutrient management-delivering the message to the Australian sugar industry. In: Proceeding of South Africa Sugar Technology Association 2005, 206.
3. Bremner JM, Mulvaney RL. Nitrogen total in methods of soil analysis. chemical and microbiological methods edited by Page AL Miler RH and Keeny Dr. American Society of Agronomy, Madison, Wisconsin 1982, 2.
4. Ceccotti S. Plant nutrient sulphur: A review of nutrient balance, environmental impact and fertilizers. In: Fertilizers and Environment. Springer 1996, 185-193.
5. Das KN, Das K. Effect of sulphur and nitrogen fertilisation on yield and N uptake by rapeseed. Journal of the Indian Society of Soil Science 1994;42:476-478.
6. Gangwar, Parameswaran PM. Phosphorus-sulphur relationship in sunflower. Oilseed Journal 1977;7:28-32.
7. Ghosh AK, Rai RK, Saxena YR, Shrivastava AK. Effect of sulphur application on the nutritional status, yield and quality of sugarcane. J Indian Society of Soil Science 1990;38(1):73-76.
8. Humbert R. The growing of Sugarcane. Elsevier, POB. Co. Amesterdam 1968.
9. Jakson ML. Soil Chemical Analysis. Prentice Hall of India PVT. Ltd., New Delhi 1973, 38.
10. Jeschke M, Diedrick K. Sulfur fertility for crop production. Crop Insights 2010, 20.
11. Muhr GR, Datta NP, Sankarasubramoney H, Dever RF, Levey VK, Donanve RL. Soil testing in India, United States Agency for International Development Mission to India, New Delhi 1963.
12. Naga Madhuri KV, Jaya Prakash M, Sarala NV. Effect of sulphur on quality of sugarcane juice and jiggery. International Journal of applied Biology and Pharmaceutical technology 2011;2(2):218-221.
13. Raikhy NP, Aggarwal RK, Raina P. Performance of pyrites and gypsum as sulphur source in an arid sandy soil. Journal of the Indian Society of Soil Science 1985;33:447-449.
14. Sagare BN, Guhe YS, Atre AH. Yield and nutrient harvest by sunflower (*Helianthus annus* L.) in response to S and Mg application in Typic Chromusterts. Annals of Plant Physiology 1990;4:15-21.
15. Singh KS, Bairathi RC. A study on the sulphur utilisation of mustard in the semi-arid tract of Rajasthan. Annals of Arid zone 1980;19:197-202.
16. Singh VK, Shukla AK, Gill MS, Sharma SK, Tiwari KN. Improving Sugarcane Productivity through Balanced Nutrition with Potassium, Sulphur, and Magnesium, Better crops -India 2008, 12-15.
17. Tiwari KN, Dwivedi BS, Upadhyay GP, Pathak AN. Sedimentary iron pyrites as amendment for sodic soils and carrier of fertiliser sulphur. Fertliser News 1984;29(10):31-41.