E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(4): 426-429
Received: 03-02-2024
Accepted: 08-03-2024

S Sheik Shalik
PG Scholar, Department of Agronomy, Faculty of Agriculture Annamalai University, Chidambaram, Tamil Nadu, India

G Sivakumar
Assistant Professor, Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu, India

M Meyyappan
Associate Professor, Department of Agronomy, Faculty of Agriculture Annamalai University, Chidambaram, Tamil Nadu, India

Corresponding Author:
S Sheik Shalik
PG Scholar, Department of Agronomy, Faculty of Agriculture Annamalai University, Chidambaram, Tamil Nadu, India

Impact of enriched bio digested bone sludge compost on the fertility percentage of rice

S Sheik Shalik, G Sivakumar and M Meyyappan

DOI: https://doi.org/10.33545/2618060X.2024.v7.i4f.585

Abstract
A field trial was carried out at the Experimental Farm of the Department of Agronomy, Annamalai University, Annamalai Nagar, in the 2022 cropping season. The objective was to investigate how using bone sludge, a by-product of the ossein industry, as a fertilizer along with other organic fertilizers such as bone sludge compost, pressmud compost, poultry manure compost, goat manure compost, and farmyard manure, affects the growth and yield of rice. The results of the experiment revealed that among the different treatments tested, application of bone sludge compost @ 5 t/ha + Pressmud compost @ 5 t/ha along with balance N and K through fertilizers (T_4) excelled all treatments and gave significantly higher fertility percentage of 92.45 when compared to other treatments. Considering the results of the present investigation, it can be concluded that application of bone sludge compost @ 5 t/ha + Pressmud compost @ 5 t/ha along with balance N and K through fertilizers registered highest values in number of spikelets/panicle, number of filled grains/panicle and fertility percentage in rice.

Keywords: Bone sludge compost, goat manure compost, poultry manure compost, pressmud compost, farmyard manure, grain yield and fertility percentage

Introduction

Rice (*Oryza sativa* L.) serves as a primary staple food for approximately half of the global population and ranks as the second most significant cereal crop worldwide, following wheat, in terms of cultivation area (Jhon and Babu, 2021) [8]. Worldwide, rice is grown across approximately 162 million hectares, yielding around 700 million tonnes annually, with an average productivity of 4.3 tonnes per hectare. In India, rice cultivation covers an area of 48.53 million hectares, resulting in a production of 112.18 million tonnes, with an average productivity of 2.31 tonnes per hectare. Within Tamil Nadu, rice is cultivated across 2.2 million hectares, generating a production of 8.65 million tonnes, with a productivity rate of 3.93 tonnes per hectare (Directorate of Economics and Statistics, 2021) [3]. The indiscriminate disposal of industrial waste presents considerable hazards to human health and soil quality, crucial for supporting plant growth. Initiatives are being pursued to investigate ways of repurposing these waste materials in ways that promote environmental well-being, especially soil vitality. The challenge lies in seamlessly incorporating these waste products into a carefully coordinated system to prevent worsening pollution concerns.

The decrease in overall production from the same area of land and the reduced effectiveness of fertilizer applications in boosting food grain yields can be attributed to the unbalanced, unsuitable, and indiscriminate application of chemical fertilizers. This practice leads to excessive nutrient depletion from the soil, resulting in diminished soil fertility. Additionally, it contributes to the deterioration of soil health and the degradation of land quality (Shova Akter *et al*., 2023) [17]. There has been a consistent decrease not just in productivity, but also in the soil's ability to recover, alongside water resource pollution and chemical contamination of food grains. Preserving soil health is vital for sustainable production, necessitating the consideration of factors that contribute to its continuous upkeep. Thus, the combined utilization of organic supplements along with chemical fertilizers is essential to maintain soil health and optimize rice yields (Jagadeesha *et al*., 2020) [6].

