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RESEARCH ARTICLE

Pressmud-enriched phosphatic fertilisers: A sustainable approach to improving sugarcane yield and soil quality

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Abstract

Sugarcane is a nutrient-exhaustive crop that demands efficient phosphorus (P) management, yet conventional mineral fertilisers often suffer from low use efficiency due to soil fixation. Phosphatic fertilisers, produced by fortifying sugar industry byproducts such as pressmud with mineral phosphates and inoculating them with phosphate-solubilising bacteria (PSB), offer a sustainable alternative that can improve P availability, crop productivity and economic returns. A field study was conducted on sugarcane variety CoC 13339 under tropical conditions to evaluate the efficiency of different enriched P formulations in comparison with conventional sources. The main objectives ofthis study were to evaluate the effect of sources and rates of phosphorus on available P content in soil, compare the efficiency of pressmud along with different sources of phosphatic fertilisers and evaluate the effects of enriched phosphatic fertilisers and their levels on growth and yield of sugarcane. Growth attributes, sugarcane yield, juice quality, nutrient uptake and soil nutrient status were monitored across crop growth stages. The results demonstrated that integrated organic mineral fertilisers enriched with pressmud and supported by PSB consistently enhanced Olsen-P levels, improved yield components and increased cane productivity. These findings highlight the potential of recycling agro-industrial residues into enriched fertilisers for sustainable nutrient management and yield enhancement in sugarcane. Futurestudies should focus on long-term field validation across ratoon cycles, nutrient dynamics in diverse soil types and integration with climate-smart management practices to support large-scale adoption.

Keywords: nutrient management; phosphorous status; pressmud; solubilizing bacteria; soil fertility

Introduction

The sugarcane plant (*Saccharum officinarum* L.) is generally regarded as a nutrient-intensive crop, needing considerable inputs of both micro and macro nutrients to sustain high output. Among them, phosphorus (P) is essential for root formation, tillering, enzyme activity and the metabolism of carbohydrates, which in turn affects cane development and sucrose buildup (1). However, the agronomic performance of standard phosphatic fertilisers remains restricted in tropical and subtropical environments due to significant immobilisation activities involving both aluminium and iron oxides or via occlusion within minerals found in soil (2, 3). As a result, a considerable proportion of supplied P becomes inaccessible to plants, demanding increased fertiliser inputs and generating issues over sustainability in both the economy and the environment.

To circumvent these restrictions, enhanced phosphorus fertilisers have emerged as promising alternatives as a potential option. Phosphate-solubilising bacteria (PSB) are often added to these formulations, which combine mineral phosphate sources with organic leftovers like pressmud, filter cake, compost, or poultry waste. In addition to increasing the ability to dissolve sparingly soluble phosphates, the combination of organic matrix and microbial inoculants also decreases fixation, promotes nutrient cycling and improves soil health by adding organic carbon (2, 4, 5). Because it is high in biological matter, calcium and other nutrients and may serve as a medium for both beneficial microorganisms and mineral P. Pressmud - a byproduct of the sugar industry- is especially well suited for this function. Pressmud can function as a fertiliser that gradually releases nutrients while concurrently boosting microbe activity and soil biochemistry when it is enhanced with solubility or slightly dissolving phosphate fertiliser, such as single superphosphate (SSP) or rock phosphate (RP) and colonised with PSB (6, 7).

The efficacy of this strategy is supported by data from past research. For example, it was shown that filter cake inoculated with PSB and amended with RP enhanced sugarcane production and phosphorus utilisation efficiency (6). Similar studies reported that organic compost enriched with phosphate rock and plant growth–promoting bacteria enhanced soil enzyme activity (8). These findings align with broader efforts to recycle agro-industrial residues into value-added inputs, contributing to a circular bioeconomy in agriculture (9).

Building upon this background, the present investigation hypothesises that supplying 100 % of the recommended P dose through pressmud-based enriched fertilisers, enriched with either SSP or RP and further inoculated with PSB, will perform on par with or superior to conventional SSP fertilisation. The study aims to evaluate this hypothesis by assessing soil phosphorus availability, nutrient uptake, crop growth, juice quality, yield and economic efficiency of sugarcane (CoC 13339) under tropical field conditions.

