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Effect of Post Methanated Distillery Effluent (PMDE) on Cane Yield, Sugar Yield and Quality of Sugarcane (Var.CO 86032) Crop Growth

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ABSTRACT: An investigation was carried out to study the effect of graded levels of PMDE integrated with graded levels of soil test based NPK on cane and sugar yield of sugarcane crop var. CO 86032. by conducting field experiment in Agricultural Engineering College and Research Institute, Kumulur, Tiruchirappalli district along with famer's holdings. The experimental soil was mixed black with sandy clay loam belonging to Poovalur series (*Typic Haplustalf*). The PMDE was applied in graded doses (main plot treatments) thoroughly mixed and allowed for natural oxidation. Different combinations of NP fertilizers (50, 75 and 100 %) with 0 and 50 per cent and K were imposed as sub plot treatments. The experiment was conducted in split plot design and treatments were replicated thrice. The cane and sugar yield of sugarcane crop got increased by the application of PMDE. The cane yield increase was in the tune of 53.9 per cent over control. The application of PMDE @ 30,000 l ha^{-1} with $N_{100}P_{100}K_0$ in sugarcane grown in sandy clay loam soil recorded the highest cane and sugar yield and hence the expenditure on K fertilizer could be saved. Thus, highest yield with lowest expenditure is obtained. However, it was on par with 40,000 L ha^{-1} of PMDE along with $N_{100}P_{100}K_{50}$. The quality parameters *viz*., Brix, polarity, purity and commercial cane sugar (per cent) were not significantly influenced by the different treatments in the present investigation. However, the marginal differences were observed at graded doses of PMDE. Therefore, application of PMDE in sugarcane as a nutrient source helps to have good crop growth on sustainable basis through adequate and balanced management of inputs without degrading the natural resources.

Key words: distillery effluent, post methanation, sugarcane

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INTRODUCTION

Adequate plant nutrients supply holds the key for improving cane production and sustaining soil health in holding soil moisture and further enhancing the water and nutrient use efficiencies. The supply of nutrients in organic form through post methanated distillery effluent (PMDE) helps improve the supply of all essential nutrients and also to maintain good soil health. It is necessary to use PMDE in conjunction with fertilizers for maximizing the productivity which is one of the inputs that brings quantum jump in the yield of sugarcane.

It is essential to apply required amount of NPK fertilizer for obtaining good production efficiency of crop. Moreover the escalation of inorganic fertilizer cost have stimulated interest in the usage of PMDE for irrigating agricultural crops in larger areas because of its essential nutrient content which serves as a fertilizer. Hence, there is a tremendous scope to reduce recommended dose of fertilizer by utilizing the PMDE as a source of plant nutrients saving of farmer's expenditure on the usage of fertilizers. It also contains high amount of potassium (K) followed by nitrogen (N), phosphorous (P). It also contains appreciable amount of secondary and micro-nutrients.

MATERIALS AND METHODS

The experimental site lies geographically in between 10^o 56' N latitude and 78^o 49' E Longitude and at an altitude of 70m mean sea level. The experimental soil was mixed black with sandy clay loam belonging to Poovalur series (*Typic Haplustalf*). The PMDE was applied in graded doses (main plot treatments) thoroughly mixed and allowed for natural oxidation.

Different combinations of NP fertilizers (50, 75 and 100 %) with 0 and 50 per cent and K were imposed as sub plot treatments. The experiment was conducted in split plot design and treatments were replicated thrice.

Treatment details of field experiment

Main plot:

M_1: Control

M_2: Post methanated distillery effluent application @ 10,000 L ha^{-1}

M_3: Post methanated distillery effluent application @ 20,000 L ha^{-1}

M_4: Post methanated distillery effluent application @ 30,000 L ha^{-1}

M_5: Post methanated distillery effluent application @ 40,000 L ha^{-1}

Sub plot:

S_1: $N_{50}P_{50}K_0$

S_2: $N_{75}P_{75}K_0$

S_3: $N_{100}P_{100}K_0$

S_4: $N_{50}P_{50}K_{50}$

S_5: $N_{75}P_{75}K_{50}$

S_6: $N_{100}P_{100}K_{50}$

DSSIFER based N, P_2O_5 and K_2O doses were 351.9, 100.3 and 272.0 kg ha^{-1}

Healthy two budded pre treated setts of sugarcane variety CO 86032 was used for planting. A furrow spacing of 90 cm was given between two furrows. Irrigations were given once in 8-10 days depending upon the soil moisture up to 10 months and after 10 months irrigations were given once in 10-12 days up to harvest. Other regular cultural practices were carried out as per the requirement. The crop was harvested at maturity in each plot separately and the weight of was recorded. Five plants in each plot were tagged in the field by fixing stick and tag and the tagged plants were used for taking yield details and the quality parameters were determined by employing the standard procedures. (Meade and Chen, 1977).

