SHORT COMMUNICATIONS

ENHANCEMENT OF GROWTH AND YIELD OF SUGARCANE THROUGH DRIP FERTIGATION AND SOIL APPLICATION OF MICRONUTRIENTS

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Abstract

A field experiment was conducted at Regional Agricultural Research Station, Anakapalle, Andhra Pradesh to study the effect of micronutrient application through soil and drip fertigation on yield and quality of sugarcane in North Coastal Zone of Andhra Pradesh. The experimental soil was sandy loam with pH 7.16, EC 0.184 dS m^{-1}, organic carbon 0.65%, available N 234.0 kg ha^{-1}, available P 77.0 kg ha^{-1}, available K 177.0 kg ha^{-1}, available Fe 13.1 ppm and available Zinc 0.98 ppm. The different treatments under test are T1: Control (without micro nutrients), T2: Soil application of $ZnSO_4$ @ 50 kg ha^{-1}, T3: Application of $ZnSO_4$ @ 25 kg ha^{-1} through drip, T4: Soil application of $FeSO_4$ @ 50 kg ha^{-1}, T5: Application of $FeSO_4$ @ 25 kg ha^{-1} through drip, T6: Soil application of B @ 1 kg ha^{-1}, T7: Application of B @ 0.5 kg ha^{-1} through drip, T8: Soil application of combination of micro nutrients (Formula-4) and T9: Application of combination of micro nutrients through drip (Formula-4). There is increase in yield to the extent of 7.7 to 15.2 t ha^{-1} due to application of micronutrients through drip as compared to control. The micronutrients Zn, Fe and Formula-4 also showed a high frequency of response in cane yield when applied through drip as compared to soil application. Significant variations were not observed in juice quality parameters due to different treatments.

Key Words : Drip fertigation, micronutrients, soil application, sugarcane

Introduction

In India, sugarcane alone covers 5.14 million hectare area with a production of 359.33 million tons (Anon 2015). Besides socio economic constraints, the most significant reason for the yield decline in an intensive cultivation is inadequate and imbalanced water and nutrient supply. Sugarcane being a long duration and huge biomass accumulating crop removes substantial amount of plant nutrients from the soil and use of NPK fertilizers alone could not maintain the higher yields over years because of emergence of secondary and micronutrient deficiencies and deterioration of soil physical properties (Naga Madhuri et al. 2013). Micronutrients are of immense significance, though the plants required them in a smaller quantity, they play a vital role in the growth, development and yield of the plants. The deficiency of any nutrient may result in retarded growth and decrease the yield and thus minimizes the usefulness of other agricultural inputs including NPK fertilizers (Panhwar et al. 2003). Use of drip fertigation is also very effective in high value row crop like sugarcane. Fertiliser use is quite high in sugarcane. Response of sugarcane to N, P and K under drip fertigation is well established but studies on micronutrient application through drip fertigation are very meagre. The present study was conducted to assess the effect of micronutrient application through soil and drip fertigation on sugarcane yield and juice quality.

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Materials and methods

A field experiment was laid out in randomized block design with three replications. Treatments consisting of T1: Control (without micro nutrients), T2: Soil application of $ZnSO_4$ @ 50 kg ha^{-1}, T3: Application of $ZnSO_4$@ 25 kg ha^{-1} through drip, T4: Soil application of $FeSO_4$@ 50 kg ha^{-1}, T5: Application of $FeSO_4$@ 25 kg ha^{-1} through drip, T6: Soil application of B @ 1 kg ha^{-1}, T7: Application of B @ 0.5 kg ha^{-1} through drip, T8: Soil application of combination of micro nutrients (Formula-4) @ 5 g l^{-1} and T9: Application of combination of micro nutrients through drip (Formula-4) @ 2.5 g l^{-1}. Formula-4 contains Fe 4.0%, Mn 3.0%, Zn 6.0%, Cu 1.0%, Mo 0.05% and B 2.0%. The physico-chemical properties of experimental soil are presented in Table 1.

Table 1. Physico-chemical properties of experimental soil

Parameter	Observed
pH	7.16
EC (dS m^{-1})	0.184
Organic Carbon (%)	0.65
Available (kg ha^{-1})	234 (low)
Available PO (kg ha^{-1})	77 (high)
Available K (kg ha^{-1})	177(medium)
Fe (ppm)	13.10 (sufficient)
Zn (ppm)	0.98 (sufficient)

Three budded setts of an early maturing variety 2000A56 (CoA07321) was planted during March, 2016 in paired method of planting (120×60 cm). Nitrogen (112 kg ha^{-1}) was applied through fertigation staring from 30 days after planting (DAP) with a weekly interval and continued up to 180 days after planting equally to all treatments while P (100 kg ha^{-1}) and K (120 kg ha^{-1}) nutrients were applied as basal at the time of planting in furrows. Micronutrients $ZnSO_4$, $FeSO_4$, Boron (B) and combination of micronutrients (Formula-4) were applied through drip starting from 45 DAP to 120 DAP at weekly interval in 10 equal splits. All other agronomic practices like hand weeding, earthing-up, trash twist propping etc., were carried out according to recommendations. During the crop growth period 1271.5 mm of rainfall was received against the average rainfall of 1139.2 mm (Table 2).

