

Original Research Article

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Effect of Treated Distillery Effluent and Biocompost on Soil Phosphatase Activity in Paddy (*Oryza sativa* L.)

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ABSTRACT

In India, sugar industry is the second largest agro-based industry producing enormous quantities of by-products like molasses, pressmud *etc.* The Treated Distillery Effluent (TDE) is waste water, which could be recycled in agriculture both as irrigation water and as a source of plant nutrients. The beneficial effect of organic matter for enhancing the soil fertility and thereby improving the crop productivity is well established. Thus, the soil application of TDE could offer the double benefit of safe disposal of wastes and its effective utilization for agricultural production. A field experiment was conducted to study the effect of Treated Distillery Effluent (TDE) and biocompost on soil phosphatase activity using paddy as a test crop (ADT- 43). The application of TDE @ 1.0 lakh litres ha⁻¹ (M3) or TDE @ 1.5 lakh litres ha⁻¹ (M4) along with 37.5% N as urea + 37.5 % N as biocompost (S7) increased the soil phosphatase activity. Based on the increase in soil phosphatase activity, it can be concluded that TDE @ 1.0 lakh litres ha⁻¹(M3) or TDE @ 1.5 lakh litres ha⁻¹ (M4) along with 37.5% N as urea + 37.5 % N as biocompost (S7) can be recommended as a nutrient source for paddy crop.

Keywords

Treated distillery effluent,
Biocompost, Paddy,
phosphatase activity,
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Introduction

Application of TDE on soils is one of the most economical resources for the soil fertility amelioration through improvement in soil water holding capacity, texture, structure and nutrients retention. Now days in our country due to the increasing number of sugar mills and distillery units, application of distillery effluent on soil nearly become mandatory. These compounds may change soil physico-chemical properties and soil enzyme activities.

Soil enzymes activities play an essential role in catalyzing reactions, which are necessary for the decomposition of organic matter and nutrient cycling in ecosystems, involving a range of plants, microorganisms, animals and their debris.

Therefore, changes in enzymes activity could alter the availability of nutrients for plant uptake and these changes are potentially sensitive indicators of soil quality. Therefore, the main objective of the present study was to

evaluate the effect of different application rates of distillery effluent, on soil phosphatase activity.

Materials and Methods

Field experiment was conducted using paddy as a test crop (ADT- 43). The experiment was conducted in a split plot design with four main plots *viz.*, control; TDE @ 0.5 lakh litres ha⁻¹; TDE @ 1.0 lakh litres ha⁻¹; TDE @ 1.5 lakh litres ha⁻¹. Different levels of N fertilizers *viz.*, 100 per cent N as urea, 75 per cent N as urea, 100 per cent N as biocompost, 75 per cent N as biocompost, 75 per cent N as urea and 25 per cent N as biocompost, 37.5 per cent N as urea and 37.5 per cent N as biocompost and control were imposed as seven subplot treatments and the treatments were replicated twice. TDE was uniformly applied to each plot as per the treatment schedule at 45 days before planting.

The soil of the experimental field belong to Poovalur series (*Typic haplustert*), neutral in pH (pH 7.58) and low in EC (0.30 dSm⁻¹). The organic carbon content (4.00 g kg⁻¹) and the alkaline KMnO₄-N (162 kg ha⁻¹) were found to be low. The Olsen-P level (16 kg ha⁻¹) and the NH₄OAc-K (205 kg ha⁻¹) were medium. The bacterial, fungal and actinomycetes population were found to be 10.2 x 10⁶ CFU g⁻¹ of soil, 14 x 10⁴ CFU g⁻¹ of soil, 5.1 x 10³ CFU g⁻¹ of soil respectively. The phosphatase activity was found to be 2.5 µg p-nitrophenol g⁻¹ of soil hr⁻¹ (Table 1).

Phosphatase enzyme activity

Five gram (w) of the fresh composite soil was taken in a boiling tube with 10 ml distilled water. To this 0.25 ml toluene and 1ml p-nitrophenol phosphate (PNPP) were added and incubated at room temperature for an hour. Then 5 ml of 0.5 M sodium chloride and 20 ml of 0.5 M sodium hydroxide was added to

the sample and filtered through Whatman No.42 filter paper. The colour intensity was read at 420 nm and the concentration of phosphatase (X) in the sample was obtained from the standard graph (Tabatabai and Bremner, 1969).

Statistical analysis

The data on various characters studied during the investigation were statistically analyzed by the method given by Gomez and Gomez (1984). The critical difference was worked out at 5 per cent (0.05) probability levels.

Results and Discussion

The impact of TDE and biocompost as well as the different levels of fertilizers on soil phosphatase activity was very well pronounced and the results are as follows.

Soil phosphatase activity as influenced by different levels of TDE and biocompost (Table 2)

Enzyme activity in soil is an indirect indication of the microbial activity, which is directly correlated with soil microbial population.

In the present investigation, greater activity of phosphatase was associated with the TDE application.

