

Original Article

Effect of Enriched Biofertilizer of Sugarcane Pressmud on Growth of Brinjal (*Solanum melongena* L.) under Laboratory Conditions

Bhosale P. R.¹, Chonde S.G.², Pokharnikar N.B.³, Jadhav A. S.⁴

^{1,2,3,4} Department of Environmental Science, Shivaji University Kolhapur

Email: prb.envsc@unishivaji.ac.in

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Sugarcane pressmud is a major by-product of the sugar industry and its disposal poses environmental challenges. The present study evaluates the effect of enriched biofertilizer prepared from sugarcane pressmud on growth, yield, biochemical parameters of brinjal and soil fertility under pot culture conditions. Four treatments were tested: control (T1), composted pressmud (T2), enriched composted pressmud (T3), and enriched composted pressmud with fruit waste (T4). Results showed that enriched pressmud significantly improved plant growth, yield attributes, chlorophyll and polyphenol content, and soil physico-chemical properties. The study demonstrates that enriched pressmud biofertilizer can serve as an effective and eco-friendly alternative to chemical fertilizers.

Keywords: Pressmud, Biofertilizer, Brinjal, Soil fertility, Microbial inoculants

Introduction

Sugarcane is one of the most important commercial crops cultivated in tropical and subtropical regions of the world. India is among the leading producers of sugarcane, and the sugar industry plays a crucial role in the country's agro-based economy by providing employment opportunities and supporting rural livelihoods (Yadav & Solomon, 2006). However, large-scale sugar production generates substantial quantities of by-products such as bagasse, molasses, and pressmud. Among these, pressmud is produced at the rate of approximately 3–4% per tonne of sugarcane crushed, creating significant disposal and environmental management challenges (Patil & Shingate, 1981; Kalaivanan & Hattab, 2008).

Pressmud is a soft, spongy, dark brown residue obtained during the clarification of sugarcane juice using lime and sulphur dioxide. It is rich in organic matter, macronutrients such as nitrogen, phosphorus, potassium, calcium, and magnesium, as well as micronutrients like iron, zinc, manganese, and copper (Bangar et al., 2000; Yadav & Solomon, 2006). Due to its high organic carbon content and water-holding capacity, pressmud has considerable potential for improving soil physical, chemical, and biological properties when applied to agricultural soils (Dotaniya & Datta, 2014).

In recent years, the excessive use of chemical fertilizers has led to declining soil fertility, nutrient imbalance, environmental pollution, and reduced crop productivity. Sustainable agriculture emphasizes the recycling of organic wastes and the use of biofertilizers to maintain soil health and crop yield (Sharma et al., 2002). Enrichment of pressmud with beneficial microorganisms such as nitrogen-fixing bacteria and phosphate-solubilizing microorganisms enhances nutrient availability, accelerates decomposition, and improves its efficiency as a biofertilizer (Patil et al., 2013; Dotaniya et al., 2013).

Brinjal (*Solanum melongena* L.) is one of the most widely cultivated vegetable crops in India and is valued for its nutritional and economic importance. Brinjal is highly responsive to soil fertility and nutrient management practices (Bhosale et al., 2012).



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Address for correspondence:

Bhosale P. R. Department of Environmental Science, Shivaji University Kolhapur

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The integration of enriched organic amendments like pressmud into brinjal cultivation can improve growth, yield, and quality while reducing dependence on chemical fertilizers (Patil et al., 2013).

The present study was undertaken to evaluate the effect of enriched sugarcane pressmud biofertilizer on the growth, yield, biochemical characteristics of brinjal, and soil physico-chemical properties under controlled pot culture conditions. The study also aims to assess the potential of enriched pressmud as an eco-friendly and sustainable nutrient source for vegetable production (Dotaniya & Datta, 2014; Yadav & Solomon, 2006).

Materials and Methods (with in-text references)

1 Collection and Processing of Pressmud

Sugarcane pressmud was collected from Shri Shahu Sahakari Sakhar Karkhana Ltd., Kagal, Kolhapur district, Maharashtra. The freshly collected pressmud was air-dried under shade to remove excess moisture and then composted to stabilize organic matter and reduce phytotoxicity (Patil & Shingate, 1981; Kalaivanan & Hattab, 2008). The composted material was sieved to obtain uniform particle size and stored for further enrichment (Yadav & Solomon, 2006).