Materials and Methods

Site and experimental design

The field experiment was conducted at the Sugarcane research station, Cuddalore, Tamil Nadu, India, positioned at 11° 46′05″ N, 79° 45′17″ E, to evaluate the efficacy of enhanced phosphatic fertilisers in sugarcane production. The experimental soil was originally assessed for its physico-chemical parameters, including pH, organic carbon and accessible nitrogen, phosphorus and potassium concentrations, before treatment application. The study was carried out with the sugarcane variety CoC 13339, with the first plant crop seeded on 5 January 2023 and harvested on 24 January 2024, followed by the second plant crop sown on 26 March 2024. The experiment was planned out in a randomised block design (RBD) with three replications. For sugarcane, the recommended nutritional dosage was 300:100:200 kg ha^{-1} of N, P_2O_5 and K_2O respectively. While nitrogen and potassium were delivered in three equal splits, with the first application occurring 45 days after planting and the subsequent splits scheduled in accordance with crop growth phases, phosphorus treatments were applied as basal dosages at planting.

Measurements and Treatments

The details of the treatments, such as phosphate-solubilising bacteria (PSB) inoculation, pressmud enrichment and phosphorus sources, are given in Table 1. Enriched pressmud was made by mixing the pressmud with either SSP or RP at an approximate ratio of 10:1 (fertiliser: manure), ensuring an overall moisture content of around 60 % to guarantee consistent nutrient uptake and microbiological activity. Growth factors, comprising cane length, girth, total number of internodes and single cane weight, were measured at regular intervals. Cane and sugar yields were determined at harvest, while quality parameters (Juice), such as Brix, Pol and commercial cane sugar (CCS), were analysed following standard International Commission for Uniform Methods of Sugar Analysis (ICUMSA) procedures (10). Leaf nitrogen, phosphate and potassium levels were determined using recognised procedures (11). Soil readily available nitrogen (N), available phosphorus (P) and exchangeable potassium (K) were evaluated at 90, 150 and 210 days after planting (DAP) and post-harvest using established methods (12, 13). To assess the effects of various treatments, an analysis of variance (ANOVA) was applied to all experimental data. Differences among treatment means were judged statistically significant at $p<0.05$ and mean comparisons were done using the critical differences (CD) test. Economic analysis was carried out to determine the cost of cultivation, gross and net returns and the benefit-to-cost (B: C) ratio for each treatment, allowing assessment of the profitability and economic viability of organic and inorganic phosphorus fertiliser application in sugarcane production (14, 15).

Table 1. Treatment details

Treatment	Phosphorus Source / Level
T_1	Recommended N and K (No P)
T_2	100 % P as SSP + PSB
T_3	100 % P as SSP enriched pressmud compost (SSPEPMC)
T_4	T_4: 100 % P as RP-enriched pressmud compost (RPEPMC)
T_5	75 % P as RPEPMC
T_6	100 % P as RPEPMC + PSB
T_7	75 % P as RPEPMC + PSB
T_8	100 % P as RPEPMC + PSB

*N- Nitrogen, K- Potassium, P- Phosphorus, RP- Rock phosphorus, SSP- Single Super Phosphate and PSB – Phosphorus-solubilising Bacteria.

Results and Discussion

Growth and yield attributes

The combined use of enriched pressmud and PSB not only enhances phosphorus availability but also improves the overall nutritional status of the soil. This increased nutrient environment supports better root growth and function, leading to more efficient absorption of other critical elements such as nitrogen and potassium (16). Results showed that treatment T_8, consisting of pressmud enriched with SSP combined with PSB, demonstrated the most significant improvement in growth of vegetative tissue, with cane length reaching around 221.0 cm, coupled with the greatest girth, maximum number of internodes and single cane weight (Table 2). When compared to all other treatments, these variations were statistically significant. Treatments T_3 (pressmud + SSP) and T_2 (100 % P as SSP + PSB) displayed comparable performance, whereas the control (T_1; prescribed N and K without P) consistently recorded the lowest growth metrics, with an average cane height of 122.9 cm. The higher performance of T_8 demonstrates the synergistic effect of enhanced organic material and PSB inoculation in boosting phosphorus availability and total nutrient absorption, consequently encouraging strong vegetative growth. These results are consistent with earlier research showing that enriched phosphatic fertilisers can improve crop growth and production characteristics, increase accessible phosphorus and modify soil microbial activity, especially when combined with microbial inoculants (2, 16).