Application of TDE and biocompost significantly increased the soil phosphatase activity. Among the main plot treatments, application of TDE @ 1.5 lakh litres ha⁻¹ (M4) recorded highest phosphatase activity of 2.31 µg p-nitrophenol g⁻¹ dry soil hr⁻¹ being on par with the application of TDE @ 1.0 lakh litres ha⁻¹ (M3) recording 2.27 µg p-nitrophenol g⁻¹ dry soil hr⁻¹. The control (S1) recorded lowest phosphatase activity of 1.40 µg p-nitrophenol g⁻¹ dry soil hr⁻¹.

Table.1 Characteristics of Initial Soil

Parameters	Values
1. Mechanical composition	
Textural class	Sandy Clay
Soil series	Poovalur Series
Soil taxonomy	<i>Typic haplustert</i>
2. Chemical composition	
pH (1: 2.5 soil water suspension)	7.58
EC (dSm ⁻¹) (1: 2.5 soil water extract)	0.30
Organic carbon (g kg ⁻¹)	4.00
KMnO ₄ - N (kg ha ⁻¹)	162
Olsen - P (kg ha ⁻¹)	16
NH ₄ OAc - K (kg ha ⁻¹)	205
3. Biological properties	
Bacteria (x 10 ⁶ CFU g ⁻¹ of soil)	10.2
Fungi (x 10 ⁴ CFU g ⁻¹ of soil)	14.0
Actinomycetes (x 10 ³ CFU g ⁻¹ of soil)	5.1
Phosphatase activity (µg p-nitrophenol g ⁻¹ of soil hr ⁻¹)	2.5

Table.2 Soil phosphatase activity as influenced by different levels of tde and biocompost

Treatments	Phosphatase activity (µg p-nitrophenol g ⁻¹ soil hr ⁻¹)							
	S1	S2	S3	S4	S5	S6	S7	Mean
M1	1.27	1.45	1.43	1.40	1.38	1.49	1.41	1.40
M2	1.81	1.95	1.95	1.90	1.88	1.99	1.93	1.92
M3	2.10	2.31	2.28	2.21	2.17	2.36	2.44	2.27
M4	2.21	2.32	2.34	2.28	2.25	2.38	2.40	2.31
Mean	1.85	2.01	2.00	1.95	1.92	2.06	2.04	1.97

	M	S	M at S	S at M
SEd	0.03	0.01	0.03	0.01
CD (5%)	0.10	0.02	0.10	0.02

M1 - Control; M2 - application of TDE @ 0.5 lakh litres ha⁻¹; M3 - application of TDE @ 1.0 lakh litres ha⁻¹;
M4 - application of TDE @ 1.5 lakh litres ha⁻¹
S1 - Control; S2- 100 % N as urea; S3 - 75 % N as urea; S4- 100 % N as biocompost; S5- 75 % N as biocompost;
S6 - 75 % N as urea and 25 % N as biocompost; S7 - 37.5 % N as urea and 37.5 % N as biocompost

The TDE being liquid organic manure increased the organic matter and nutrients content of the soil and subsequently enhanced the microbial biomass.

The high dose of TDE along with the recommended dose of NPK recorded the highest value. It implies that organic and inorganic nutrient inputs provided a nutrient rich environment, which is essential for the development of microbes and synthesis of enzymes.

Engracia Madejon *et al.*, (2003) found a positive correlation between the organic residues and dehydrogenase, β -glucosidase, urease and protease activities of the soil.

Ramana *et al.*, (2002) also reported that the enzyme activities were increased due to the application of distillery effluent.

Generally, organic manure addition was found to enhance the microbial activities which in turn favoured the synthesis of various enzymes in soil.

These three enzymes play a significant role in the bio-transformation of nutrients in soil, and thus influence the nutrients availability in soil and uptake by crops. The mineralization rate of organic P is relevant to both P nutrition of crops and phosphatase activity in soil.

Therefore, higher enzyme activities in soil suggested that the mineralization of N and P was greater due to the application of spent wash. Similar results was reported by Dinesh (2011) and Previna (2012).

Among the N fertilizer levels, S6 (75% N as urea +25% N as biocompost) recorded higher phosphatase activity of 2.06 μg p-nitrophenol g^{-1} dry soil hr^{-1} which was being comparable with S7

(37.5% N as urea + 37.5% N as biocompost) recording 2.04 μg p-nitrophenol g^{-1} dry soil hr^{-1} . The interaction effect of M \times S treatment was found to be significant. Application of TDE @ 1.0 lakh litres ha^{-1} along with 37.5% N as urea + 37.5% N as biocompost (M3S7) recorded higher phosphatase activity of 2.44 μg p-nitrophenol g^{-1} dry soil hr^{-1} followed by the application of TDE @ 1.5 lakh litres ha^{-1} along with 37.5% N as urea + 37.5% N as biocompost (M4S7) recording higher phosphatase activity of 2.40 μg p-nitrophenol g^{-1} dry soil hr^{-1} .

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