2. Isolation and Mass Multiplication of Microorganisms

Indigenous nitrogen-fixing and phosphate-solubilizing microorganisms were isolated from pressmud samples using standard serial dilution and plating techniques (Wollum, 1982). Nitrogen-fixing bacteria were isolated on Ashby's nitrogen-free medium, while phosphate-solubilizing microorganisms were isolated on Pikovskaya's agar medium (Pikovskaya, 1948; Subba Rao, 1999). Efficient isolates showing maximum growth and nutrient solubilization were selected for mass multiplication.

Selected microbial cultures were grown in sterile nutrient broth and incubated at room temperature on a rotary shaker at 70–80 rpm for 36–40 hours (Somasegaran & Hoben, 1994). The actively growing cultures were centrifuged to obtain microbial biomass, which was used for enrichment of pressmud.

3 Preparation of Enriched Pressmud Biofertilizer

The composted pressmud was sterilized and thoroughly mixed with microbial biomass to obtain an approximate population density of 10^5 colony-forming units per gram of carrier material, following standard biofertilizer preparation techniques (Subba Rao, 1999; Patil et al., 2013). The enriched pressmud was cured for stabilization and stored under ambient conditions until use.

4 Experimental Design and Crop Management

A pot culture experiment was conducted during the rabi season using healthy and uniform brinjal seedlings. Pots were filled with well-mixed soil and treatments were applied as follows:

T1: Control (no amendment)

T2: Composted pressmud

T3: Enriched composted pressmud

T4: Enriched composted pressmud with fruit waste

All treatments were replicated and arranged in a completely randomized design (CRD) (Gomez & Gomez, 1984). Uniform irrigation, weeding, and plant protection measures were followed throughout the experimental period.

5 Growth, Yield, and Biochemical Analysis

Plant height, number of leaves, branches, flowers, and fruits were recorded at 30-day intervals up to 150 days after planting following standard agronomic procedures (Panse & Sukhatme, 1985). Leaf chlorophyll content was estimated using standard spectrophotometric methods (Arnon, 1949). Polyphenol content was determined to assess plant metabolic and defense responses using established biochemical methods (Sadasivam & Manickam, 1996).

6 Soil Analysis

Soil samples were collected before planting and after harvesting. Parameters such as pH, organic carbon, organic matter, available nitrogen, phosphorus, potassium, and water-holding capacity were analyzed using standard laboratory procedures (Jackson, 1973; Allison, 1965).

7 Statistical Analysis

Experimental data were subjected to statistical analysis to evaluate treatment effects and determine significant differences among treatments using appropriate statistical methods (Gomez & Gomez, 1984).

Results and Discussion

1 Effect of Enriched Pressmud on Plant Height

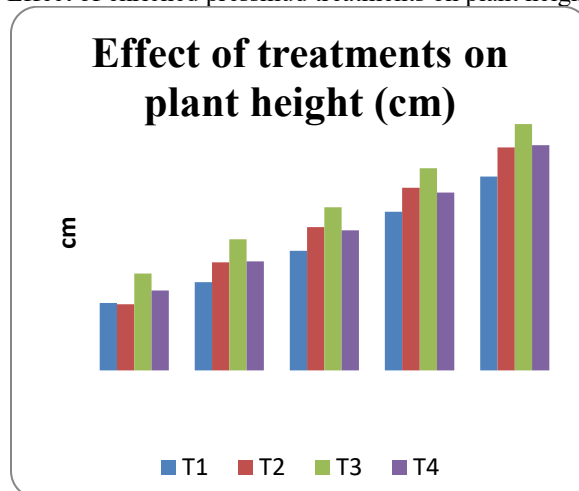
Plant height increased progressively with crop age in all treatments; however, the magnitude of increase varied significantly among treatments. Enriched composted pressmud (T3) consistently recorded the highest plant height at all growth stages. At 150 days after planting, T3 recorded a maximum plant height of 53.54 cm, followed by T4 (48.94 cm) and T2 (48.44 cm), while the control recorded the lowest height (42.14 cm).