Cane and sugar yield

The enrichment of pressmud with SSP enhances the rapid availability of phosphorus. By solubilising inorganic phosphorus through the synthesis of organic acids and phosphatases, the addition of PSB further increases P availability by transforming insoluble compounds into plant-available ones (17). Thus, the treatment T_8 (pressmud enhanced with SSP + PSB) generated the greatest cane yield (99.5 t ha^{-1}) and the greatest amount of sugar (12.85 t ha^{-1}), considerably outperforming all other treatments *(p<0.05)* (Fig. 1). The increased phosphorus availability from enriched pressmud and the solubilising action of PSB, which enhances nutrient absorption efficacy and photosynthesis

Table 2. Effect of enriched phosphatic fertiliser on yield and yield attributes

Treatment details	Cane height (cm)	Cane grith (cm)	No. of inter-node	Single cane weight (kg)	Internode length (cm)	Cane yield (t ha^{-1})
T_1: Recommended N and K (No P)	122.9	2.00	22.89	1.78	7.90	85.7
T_2: 100 % P as SSP + PSB	196.0	2.77	29.35	2.26	9.56	94.6
T_3: 100 % P as SSP enriched pressmud compost (SSPEPMC)	202.5	2.98	30.27	2.32	9.84	97.5
T_4: 100 % P as RP-enriched pressmud compost (RPEPMC)	179.0	2.68	28.00	2.16	9.34	92.8
T_5: 75 % P as RPEPMC	159.5	2.20	25.95	2.06	9.15	90.5
T_6: 100 % P as RPEPMC + PSB	186.9	2.76	29.27	2.23	9.46	94.0
T_7: 75 % P as RPEPMC + PSB	172.3	2.52	27.03	2.04	8.77	91.8
T_8: 100 % P as RPEPMC + PSB	221.0	3.03	31.69	2.51	10.66	99.5
Mean	180.0	2.62	28.06	2.17	9.33	93.3
SEd	4.79	0.06	0.66	0.04	0.24	1.76
CD (p=0.05)	10.29	0.12	1.43	0.09	0.51	3.78

N- Nitrogen, K- Potassium, P- Phosphorus, RP- Rock phosphorus, SSP- Single super phosphate, PSB- Phosphorus-solubilising bacteria, CD- Critical difference.

allocation to cane biomass and sucrose buildup, work in concert to produce the higher yields in T_8 (18). Treatments T_3 (pressmud + SSP) and T_2 (100 % P as SSP + PSB) performed quantitatively equivalent, yielding 97.5 t ha^{-1} and 12.20 t ha^{-1}, respectively, but the control (T_1-prescribed N and K without P) reported the lowest yields (85.7 t ha^{-1} cane). These results complement past studies demonstrating that the combination of inorganic as well as organic fertilisers with microbial inoculants may preserve high sugarcane yields while lowering reliance on traditional mineral P sources (4, 5).

Soil nutrient dynamics

The coupling of organic amendments like pressmud with PSB inoculation can greatly boost nutrient availability and absorption in sugarcane. For instance, studies have found higher phosphorus content in sugarcane tissues and enhanced growth metrics when PSB were treated in conjunction with organic fertilisers (19). Soil accessible nitrogen ($KMnO_4$-N), phosphorus (Olsen-P) and potassium (NH_4OAc-K) were consistently greater in T_8 through the crops' life cycle (90, 150, 210 days after planting and post-harvest) compared to other treatments (Fig. 2). Olsen-P values varied from 10.4 to 16.2 kg ha^{-1} at 90 DAP, with T_8 retaining better availability at all development stages. Treatments T_3 and T_4 also boosted nutritional availability relative to the control, albeit to a lesser extent. The slow-release properties of pressmud, better nutrient retention in the rhizosphere and greater solubilisation of otherwise fixed phosphorus by PSB are all reflected in the preservation of higher soil nutrient concentrations in organic plus inorganic fertiliser along with PSB treatments (20). According to studies, the combination of organic and inorganic fertilisers can improve phosphorus cycling, alter soil microbial populations and increase nutrient-use efficiency in sugarcane systems (2). This prolonged nutrient availability also promotes optimal vegetative and reproductive development. On the other hand, the decrease in soil N, P and K in the control group emphasises the danger of nutrient depletion in intensive cropping systems in the absence of sufficient phosphorus supplementation (21).

