

Characterization of Sugar Mill Effluent and Effect of SME Irrigation on Growth and Productivity of Ratoon Sugarcane in Cauvery Command Area

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ABSTRACT

A field experiment was conducted in the premises of M/s Sri Chamundeshwari Sugars Pvt. Ltd., Bharathinagar, Mandya District, during 2014 to study the characterization of sugar mill effluent and effect of sugar mill effluent (SME) irrigation on growth and yield of ratoon sugarcane with eight treatments replicated thrice using RCBD. The treated sugar mill effluent (SME) was neutral in reaction (pH 7.23) with electrical conductivity of 1.55 dSm^{-1} and it has low concentration of total nitrogen (3.43 ppm), total phosphorus (1.72 ppm) and total potassium (38.9 ppm). The calcium, magnesium and sulphate content were 51.4, 20.3 and 46.3 mg l^{-1} . It also contained sodium, chlorides and bicarbonates to the extent by 37.8, 57.3 and 5.6 mg l^{-1} , respectively. Significantly higher growth parameters like cane height (249.8 cm), number of tillers per clump (12.22) and number of internodes per cane (29.00) and cane yield (104.93 t^{-1}) were recorded in treatment which received cycle of 3 irrigations with freshwater + 1 irrigation with sugar mill effluent+ RDF as compared to other treatments. Significantly lower growth parameters and ratoon sugarcane yield (87.40 t ha^{-1}) was observed in treatment which received irrigation with sugar mill effluent alone.

THE sugar industry is one of the most important agro-based industries in India and is highly responsible for creating significant impact on rural economy in particular and nation's economy in general. Sugar industries rank second among the agro-based industries next to textiles in India and are seasonal in nature operating only for 120 to 160 days in a year. A significantly large amount of wastes are generated during the manufacture of sugar containing a high amount of pollutants load particularly in terms of suspended solids, organic matter, effluent, sludge, press-mud and bagasse. In India sugar mills consume around 1,500 to 2,000 litres of water and generate about 1,000 litres as effluent for every one tonne of cane crushed (Anonymous, 2014). Generally, the sugar mill effluent is generated from mill house, boiling house waste water, boiler blow-down water, condenser cooling water and soda and acid wastes. The generated effluent mainly comprises floor washing waste water, condensate water, leakages in valves and glands of the pipeline, sugarcane juice, syrup and leaked molasses. Sugarcane (*Saccharum Spp.*) being water loving crop requires larger quantities of water for its successful completion of life cycle. Hence recycling of water used for sugar production in industries which comes out as effluents for irrigation in sugarcane to reduce usage of fresh water for irrigation is in need of

the hour. Keeping this in view, an experiment was conducted to study effect of SME (Sugar Mill Effluent) on growth and productivity of ratoon sugarcane was carried out.

A field experiment was laid out at the research and development farm of M/s. Chamundeswari Sugars, Ltd., Bharathi Nagar, Maddur (Tq), Mandya (Dist.) located in Southern dry zone of Karnataka with 8 treatments replicated thrice with randomized complete block design (RCBD). Treatment detail includes, T_1 : Irrigation with fresh water + RDF, T_2 : Irrigation with sugar mill effluent + RDF, T_3 : Alternate irrigation with FW and SME + RDF, from T_4 to T_7 sugar mill effluent and fresh water with RDF was given in different cycles i.e. 2:1, 1:2, 3:1, 1:3 and finally T_8 : Irrigation with SME alone without application of any fertilizers. The site selected was not irrigated with sugar mill effluent prior to the experiment. The variety taken was C0-8011 with a plot size of $9.0 \times 7.0 \text{ m}$, sugarcane couper was used to open furrows at 4.5 ft spacing between the two crop rows. Within the plots the land was leveled and brought to fine tilth. The ratoon initiation was done on 23rd January, 2014 following the practices of stubble shaving, shoulder breaking and gap filling operations. Recommended dose of fertilizers ($250:100:125 \text{ kg ha}^{-1}$ N, P_2O_5 and K_2O) was applied. Thirty per cent of nitrogen and entire quantity of

phosphorus and potassium were applied one month after ratoon initiation and remaining nitrogen was applied in equal splits i.e. 8 weeks (35 %) and 12 weeks (35 %). The fertilizers were incorporated into the soil in the plough furrows and then covered with soil. Representative treated sugar mill effluent samples were collected from M/s Chamundeshwari Sugars Limited, Maddur Taluk, Mandya district at three months interval during 2014. The samples were analyzed for pH, electrical conductivity, total suspended solids, total dissolved solids, total nitrogen, phosphorus, potassium, sodium, calcium, magnesium, chlorides, sulphates and carbonates and bicarbonates content by following standard procedures.

The treated sugar mill effluent (SME) was neutral in reaction (pH 7.23) with electrical conductivity of 1.55 dSm^{-1} (Table 1). It had low concentration of total nitrogen (3.43 ppm), total phosphorus (1.72 ppm) and total potassium (38.9 ppm). The calcium, magnesium and sulphate content were

51.4, 20.3 and 46.3 mg l^{-1} , respectively. It also contained sodium, chlorides and bicarbonates to the extent by 37.8 mg l^{-1} , 57.3 mg l^{-1} and 5.6 mg l^{-1} , respectively. Whereas carbonates were absent. It had dissolved and suspended solids content of 1926 and 96.3 mg l^{-1} , respectively. Similar findings were reported by Vinod Kumar and Chopra (2010).

