

## COMPARATIVE EFFICACY OF SOIL AND FOLIAR APPLICATION OF $ZnSO_4$ AND $FeSO_4$ ON SUGARCANE

K. R. KUMARESAN, P. SAVITHRI, T. S. MANICKAM, G. V. KIJHANDARAMAN\* and K. CHARLES DANIEL\*\*

Field experiments were conducted at seven locations in the Nellikuppam sugar factory area where Zn and Fe deficiencies are noticed, to study the comparative efficacy of soil and foliar application of  $ZnSO_4$  and  $FeSO_4$  for sugarcane. The treatments consisted application of  $ZnSO_4$  (0, 18.75 and 37.5 kg/ha);  $FeSO_4$  (0, 50 and 100 kg/ha); foliar application of 1%  $ZnSO_4$ , 2%  $FeSO_4$  and 2% urea on 90th, 110th and 130th days. Sugarcane varieties COC 8001, COC 671, COC 8201 and CO 6304 were tested. The cane yield was significantly increased at three locations viz., P. V. Natham, P. N. Palayam and Ramhakkam with the application of  $ZnSO_4$  and  $FeSO_4$  in COC 8001 at two locations and another in COC 671 varieties. The cane yield increase ranged from 3.28 to 8.46 t/ha between NPK control and other treatments. Consideration of the mean yield values for different treatments for three locations indicated higher response for the application of 18.75 kg  $ZnSO_4$  + 50 kg  $FeSO_4$ /ha + 1%  $ZnSO_4$  + 2%  $FeSO_4$  + 2% urea (foliar sprays given on 90th, 110th and 130th days). But this was on par with the other treatments including the 2% urea foliar spray. The mean Pol percentage (Sucrose content) was increased significantly in five locations in all the varieties tried. Although cane yield was significantly increased for the urea 2% spray, tune of increase in Pol % was markedly higher only for the Zn and Fe treatments. Foliar spray of Zn and Fe had greater effect than the soil application.

A world wide geographical survey of sugarcane indicated that it is a crop grown in over 80 countries, an agricultural resource of greatest importance, and cultivated under the most diverse environmental and socio-economic conditions. In some soils prevalence of micronutrient deficiency directly causes reduction in the yield and quality of crops. The micronutrient deficiencies occurred mainly because of the continuous use of high analysis fertilizers, increased crop removal, intensive cultivation of different high yielding varieties and monoculture of crops over a long period. Soil has also become limiting in micronutrient availability due to high content of calcium carbonate

causing the chlorosis in the leaves by which reduction in cane yield and quality.

A survey on sugarcane soils of Tamil Nadu indicated that the deficiencies for Zn and Fe are more prevalent in the soils of monoculture cane growing area (Anon, 1984). In calcareous soils with low Fe availability, the  $FeSO_4$  foliar application either singly or in combination with  $MnSO_4$  and urea had been resorted to obtain increased yield, in Coimbatore district of Tamil Nadu (Anon, 1984). Hence the present investigation was undertaken to study the response for the micronutrients

\* Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641 003.

\*\*Deputy Chief Cane Superintendent, EID Parry (India) Ltd, Nellikuppam, South Arcot district.

application in relation to yield and quality in different sugarcane varieties.

#### MATERIALS AND METHODS

Field experiments at seven locations were conducted in the farmers holdings of Nellikuppam (supplying cane to EID Parry (India) Ltd.) sugarcane growing area, where sugarcane is cultivated as monoculture crop for more than a century. The particulars regard-

ing locations, varieties, initial soil analysis and soil taxonomical classification are given in Tables 1 and 2. The initial soil available micronutrients were estimated by the procedure of Lindsay and Norvell (1978).