Juice quality

Phosphorus affects several metabolic activities, including photosynthesis and sugar production and is essential for the transport and storage of energy in plants. It has been demonstrated that adequate phosphorus supply increases the activity of enzymes involved in the production of sucrose, increasing the amount of sugar in sugarcane juice (22). The pressmud supplemented with SSP and inoculated with PSB revealed higher juice quality metrics, including Brix (20.63 %), Pol (18.53 %) and commercial cane sugar

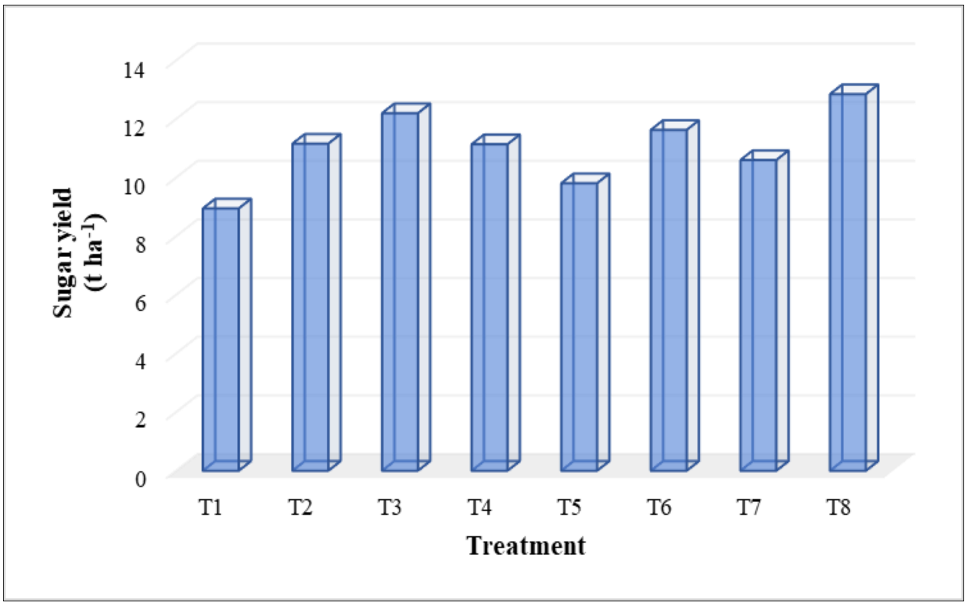
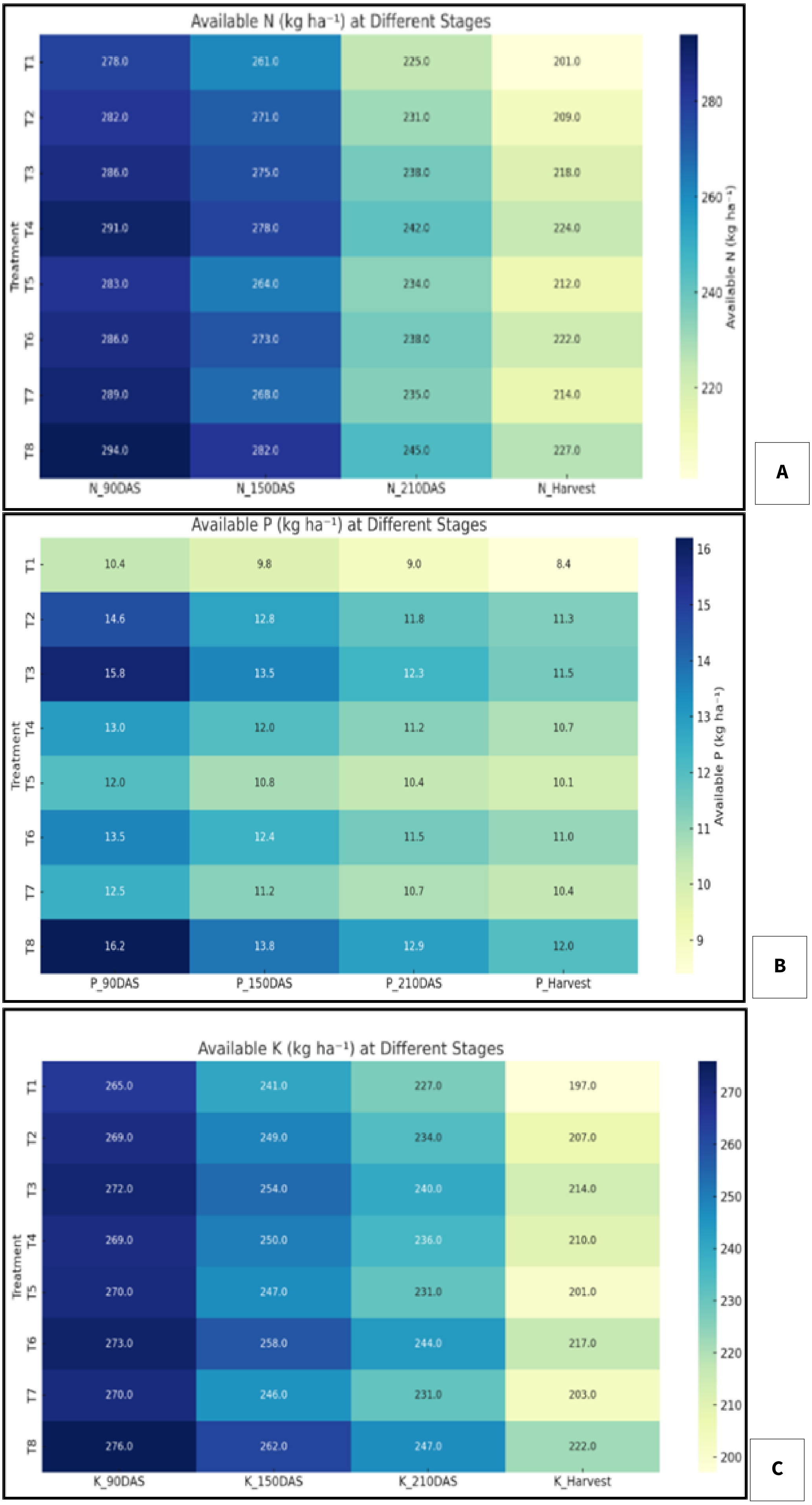
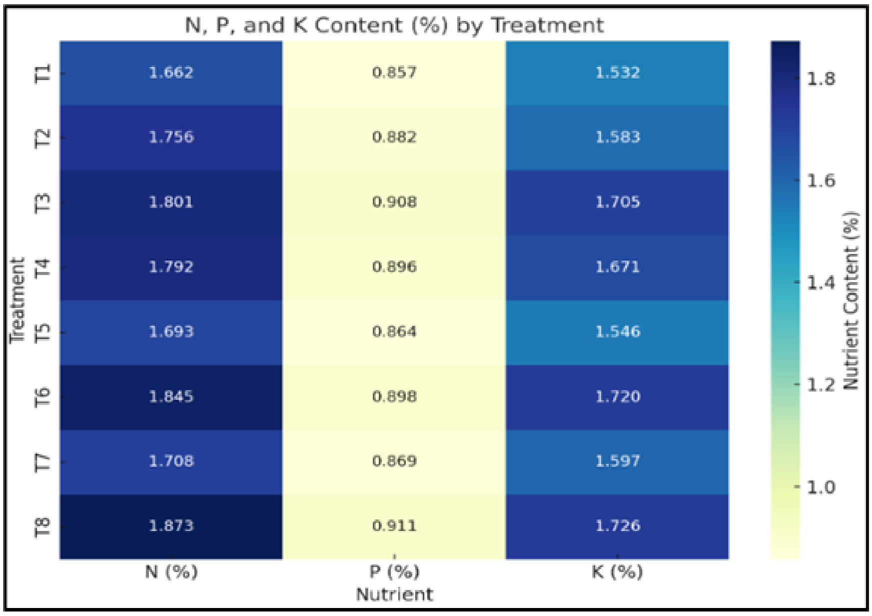