The increasing global population, coupled with its expanding needs for food, fiber, and energy, creates a rising annual demand that must be sustainably met. Addressing this demand requires prioritizing productivity enhancement. Therefore, it is imperative to develop a comprehensive strategy that not only aims to increase yields but also focuses on maintaining and enhancing deteriorating soil health Kapse *et al.* (2017) [9].

Therefore, the complementary function of organic supplements alongside chemical fertilizers is crucial for maintaining soil health, thereby unlocking the maximum yield potential in rice cultivation (Lency, 2001) [11]. Given the current situation, there is increasing attention towards integrating both inorganic and organic materials such as crop residues, agro-industrial wastes, and by-products to enhance soil quality. This integration not only improves soil nutrient levels but also enhances the physical, chemical, and biological properties of the soil, leading to overall soil quality enhancement and increased permeability. Consequently, the higher addition of humus results in improved fertilizer use efficiency (Prakhyath *et al*., 2022) [14].

There is a growing inclination towards utilizing recycled industrial wastes from both agricultural and non-agricultural sectors to enhance soil quality. These repurposed materials provide essential plant nutrients, improving the efficiency of fertilizers and supporting cost-effective agricultural methods. This strategy utilizes locally sourced resources and offers economically viable inputs to achieve profitable crop production (Imran khan *et al.*, 2022) [5].

Pressmud compost, a significant by-product of the sugar industry, contains vital macro and micronutrients. It acts as a valuable source of nitrogen (N) and phosphorus (P), enriching soil nutrients and improving the availability of micronutrients in crop systems (Krishnaveni *et al*., 2020) [10]. Bone sludge, a by-product extracted from the ossein industry, comprises bone particles suspended in bone washings. These particles undergo filtration and sun-drying, retaining significant quantities of both macro and micronutrients (Sivakumar, 2015) [18]. Various organic manures such as pressmud compost, poultry manure compost, goat manure compost, bone sludge compost, and farmyard manure serve as excellent organic fertilizers due to their rich content of nitrogen, phosphorus, potassium, and other essential nutrients. These organic fertilizers have shown promise in reversing the declining trend of soil health and increasing productivity by addressing marginal nutrient deficiencies. Therefore, this study aimed to develop an effective agricultural practice utilizing bio-digested bone sludge compost in combination with locally available organic sources and inorganic fertilizers to enhance rice productivity.

Materials and Methods

The field experiment was conducted in Q block of experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar. The geographical location of Annamalai Nagar is 11º24' N latitude and 79º44' E longitude at an altitude of +5.79 m above mean sea level. The soil of the experimental field is classified as Udic chromustert (clay) according to FAO (1974) [4]. The initial analysis of the experimental soil revealed that heavy clay was neutral in reaction (pH = 7.6), with low soluble salts (EC = 0.33 dS/m), medium in available N (230 kg/ ha), low in available P_2O_5 (21 kg/ha) and high in available K_2O (280 kg/ha). The experiment was laid out in randomized block design with three replications. The experiment comprised eight treatments *viz.*, T_1 – Bone sludge compost @ 2.5 t ha^{-1} + Balance N and K through fertilizers, T_2– Bone sludge compost @ 2.5 t ha^{-1} + Pressmud compost @ 2.5 t ha^{-1} + Balance N and K through fertilizers, T_3– Bone sludge compost @ 2.5 t ha ^{1} + Poultry manure compost @ 2.5 t ha^{-1} + Balance N and K through fertilizers, T_4 – Bone sludge compost @ 5 t ha^{-1} + Pressmud compost @ 5 t ha^{-1} + Balance N and K through fertilizers, T_5 – Bone sludge compost @ 5 t ha^{-1} + Poultry manure compost @ 5 t ha^{-1}+ Balance N and K through fertilizers, T_6 – Bone sludge compost @ 5 t ha^{-1} + Goat Manure compost @ 5 t ha^{-1} +Balance N and K through fertilizers, T_7– FYM @ 12.5 t ha^{-1} + Recommended NPK ha^{-1} and T_8 – Control (No nutrient supply). Rice variety ADT43 was chosen as test crop for the investigation bone sludge compost, pressmud compost, poultry manure compost, goat manure compost and FYM were applied in the respective plots as per the treatment schedule. Pressmud compost, poultry manure compost and FYM were obtained from farm unit of Department of Agronomy, Faculty of agriculture, Annamalai University, Annamalai Nagar. Annamalai University, Annamalai Nagar. Bone sludge compost used in this study was obtained from Pioneer Jellice India Pvt. Ltd., Cuddalore. The nutrient content of organic manure composts *viz*., Bone sludge N–2.10%, P–9.96%, K–0.38%, pressmud compost N– 2.63%, P–2.54%, K 2.36%, goat manure compost N–1.50%, P–0.40%, K–0.37%, poultry manure compost N–2.20%, P–1.40%, K–1.20% and FYM N–0.58%, P–0.27%, K–0.60%, respectively. The recommended package of practices was followed, and the crop was harvested. For recording plant height and for estimation of dry matter production, five plants were randomly removed at harvest stage. These samples were first air-dried in shade and then oven-dried at 80±5 °C till a constant weight was obtained and the weight was recorded. The mean dry weight was expressed in kg/ha. All the recorded data were analyzed statistically with analysis of variance using Agres software with a critical difference at 0.05 level of probability.