The experiments were laid out in simple RBD with four replications and 9 treatments viz., ZnSO<sub>4</sub> (0, 18.75 and 37.5 kg/ha) ; FeSO<sub>4</sub> (0, 50 and 100 kg/ha), foliar application of 1% ZnSO<sub>4</sub> and

Table 1. Particulars of experiment allocations and initial soil analysis

Sl. No.	Locations	Variety	Available micronutrients (ppm)			
			Zn	Cu	Fe	Mn
I.	P. V. Natham	COC 8001 pl.	0.96	2.0	3.0	9.17
II.	P. N. Palayam	COC 8001 pl.	1.14	2.5	0.75	3.66
III.	Kandrakottai	COC 8001 pl.	1.10	2.0	1.0	9.6
IV.	Manthipalayam	COC 671 pl.	0.72	1.02	1.5	12.0
V.	Rambakkam	COC 8201 pl.	0.82	2.0	4.0	14.0
VI.	Sornavoor	CO 6304 pl.	0.82	2.0	1.0	14.4
VII.	Edayanvelly	CO 6304 pl.	1.2	2.25	1.5	8.4

Table 2. Soil taxonomical classification of the experimental sites

Sl. No.	Locations	Symbol	Order	Soil type	Soil texture
I.	P. V. Natham	Vuop	Inceptisol	Vertic ustocrepts	Sandy clay
II.	P. N. Palayam	Uhsf	Alfisol	Udic haplustalf	Loamysand
III.	Kandarakottai	Ushf	Alfisol	Udic haplustalf	Sandy clay loam
IV.	Manthipalayam	Uhsf	Alfisol	Udic haplustalf	Loamy sand
V.	Rambakkam	Vuop	Inceptisol	Vertic ustocrept	Sandy clay
VI.	SornaVoor	Vuop	"	"	"
VII.	Edayanvelly	Vuop	"	"	"

2% urea at 90th, 110th and 130th days, besides NPK control (275:62.5:112 kg/ha). NPK each as urea, single superphosphate and muriate of potash respectively. While P was applied in full at the time of planting, N and K were applied in two equal splits at 45th and 90th days after planting. The  $ZnSO_4$  and  $FeSO_4$  were mixed with sand and applied in the furrows before planting of cane. Foliar spray of  $ZnSO_4$  and  $FeSO_4$  and urea were given in three sprays, at an interval of 20 days from 90 days after planting. Weight of cane harvested from net plot area was recorded. The sucrose content was estimated with the help of a juice analyser known as sucrolyser. The juice samples were clarified as per Horne's dry lead sub-acetate method (Meade-Chen, 1977) before feeding to the instrument. The data were statistically scrutinized.

## RESULTS AND DISCUSSION

### (a) Cane yield :

The sugarcane yield was significantly increased at three locations viz., P. V. Natham, P. N. Palayam and Rambakkam for the application of  $ZnSO_4$  and  $FeSO_4$ . Soil and foliar treatments in COC 8001 at two locations and another in COC 8201 varieties (Table 3). The cane yield increase ranged from 3.28 to 8.46 t/ha. In other locations though the cane yield had not attained the level of significance, the increased cane yield over control was recorded for the  $ZnSO_4$  and  $FeSO_4$  fertilization. It is obvious that  $ZnSO_4$  and  $FeSO_4$  definitely had an impact in increasing cane yield. This might be due to the response of the  $ZnSO_4$  and  $FeSO_4$  fertilization in the high order in

the soils which are highly deficient in DTPA-Zn (1.1 ppm) and DTPA-Fe (1.0 ppm). Increased cane yields were recorded (80.9 t/ha and 104.9 t/ha) at locations P.V. Natham and Sornavoor respectively over the NPK control (74.4 t/ha and 98.1 t/ha) for the application of 18.75 kg  $ZnSO_4$ /ha + 50 kg  $FeSO_4$ /ha + 1%  $ZnSO_4$  + 2%  $FeSO_4$  foliar spray at 90th, 110th and 130th days. Here it is interesting to note that the soils of experimental sites are deficient (0.96 and 0.82 ppm for DTPA-Zn and 3.0 and 1.0 ppm for DTPA-Fe). At locations P. N. Palayam and cane Farm Edayanvelly, the cane yield increased to 106.5 t/ha and 83.7 t/ha respectively over the NPK control (100.5 t/ha ; 78.6 t/ha) in COC 8001 and CO 6304 for the foliar application of 1%  $ZnSO_4$  + 2%  $FeSO_4$ . This might be due to the highest response to the applied Zn and Fe where these soils are deficient in these elements. Compared to the soil application, the foliar application was found to be good in increasing the cane yield. This is in line with the findings of Srivastava *et al.*, (1978). At locations Manthipalayam and Rambakkam though 2% urea foliar spray had increased cane yield, it was on par with  $ZnSO_4$  and  $FeSO_4$  soil and foliar application in COC 671, COC 8201. And CO 6304 had responded well to the micronutrient fertilization than that of the varieties COC 671 and 8201 in increasing the cane yield.