RESULTS AND DISCUSSION

A. Cane yield

The yield of crop is a function of many factors, which includes soil, crop and climatic factors and the effective management of monetary and non-monetary inputs. The application of graded doses of PMDE significantly increased the yield of sugarcane (Fig.1).

The cane yield was significantly increased by the application of PMDE integrated with soil test based NPK. The highest cane yield was recorded by the addition of PMDE @ 30,000 L ha^{-1} with NP ($N_{100}P_{100}K_0$) alone followed by PMDE @ 40,000 L ha^{-1} with $N_{100}P_{100}K_{100}$. These results well revealed that application of K nutrients can be skipped if PMDE is applied @ 30,000 L ha^{-1}, since PMDE is a rich source of K nutrient (8350 mg L^{-1}) as evidenced by the findings of (Rajukannu and Manickam, 1996). They reported that distillery effluent can supply 100 per cent K requirement of the crop.

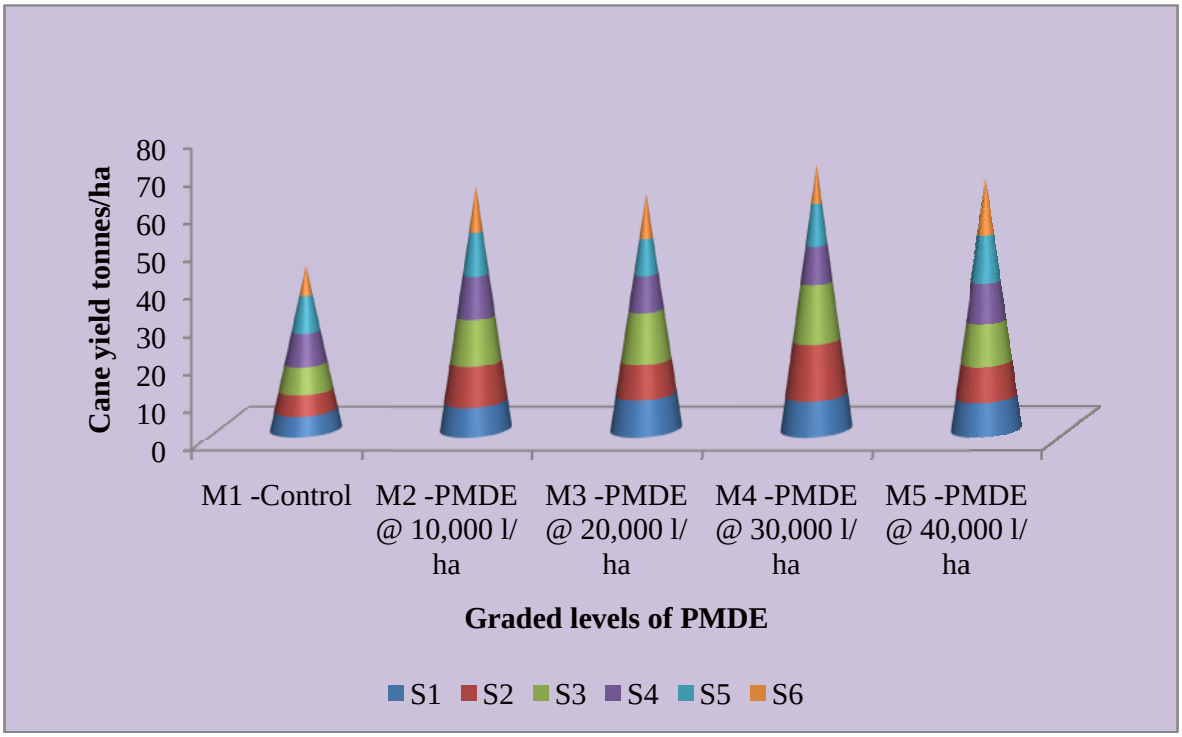

Fig. 1. Effect of PMDE application with graded levels of NPK on Cane Yield (t ha^{-1}).