Results and discussion

The sugarcane response to micronutrient application varied significantly with respect to the soil and drip fertigation. Significant responses were found in number of millable canes and cane yield. However, micronutrient application either through soil or drip fertigation did not affect the juice quality parameters.

Number of millable canes

The data depicted in Table 3 showed that maximum number of millable canes (NMC) in different micronutrient applied treatments ranged between 74557 ha^{-1} to 82,965 ha^{-1}. It was observed that maximum NMC was recorded in application of $FeSO_4$ @ 25 kg ha^{-1} through drip (82,965 ha^{-1}) but found on par with the soil application of B @ 1 kg ha^{-1} and application of combination of micro nutrients (Formula-4) through drip. In the control treatment where no micronutrients are applied either through soil or drip, lowest NMC was observed (77,655 ha^{-1}). The results of the present investigation are in line with the finding of Naga Madhuri et al. (2013) who also observed significant improvement in NMC, cane length, cane diameter and cane yield by the application of zinc and iron at Tirupati, Andhra Pradesh.

Table 2. Rainfall received during the crop growth period (2016-'17) against average rainfall

Month	Average		Actual (2016-'17)	
	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy Days
March	19.3	1	0.0	0
April	24.7	2	0.0	0
May	99.6	4	209.2	6
June	115.5	7	186.4	9
July	132.7	9	158.4	9
August	169.7	10	182.0	10
September	228.6	11	352.1	18
October	199.6	7	183.4	7
November	108.6	3	0.0	0
December	22.2	1	0.0	0
January	5.8	0	0.0	0
February	12.9	0	0.0	0
TOTAL	1139.2	55	1271.5	59

Table 3. Yield and quality of sugarcane as influenced by application of different micronutrients through soil and drip fertigation during 2016-'17

Treatment	NMC per ha	Cane yield (t ha^{-1})	Juice sucrose (%)	CCS (%)	Sugar yield (t ha^{-1})
T: Control (without micro nutrients)	77,655	101.8	18.9	13.6	13.8
T2: Soil application of $ZnSO_4$ @ 50 kg ha^{-1}	78,097	108.1	18.9	13.6	14.7
T3: Application of $ZnSO_4$ @ 25 kg ha^{-1} through	82,300	116.6	20.6	14.9	17.3
T4: Soil application of $FeSO_4$ @ 50 kg ha^{-1}	77,655	104.4	18.2	13.0	13.6
T5: Application of $FeSO_4$ @ 25 kg ha^{-1} through	82,965	116.4	18.6	13.3	15.5
T6: - Soil application of B @ 1 kg ha^{-1}	82,610	110.4	17.9	12.8	14.0
T7: Application of B @ 0.5 kg ha^{-1} through drip	74,557	109.5	18.4	13.1	14.3
T8: Soil application of combination of micro nutri- ents (Formula-4)	80,973	115.7	17.7	12.7	14.6
T9: Application of combination of micro nutrients (Formula-4) through drip	82,079	117.0	19.2	13.8	16.1
SEm	957.0	2.80	1.04	0.83	1.05
CD (0.05)	2869.0	8.35	NS	NS	3.10

NS denotes 'not significant'

Cane yield

The application of combination of micro nutrients (Formula-4) through drip increased the cane yield (117.0 t ha^{-1}) as compared to the control. The yield gain due to application of micronutrients through drip or soil application ranged between 2.6 to 15.2 t ha^{-1}as compared to control. At Brazil, Mellis et al. (2016) observed positive responses to micronutrients application in all growth and yield parameters of sugarcane except total recoverable sugar, especially with Zn fertilization. The micronutrients Zn, Fe and Formula-4 also showed a high frequency of response in cane yield when applied through drip as compared to soil application (Table 3). The localization of the nutrients at the root zone is very poor when fertilizers were banded in soil near the crop row and single application of the fertilizers during the life cycle of the crop limiting its availability to certain periods which reduces the fertilizer absorption and use. Chen et al. (2012) observed that there was increase in yield to the extent of 31.9% in sub surface drip fertigation with $ZnSO_4$ and borax along with NPK.

Juice quality

Significant variations were not observed in juice sucrose due to different treatments. However, application of $ZnSO_4$ @ 25 kg ha^{1} through drip fertigation recorded higher sucrose 20.6%. CCS did not vary significantly due to different treatments. CCS in different treatments ranged between 12.7% to 14.9%. Significantly higher sugar yield was recorded in application of $ZnSO_4$ @ 25 kg ha^{-1} through drip (17.3 t ha^{-1}) followed by application of combination of micro nutrients (Formula-4) through drip (16.1 t ha^{-1}).

Conclusion

The study indicated that application of combination of micronutrients through drip significantly enhanced the cane yield in addition to saving of nutrients.

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