### (b) Sucrose content : (Table 4)

The mean Pol per cent (sucrose content) was increased significantly at Kandrakottai, Manthipalayam, Rambakkam and cane farm Edayanvelly in all varieties tested. The increase in sucrose content ranged from 0.86 to 2.4% for

Table 3. Cane yield (t/ha) (Mean of three replications)

Sl. No.	Treatments	Locations													
		P. V. Natham		P. N. Palayam		Kandra-kottai		Manthi-Palayam		Rambak-kam		Sorna-voor		Edayan-velly	
		COC	8001	COC	8001	COC	8001	COC	671	COC	8201	COC	6304	COC	6304
1.	NPK Control N : P <sub>2</sub> O <sub>5</sub> : K <sub>2</sub> O (275 : 62.5 : 112 kg/ha)	74.4	100.5	108.8	72.3	107.0	98.1	78.6							
2.	NPK + 37.5 kg ZnSO <sub>4</sub> + 100 kg FeSO <sub>4</sub> /ha	78.9	104.1	113.9	74.3	110.3	102.3	81.8							
3.	NPK + 1% ZnSO <sub>4</sub> + 2% FeSO <sub>4</sub> foliar spray on 90th, 110th and 130th days	80.7	106.5	110.6	73.8	111.9	103.8	83.7							
4.	NPK + 2% Urea foliar spray on 90th, 110th and 130th days	80.8	105.5	111.7	74.7	115.5	102.3	82.8							
5.	NPK + 2% Urea + 1% ZnSO <sub>4</sub> + 2% FeSO <sub>4</sub> on 90th, 110th and 130th days	80.8	106.1	109.9	74.4	114.0	102.9	83.2							
6.	NPK + 18.75 kg ZnSO <sub>4</sub> /ha + 1% ZnSO <sub>4</sub> + 2% urea foliar spray on 90th, 110th and 130th days	80.4	106.8	107.9	73.8	113.1	103.9	81.3							
7.	NPK + 50 kg FeSO <sub>4</sub> /ha + 2% FeSO <sub>4</sub> + 2% urea foliar spray on 90th, 110th and 130th days	80.8	105.5	110.1	72.9	114.6	103.5	80.3							
8.	NPK + 18.75 kg ZnSO <sub>4</sub> /ha + 50 kg FeSO <sub>4</sub> /ha + 1% ZnSO <sub>4</sub> + 2% FeSO <sub>4</sub> foliar spray on 90th, 110th and 130th days	80.9	104.9	109.9	74.2	113.1	104.9	82.5							
9.	NPK + 18.75 kg ZnSO <sub>4</sub> /ha + 50 kg FeSO <sub>4</sub> /ha + 2% urea foliar spray on 90th, 110th, 130th days	80.7	106.5	109.4	73.4	114.9	102.9	82.9							
	S. E.	0.47	0.61	1.85	0.54	0.60	1.51	1.03							
	C. D.	1.41	1.83	NS	NS	1.80	NS	NS							

Table 4. Pol % (Sucrose content). (Mean of three replications)