The enhanced plant height under T3 treatment may be attributed to improved availability of essential nutrients, particularly nitrogen and phosphorus, due to microbial activity. Nitrogen-fixing bacteria contribute to continuous nitrogen supply, while phosphate-solubilizing microorganisms increase phosphorus availability, promoting cell division and elongation. Similar improvements in plant height due to pressmud application have been reported earlier.

Table 1. Effect of treatments on plant height (cm)

Treatment	30 days	60 days	90 days	120 days	150 days
T1	14.68	19.20	26.00	34.50	42.14
T2	14.40	23.48	31.10	39.66	48.44
T3	21.06	28.52	35.46	43.92	53.54
T4	17.36	23.68	30.42	38.66	48.94

Figure 1. Effect of enriched pressmud treatments on plant height of brinjal.



2 Effect on Leaf Production and Branching

The number of leaves and branches per plant increased with plant age in all treatments. Enriched pressmud (T3) and enriched pressmud with fruit waste (T4) showed significantly higher leaf numbers compared to control. Increased leaf production enhances photosynthetic capacity, leading to higher biomass accumulation.

Branch formation followed a similar trend, with T3 recording the highest number of branches at later growth stages. Enhanced branching is indicative of improved vegetative vigor and nutrient uptake, resulting from improved soil fertility and microbial activity.

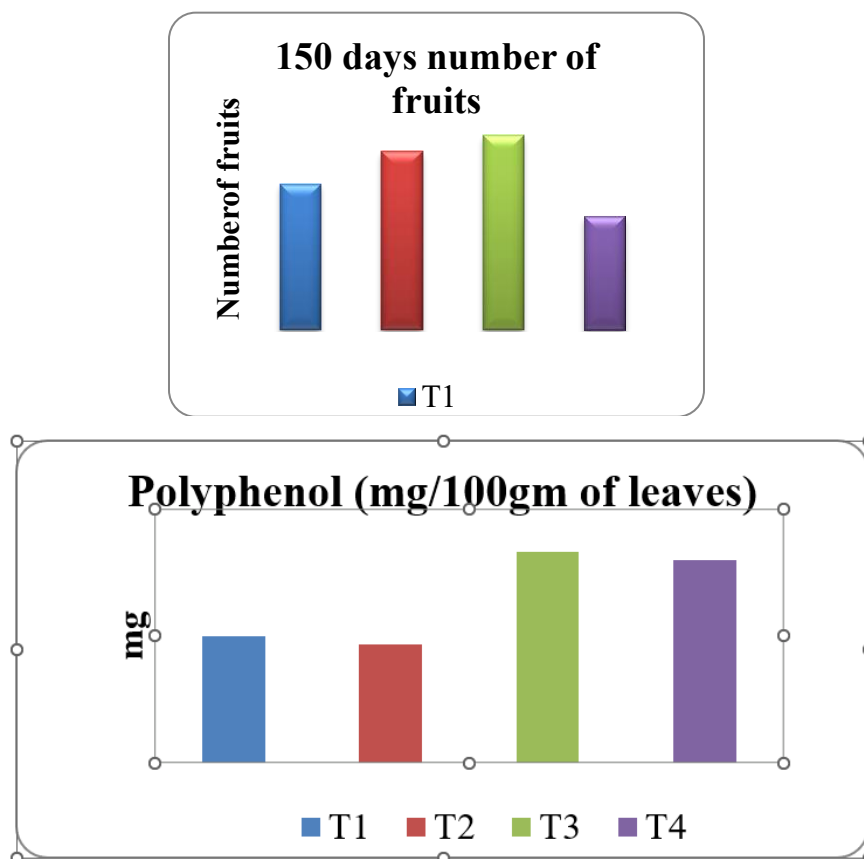
3. Effect on Flowering and Fruiting

Flower initiation and fruit development were positively influenced by enriched pressmud application. T3 recorded the highest number of flowers and fruits per plant at harvest. Balanced nutrient supply and improved physiological processes under enriched treatments contributed to enhanced reproductive growth.