The cane yield varied from 67.18 to 136.8 t ha^{-1}. The improvement in yield might be due to availability of nutrients from the mineralization of PMDE applied in soil. Similar results on the yield of crops were obtained due to application of PMDE (Tripathi *et al*. 2007). It revealed that availability of nutrients applied through PMDE is responding to enhance crop yield.

There observed 53 per cent cane yield increment over control in the plots that receive PMDE @ 30,000 L ha^{-1} along with 100 per cent soil test based NP. Not only the supply of essential nutrients but also the improvement in biological property of the soils by distillery effluent might have increased the yield of sugarcane. The increasing doses of TDE application increased the yield attributes and cane yield due to the enhanced supply of nutrients (Janaki, 2008). Basker *et al.*, (2001) stated that in distillery effluent applied plots, N&P and NPK gave comparable yields which indicated that K fertilizer could be skipped in the distillery effluent applied field. The results were in close agreement with the findings of Subash Chandra Bose *et al*. (2002). The positive correlation for the yield and the available nutrients (N, P and K) established in the study also lend support to the above reasoning (r = 0.995**, 0.885** and 0.823**).

B. Sugar yield

Biological yield of any plant, showing its response towards any applied treatment and directly interlinked with total plant response towards the final yield (cane yield) by increasing the surface area for the food factory (Photosynthesis) and ultimately gave good economic benefit. Sugar recovery is the foremost one for the sugar industries. The sugar yield is a reflection of cane yield and recovery per cent (Fig. 2).

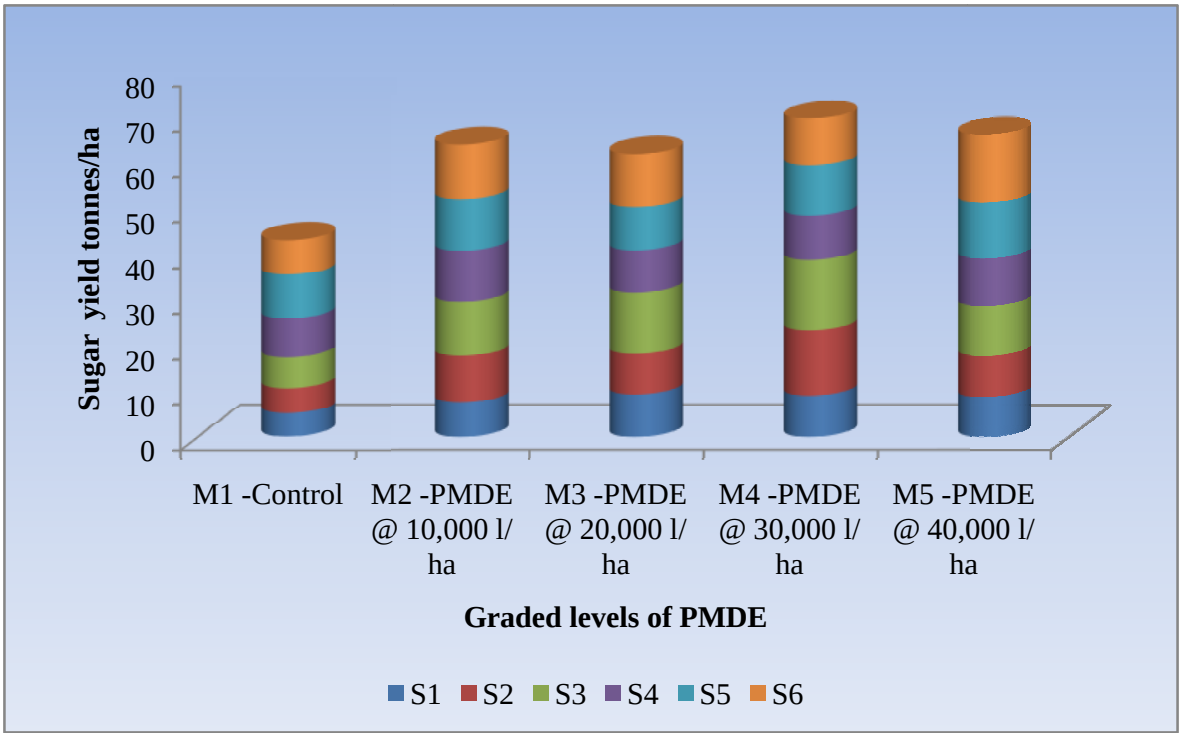

Fig. 2. Effect of PMDE application with graded levels of NPK on Sugar yield (t ha^{-1}).