Sl.No.	Treatments	Locations													
		P. V. Natham		P. N. Kandra- Palayam		Kandri- kottai		Manthi- Palayam		Rambak- kam		Sorna- voor		Edayan- velly	
		COC	8001	COC	8001	COC	8001	COC	671	COC	8201	COC	6304	COC	6304
1.	NPK Control N : P <sub>2</sub> O <sub>5</sub> : K <sub>2</sub> O (275 : 62.5 : 112 kg/ha)	17.6	18.7	18.7	16.9	18.3	16.3	16.9	15.2						
2.	NPK + 37.5 kg ZnSO <sub>4</sub> + 100 kg FeSO <sub>4</sub> /ha	18.6	18.9	17.1	18.5	18.8	17.7	15.4							
3.	NPK + 1% ZnSO <sub>4</sub> + 2% FeSO <sub>4</sub> foliar spray on 90th, 110th and 130th days	19.7	19.6	18.6	19.9	18.5	17.8	15.7							
4.	NPK + 2% Urea foliar spray on 90th, 110th and 130th days	18.7	18.9	18.1	18.9	18.1	17.5	15.4							
5.	NPK + 2% Urea + 1% ZnSO <sub>4</sub> + 2% FeSO <sub>4</sub> on 90th, 110th and 130th days	18.8	19.5	18.4	19.1	18.4	17.6	15.6							
6.	NPK + 18.75 kg ZnSO <sub>4</sub> /ha + 1% ZnSO <sub>4</sub> + 2% urea foliar spray on 90th, 110th and 130th days	19.1	20.0	18.7	20.6	17.5	17.4	16.0							
7.	NPK + 50 kg FeSO <sub>4</sub> /ha + 2% FeSO <sub>4</sub> + 2% urea foliar spray on 90th, 110th and 130th days	18.9	19.8	18.8	19.3	17.2	17.2	16.3							
8.	NPK + 18.75 kg ZnSO <sub>4</sub> /ha + 50 kg FeSO <sub>4</sub> /ha + 1% ZnSO <sub>4</sub> + 2% FeSO <sub>4</sub> foliar spray on 90th, 110th and 130th days	19.5	19.8	19.2	19.3	18.2	17.4	16.1							
9.	NPK + 18.75 kg ZnSO <sub>4</sub> /ha + 50 kg FeSO <sub>4</sub> /ha + 2% urea foliar spray on 90th, 110th, 130th days	19.3	19.1	19.3	19.3	17.6	17.6	16.4							
	S. E.	0.51	0.34	0.22	0.29	0.25	0.35	0.13							
	C. D.	NS	NS	0.67	0.89	0.74	NS	0.38							

the  $ZnSO_4$  and  $FeSO_4$  application. Eventhough cane yield was significantly increased for the urea 2% foliar spray, the tune of increase in Pol % was markedly higher only for the Zn and Fe treatments. Wherever the increased cane yield obtained for the  $ZnSO_4$  and  $FeSO_4$  application the sucrose content was got reduced especially in COC 8001 and CO 6304 varieties. The least increase in Pol % was recorded in CO 6304 at Sornavoor. At Rambakkam and Sornavoor attained maximum sucrose content (18.5 and 17.8 %) due to 1%  $ZnSO_4$  + 2%  $FeSO_4$  foliar application in COC 8201 and CO 6304 varieties. At P.V. Natham the increase in Pol % (19.5%) was due to the soil and foliar application of Zn and Fe. At P. N. Palayam and Manthipalayam, soil application of 18.75 kg  $ZnSO_4$ /ha + 1%  $ZnSO_4$  along with 2% urea foliar spray is needed to attain maximum Pol % of 20.0 to 20.6% in COC 8001 and COC 671 varieties. The  $ZnSO_4$  and  $FeSO_4$  soil and foliar application along with 2% urea spray also increased the Pol % at two locations viz., Kandrakottai and cane farm. Further the foliar spray of Zn and Fe had greater effect than that of soil appli-

cation. The results indicated clearly the possibility of using micronutrient fertilizers suitably in deficient soils for enhancing not only the yield but also the sucrose content.

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