Table 2. Effect of treatments on fruits per plant (150 days)

Treatment	Fruits per plant
T1	1.8
T2	2.2
T3	2.4
T4	1.4

Figure 2. Effect of enriched pressmud on fruit yield of brinjal.



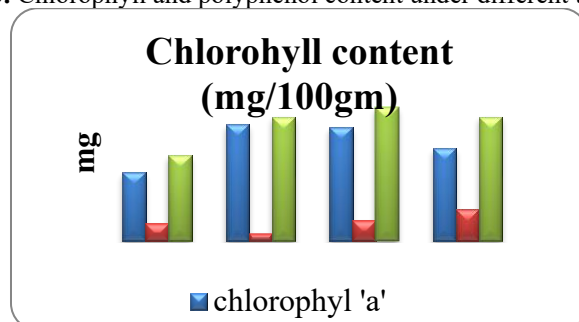
4 Biochemical Parameters

Total chlorophyll content was highest in T3, indicating enhanced photosynthetic efficiency due to improved nitrogen availability. Polyphenol content was also significantly higher in enriched treatments, suggesting improved metabolic activity and plant defense mechanisms.

Table 3. Biochemical parameters of brinjal leaves

Treatment	Total Chlorophyll (mg/100 g)	Polyphenol (mg/100 g)
T1	9.74	6000
T2	14.07	5600
T3	15.12	10000
T4	14.09	9600

Figure 3. Chlorophyll and polyphenol content under different treatments.



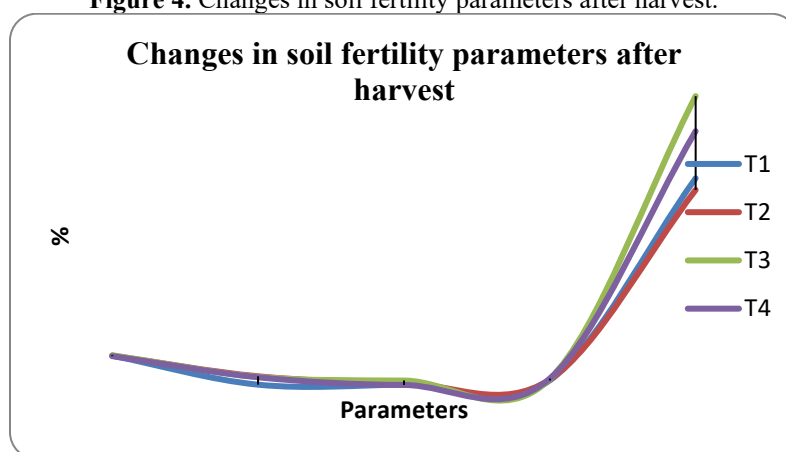
5 Soil Physico-Chemical Properties

Application of enriched pressmud significantly improved soil organic carbon, nitrogen, phosphorus, potassium, and water-holding capacity. Soil pH remained near neutral, indicating the safe use of pressmud without adverse effects. Improved soil structure and moisture retention under enriched treatments contributed to better plant growth and yield.

Table 4. Post-harvest soil properties

Parameter	T1	T2	T3	T4
pH	7.2	7.2	7.3	7.1
Organic carbon (%)	0.45	2.40	2.27	2.17
Nitrogen (%)	0.49	0.84	1.41	0.38
Phosphorus (%)	1.45	1.67	1.76	1.88
Water holding capacity (%)	48.51	45.80	67.64	59.48

Figure 4. Changes in soil fertility parameters after harvest.



Conclusion

The study concludes that enriched composted pressmud significantly enhances growth, yield, biochemical properties of brinjal, and improves soil fertility. Enrichment with nitrogen-fixing and phosphate-solubilizing microorganisms plays a key role in nutrient mobilization and plant growth promotion. The use of enriched pressmud biofertilizer offers a sustainable, eco-friendly alternative to chemical fertilizers while simultaneously addressing pressmud disposal problems of the sugar industry.

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