Fig. 1. Effect of enriched phosphatic fertiliser on sugar yield.


Available N (kg ha⁻¹) at Different Stages
N_90DAS N_150DAS N_210DAS N_Harvest
T1 278.0 261.0 225.0 201.0
T2 282.0 271.0 231.0 209.0
T3 286.0 275.0 238.0 218.0
T4 291.0 278.0 242.0 224.0
T5 283.0 264.0 234.0 212.0
T6 286.0 273.0 238.0 222.0
T7 289.0 268.0 235.0 214.0
T8 294.0 282.0 245.0 227.0
Treatment
Available N (kg ha⁻¹)
280
260
240
220
A
Available P (kg ha⁻¹) at Different Stages
P_90DAS P_150DAS P_210DAS P_Harvest
T1 10.4 9.8 9.0 8.4
T2 14.6 12.8 11.8 11.3
T3 15.8 13.5 12.3 11.5
T4 13.0 12.0 11.2 10.7
T5 12.0 10.8 10.4 10.1
T6 13.5 12.4 11.5 11.0
T7 12.5 11.2 10.7 10.4
T8 16.2 13.8 12.9 12.0
Treatment
Available P (kg ha⁻¹)
16
15
14
13
12
11
10
9
B
Available K (kg ha⁻¹) at Different Stages
K_90DAS K_150DAS K_210DAS K_Harvest
T1 265.0 241.0 227.0 197.0
T2 269.0 249.0 234.0 207.0
T3 272.0 254.0 240.0 214.0
T4 269.0 250.0 236.0 210.0
T5 270.0 247.0 231.0 201.0
T6 273.0 258.0 244.0 217.0
T7 270.0 246.0 231.0 203.0
T8 276.0 262.0 247.0 222.0
Treatment
270
260
250
240
230
220
210
200
C



D

***Panel A** – Available N (kg ha-1), Displays nitrogen dynamics by stage. **Panel B** – Available P (kg ha-1), Illustrates phosphorus availability over time. **Panel C** – Available K (kg ha-1), Shows potassium levels across crop stages (90 DAS → harvest). **Panel D** – N, P, K content (%), Final tissue nutrient percentages. Together these panels provide a concise visual comparison of nutrient availability and plant nutrient content across all treatments (T1-T8).

Fig. 2. Effect of enriched phosphatic fertiliser on available nutrients and total nutrient content in the leaf with the midrib. **A**. Available N (kg ha^{-1}), Displays nitrogen dynamics by stage. **B.** Available P (kg ha^{-1}), illustrates phosphorus availability over time, **C.** Available K (kg ha^{-1}), Shows potassium levels across crop stages (90 DAS → harvest), **D.** N, P and K content (%), Final tissue nutrient percentages. Together, these panels provide a concise visual comparison of nutrient availability and plant nutrient content across all treatments (T_1-T_8).

(CCS) (12.91 %) as well as elevated leaf nutritional content (N, P, K), as shown in Table 3. These increases are attributable to the combined effects of enhanced phosphorus availability and microbial activity, which, combined, stimulate sugar synthesis and accumulation in sugarcane (23). Furthermore, the presence of PSB improves phosphorus availability by solubilising inorganic phosphates, thereby enhancing nutrient uptake and utilisation efficiency (24).