The results of the field experiment revealed that the application of graded doses of PMDE significantly increased the sugar yield of sugarcane. An increased sugar yield of 62.0 per cent was recorded for the application of PMDE @ 30,000 Lha^{-1} along with 100 per cent soil test based NP over control. Singndhupe *et al.* (2009) opined that the balance supply of nitrogen through PMDE promotes sugarcane yield as well as sugar yield (Table 1). The positive and significant correlation established in the present study between cane yield and sugar yield (r = 0.999**) also confirm the results.

C. Quality parameters

In sugarcane, juice quality is also another parameter which decides the sugar yield. The juice quality generally depends upon variety and genetic makeup of the cane. None of the treatments had any significant effect on juice quality *viz*., Brix, polarity, purity and commercial cane sugar.

Table 1: Effect of PMDE application with graded levels of NPK on sugar yield (t ha^{-1}).

S.No	Treatment	Sugar yield (t ha^{-1})						
		S_1	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**	**Mean**
1	M_1 -Control	5.03	5.48	6.89	8.57	9.60	7.60	**7.20**
2	M_2 -PMDE @ 10,000 l ha^{-1}	7.47	10.35	11.95	11.14	11.34	12.06	**10.72**
3	M_3 -PMDE @ 20,000 l ha^{-1}	9.29	9.03	13.36	9.33	9.58	11.62	**10.37**
4	M_4 -PMDE @ 30,000 l ha^{-1}	9.02	14.46	15.44	9.73	11.04	10.35	**11.67**
5	M_5 -PMDE @ 40,000 l ha^{-1}	8.62	9.14	10.95	10.49	12.29	14.97	**11.08**
	Mean	**7.88**	**9.69**	**11.72**	**9.85**	**10.77**	**11.32**	**10.21**
		M		**S**		**M at S**		**S at M**
	SEd	0.14		0.17		0.37		0.37
	CD (P =0.05)	0.31		0.34		0.75		0.74

Table 2: Effect of PMDE application with graded levels of NPK on cane yield (t ha^{-1}).

S.No	Treatment	Cane yield (t ha^{-1})						
		$N_{50}P_{50}K_0$	**$N_{75}P_{75}K_0$**	**$N_{100}P_{100}K_0$**	**$N_{50}P_{50}K_{50}$**	**$N_{75}P_{75}K_{50}$**	**$N_{100}P_{100}K_{50}$**	**Mean**
1	M_1 -Control	46.93	51.20	64.34	80.00	89.60	70.98	**67.18**
2	M_2 -PMDE @ 10,000 l ha^{-1}	67.28	93.16	107.6	100.3	102.1	108.6	**96.51**
3	M_3 -PMDE @ 20,000 l ha^{-1}	82.88	80.58	119.2	83.30	85.50	103.7	**92.53**
4	M_4 -PMDE @ 30,000 l ha^{-1}	79.95	128.1	136.8	86.19	97.75	91.72	**103.42**
5	M_5 -PMDE @ 40,000 l ha^{-1}	76.86	81.50	97.68	93.51	109.6	133.5	**98.78**
	Mean	**70.78**	**86.91**	**105.1**	**88.66**	**96.91**	**101.7**	**91.68**
		M		**S**		**M at S**		**S at M**
	SEd	1.54		1.00		2.56		2.24
	CD (P =0.05)	3.54		2.02		5.42		4.50

There was no deleterious effect noticed in juice quality with PMDE application as was observed in this study which is in line with the findings of Pushpavalli *et al*. (2002) and Baskar *et al*. (2004). Similar was the report by Rakkiyappan *et al*. (2001). In the present investigation, increased supply of nutrients due to various treatments and favourable soil environment created by the application of PMDE and has proportionately enhanced the growth which resulted in maintaining the juice quality under high cane yields. The quality of juice (pH, EC and specific gravity) had highest values in 40 m^3 distillery effluent applied plot. This indicates that distillery effluents contributes good amount of plant nutrients and improves soil properties.

CONCLUSION

Application of PMDE enhances the soil fertility in terms of organic carbon and available nutrients. The cane and sugar yield of sugarcane gets increased by the application of PMDE. The increase of cane yield was in the tune of 53.9 per cent over control. The application of PMDE @ 30,000 l ha^{-1} with $N_{100}P_{100}K_0$ in sugarcane grown in sandy clay loam soil recorded the highest cane and sugar yield and hence the expenditure on K fertilizer could be saved. Thus, highest yield with lowest expenditure is obtained.

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