Significantly higher plant height (249.77 cm), number of tillers per clump (12.22) number of internodes per cane (29.00) and ratoon sugarcane yield (104.93 t^{-1}) were recorded in treatment which received cycle of 3 irrigations with FW + 1 irrigation with SME + RDF as compared to other cycles of irrigation and irrigation with SME alone treatment. However, number of leaves per cane was not significantly differed. Significantly lower plant height, number of tillers per clump, number of internodes per cane and ratoon sugarcane yield (178.11 cm, 8.10, 21.66 and 87.40 t ha^{-1} , respectively) were observed in treatment which received irrigation with sugar mill effluent alone. Similar trend of yield increase in sugarcane was witnessed by Vinod Kumar and Chopra (2014). The increase in growth parameters and yield of ratoon sugarcane was due to dilution effects of SME with fresh water which resulted in better availability of nutrients and improved the growth parameters in ratoon sugarcane (Previna Sivalonganathan *et al.*, 2013). Higher growth parameters resulted in higher cane yield as growth and yield are interlinked with each other. Presence of nitrogen and phosphorus in effluent was greatly available to crop when there is proper dilution of SME with fresh water for ratoon crop and supply of essential nutrients in adequate quantity in a steady manner along with recommended dose of fertilizers and organic manures played an important role in improving growth parameters and yield of the crop (Aneg Singh *et al.*, 2010) (Table 2)

From the field experiment, it can be concluded that application of treated SME + RDF in the 2:1 and 3:1 cycles with fresh water has improved the growth and yield of ratoon sugar cane and it also aids in safe disposal of sugar mill waste water. The response was found better, when cycles of treated sugar mill effluent decreased and fresh water was increased followed by next treatment of continuous application of treated

TABLE I

Physico-chemical properties of treated sugar mill effluent sample collected at different intervals from M/s Sri Chamundeshwari Sugars Pvt. Ltd, K.M.Doddi. (Mean of ten samples)

Parameters	Mean
pH	7.23
EC (dSm^{-1})	1.55
Total Nitrogen (ppm)	3.43
Total Phosphorus (ppm)	1.72
Total Potassium (ppm)	38.9
Calcium (mg l^{-1})	51.4
Magnesium (mg l^{-1})	20.3
Sulphate (mg l^{-1})	46.3
Sodium (mg l^{-1})	37.8
Carbonates (mg l^{-1})	Nil
Bicarbonates (mg l^{-1})	5.6
Suspended Solids (mg l^{-1})	96.3
Dissolved Solids (mg l^{-1})	1926
Chlorides (mg l^{-1})	57.3

TABLE II

Growth parameters and cane yield ($t\ ha^{-1}$) of ratoon sugarcane as influenced by different cycles of sugar mill effluent irrigation

Treatments	Cane height (cm)	No. of leaves per cane	No. of tillers per clump	No. of internodes per cane	Cane yield ($t\ ha^{-1}$)
Irrigation with FW + RDF	200.88	9.22	9.66	24.00	90.83
Irrigation with SME + RDF	221.99	10.10	11.17	24.16	94.34
Alternate irrigation with FW and SME + RDF	222.55	9.55	11.11	23.50	93.96
Cycle of 2 irrigations with FW + 1 irrigation with SME + RDF	226.33	10.33	12.22	28.50	101.31
Cycle of 1 irrigation with FW + 2 irrigations with SME + RDF	211.77	9.21	10.77	26.83	94.28
Cycle of 3 irrigations with FW + 1 irrigation with SME + RDF	249.77	9.77	12.22	29.00	104.93
Cycle of 1 irrigation with FW + 3 irrigations with SME + RDF	243.00	9.55	10.11	26.83	93.58
Irrigation with SME alone	178.11	9.10	8.10	21.66	87.40
S. Em+CD at 5 %	15.05	0.84	1.45	1.08	4.74
	45.65	NS	4.04	3.29	14.38

Note: FW: Fresh water, RDF: Recommended dose of fertilizer, SME: Sugar mill effluent

sugar mill effluent along with RDF was found at par with each other.

REFERENCES

- ANEG SINGH, R. N., SRIVASTAVA, S. P., SINGH, R. P., SRIVASTAVA AND SHARMA, M. L., 2010, Effect of effluent of sugar mills on growth, yield and juice quality of sugarcane. *Indian J. Sugar Tech.*, **25**(2) : 63-65.
- ANONYMOUS, 2014, *Parivesh*, A News letter frsom ENVIS centre-central pollution control board. www.cpcbenvvis.nic.in/newsletter.
- PREVINA SIVALONGANATHAN, BASKAR MURUGAIYAN, SARAVANAN APPAVOU AND LENINRAJ DHARMARAJ, 2013, Effect of dilution of treated distillery effluent (TDE) on soil properties and yield of sugarcane. *American J. Plant Sci.*, **4** : 1811-1814.
- VINOD KUMAR AND CHOPRA, A. K., 2010, Influence of sugar mill effluent on physic-chemical characteristics of soil at Haridwar (Uttarakhand), India. *J. Applied and Natural Sci.*, **2**(2) : 269-279.
- VINOD KUMAR AND CHOPRA, A. K., 2014, Fertigational effects of sugar mill effluent on agronomical characteristics of high yield cultivar of sugarcane (*Saccharum officinarum* L.) in two seasons. *Acta Advances Agric. Sci.*, **2**(9) : 17-39.

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