Conclusion

Under tropical conditions, the use of enriched phosphatic fertilisers, pressmud supplemented with single SSP and inoculated with PSB, significantly improved sugarcane growth, yield, juice quality and soil nutrient availability. This integrated strategy enhanced phosphorus availability, preserved soil fertility over the crop cycle and contributed to efficient nutrient absorption, ultimately enabling better crop yield and profitability. The results demonstrate that a sustainable nutrient management approach that reduces reliance on traditional mineral fertilisers while maintaining crop performance may be achieved by mixing organic wastes, mineral fertilisers and microbial inoculants. Future research should focus on long-term field validation and improvement of enrichment procedures to further boost the effectiveness of biomineral fertilisers in sugarcane production.

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Table 3. Effect of enriched phosphatic fertiliser on the quality of sugarcane juice

Treatment details	Brix (%)	Pol (%)	Purity (%)	CCS (%)
T_1: Recommended N and K (No P)	16.57	14.95	90.22	10.44
T_2: 100 % P as SSP + PSB	18.66	16.87	90.41	11.79
T_3: 100 % P as SSP enriched pressmud compost (SSPEPMC)	19.07	17.69	92.76	12.51
T_4: 100 % P as RP-enriched pressmud compost (RPEPMC)	18.79	17.11	91.06	12.00
T_5: 75 % P as RPEPMC	17.13	15.50	90.48	10.84
T_6: 100 % P as RPEPMC + PSB	19.33	17.63	91.21	12.37
T_7: 75 % P as RPEPMC + PSB	18.13	16.48	90.90	11.55
T_8: 100 % P as RPEPMC + PSB	20.63	18.53	89.82	12.91
Mean	18.54	16.85	90.91	11.80
SEd	0.47	0.31	NS	0.32
CD (*p*=0.05)	1.02	0.66	NS	0.69

*N- Nitrogen, K- Potassium, P- Phosphorus, RP- Rock phosphorus, SSP- Single super phosphate, PSB- Phosphorus-solubilising bacteria, NS- Non-significant, CD- Critical difference.

Authors' contributions

GP, MB, GA, MPS, PR, MB, RA & PMK contributed equally to data collection, analysis, writing the original manuscript draft, editing and reviewing. All the authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

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Declaration of generative AI and AI-assisted technologies in the writing process: Grammarly was used only for language corrections.

References

1. Patil KB, Tripathi S, Jangir R, Saini L. Influence of phosphorus management on growth, development and yield of sugarcane. Indian J Pure Appl Biosci. 2020;8:25–31. https://doi.org/10.18782/2582-2845.8264
2. Silva AM, Estrada-Bonilla GA, Lopes CM, Matteoli FP, Cotta SR, Feiler HP, et al. Does organomineral fertilizer combined with phosphate-solubilizing bacteria in sugarcane modulate soil microbial community and functions? Microb Ecol. 2022;84(2):539–55. https://doi.org/10.1007/s00248-021-01855-z
3. Roy ED, Richards PD, Martinelli LA, Coletta LD, Lins SR, Vazquez FF, et al. The phosphorus cost of agricultural intensification in the tropics. Nat Plants. 2016;2(5):1–6. https://doi.org/10.1038/nplants.2016.43
4. Crusciol CAC, Campos MD, Martello JM, Alves CJ, Nascimento CA, Pereira JC, et al. Organomineral fertilizer as a source of P and K for sugarcane. Sci Rep. 2020;10(1):5398. https://doi.org/10.1038/s41598-020-62315-1
5. Santos EA, Soares FA, Teixeira MB, da Silva EC, Sousa AE, Vale LS. Effect of organic and mineral phosphate fertilization of the plant cane and first ratoon on agronomic performance and industrial quality of the second ratoon in the Brazilian Cerrado region. Agronomy. 2025;15(8):2004. https://doi.org/10.3390/agronomy15082004
6. Borges BM, Abdala DB, de Souza MF, Viglio LM, Coelho MJ, Pavinato PS, et al. Organomineral phosphate fertilizer from sugarcane byproduct and its effects on soil phosphorus availability and sugarcane yield. Geoderma. 2019;339:20–30. https://doi.org/10.1016/j.geoderma.2018.12.036
7. Silva GP. Microbial inoculation and phosphate fertilization on sugarcane yield and phosphorus fractions in multi-sites of south-central Brazil [doctoral dissertation]. São Paulo: Universidade de São Paulo; 2025. https://doi.org/10.11606/D.11.2025.tde-04042025-095019
8. Lopes CM, Silva AM, Estrada-Bonilla GA, Ferraz-Almeida R, Vieira JL, Otto R, et al. Improving the fertilizer value of sugarcane wastes through phosphate rock amendment and phosphate-solubilizing bacteria inoculation. J Clean Prod. 2021;298:126821. https://doi.org/10.1016/j.jclepro.2021.126821
9. Adesemoye AO, Kloepper JW. Plant–microbe interactions in enhanced fertilizer-use efficiency. Appl Microbiol Biotechnol. 2009;85(1):1–12. https://doi.org/10.1007/s00253-009-2196-0
10. International Commission for Uniform Methods of Sugar Analysis. Methods Book 2011: International methods of sugar analysis. Vol. 1. Berlin: ICUMSA; 2011. https://www.icumsa.org/icumsa-methods-book/
11. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India; 1958. p. 29
12. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circ. 1954;939:1–19
13. Piper CS. Soil and plant analysis. New York: Longmans, Green and Co.; 1945
14. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1967
15. Lal H. Principles of agricultural economics. Agra: Shiva Lal Agarwala & Co.; 2008
16. Estrada-Bonilla GA, Durrer A, Cardoso EJBN. Use of compost and phosphate-solubilising bacteria affects sugarcane mineral nutrition, phosphorus availability and the soil bacterial community. Appl Soil Ecol. 2021;157:103760. https://doi.org/10.1016/j.apsoil.2020.103760
17. Ram B, Chouhan S, Priyadarshi R, Kumar R, Sinha SK, Kumari S. Enhancing soil fertility in calcareous soil through sulphitated press mud, *Trichoderma viride* and biofertilizer integration in sugarcane (*Saccharum officinarum* L.). J Eco-friendly Agric. 2024;19(2):417–23. https://doi.org/10.48165/jefa.2024.19.02.30
18. Niazi MT, Kashif SU, Asghar HN, Saleem M, Khan MY, Zahir ZA. Phosphate-solubilising bacteria in combination with pressmud improve growth and yield of mash bean. J Anim Plant Sci. 2015;25(4):1049–54.
19. Sajid U, Aslam S, Hussain A, Mumtaz T, Kousar S. Pressmud compost for improved nitrogen and phosphorus content employing *Bacillus* strains. Recycling. 2024;9(6):104. https://doi.org/10.3390/recycling9060104
20. Ram B, Chouhan S, Tutlani A, Kumar R, Sinha SK, Kumari S. Optimising sugarcane productivity and soil nutrient uptake with sulphitated press mud (SPM), phosphorus-solubilising bacteria (PSB) and *Trichoderma viride* integration in calcareous soil. Plant Arch. 2024;24(1):122–30. https://doi.org/10.51470/plantarchives.2024.v24.no.1.018
21. Tayade AS, Geetha P, Anusha S. Integrated nutrient management in sugarcane. In: Recent scientific advances in sugarcane cultivation for doubling farmers' income. New Delhi: IBP Books; 2022. p. 290–301
22. Raghothama KG. Phosphorus and plant nutrition: an overview. In: Phosphorus: Agriculture and the Environment. Agronomy Monograph 46. Madison (WI): ASA-CSSA-SSSA; 2005. p. 353–78. https://doi.org/10.2134/agronmonogr46.c11
23. Costa AD, Rolim MM, Bonfim-Silva EM, Simões Neto DE, Pedrosa ER, França e Silva ÊF. Accumulation of nitrogen, phosphorus and potassium in sugarcane cultivated under different types of water management and doses of nitrogen. Crop J. 2016;10(3):362–69
24. Etesami H. Enhanced phosphorus fertilizer use efficiency with microorganisms. In: Meena RS, editor. Nutrient dynamics for sustainable crop production. Singapore: Springer; 2019. p. 215–45. https://doi.org/10.1007/978-981-13-8660-2_8

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