The percentage of spikelets fertility was worked out using the following Formula

$$\text{Fertility percentage} = \frac{\text{Number of filled grain panicle}^{-1}}{\text{Total number of spikelets panicle}^{-1}} \times 100$$

Results and Discussion

Number of filled grains and spikelets panicle^{-1}

The yield attribute of rice *viz*., number of filled grains/panicle and number of spikelets/panicle was favourably influenced by the application of bio digested bone sludge compost @ 5 t/ha + Pressmud compost @ 5 t/ha along with balance N and K through fertilizers (Table 1). The maximum number of filled grains/panicle (98.00) and number of spikelets/panicle (106) was registered under the application of bone sludge compost @ 5 t/ha + pressmud compost @ 5 t/ha along with Balance N and K through fertilizers (T_4). It was followed by the application of bone sludge compost @ 5 t/ha + poultry manure compost @ 5 t/ha along with Balance N and K through fertilizers (T_4). The treatment with control (no nutrient supply) (T_8) registered the minimum filled grains/panicle (76.70) and number of spikelets/panicle (89). Using a combination of inorganic fertilizers and organic manure sources could aid in maintaining an optimal nutrient balance during different growth stages of rice. This integrated method has the potential to enhance the availability of both major and minor nutrients, thereby promoting better nutrient uptake. Consequently, it may lead to improved movement of photosynthates from the source to the sink, resulting in a higher number of spikelets and filled grains per panicle in rice plants. These findings are in conformity with the earlier reports of Coulibaly *et al.* (2020) [1], Rahman and Barmon (2019) [15] Jay Nath Patel *et al.* (2023) [7] in rice.

The treatment combination involving the application of bone sludge compost and pressmud compost resulted in the highest grain percentage. This outcome is likely due to the balanced nutrient supply provided to the plants throughout their growth stages by both mineral fertilizers and the mineralization process of organic manures. This balanced nutrient availability prevented nutrient stress in the plants at any stage, resulting in maximum production and proper grain filling. The results are supported by De Fatima Esteves *et al*. (2020) [2] and Rawat *et al*. (2020) [16].

Fertility percentage

Bio digested bone sludge compost significantly influenced the fertility percentage of rice (Table 1). Application of bone sludge compost @ 5 t/ha + pressmud compost @ 5 t/ha along with Balance N and K through fertilizers (T_4) significantly registered the highest fertility percentage of 92.45. It was followed by application of bone sludge compost @ 5 t/ha + poultry manure compost @ 5 t/ha along with Balance N and K through fertilizers recorded with a fertility percentage of 91.54. Treatment with control (no nutrient supply) (T_8) registered the minimum fertility percentage of 86.18. The enhanced yield attributes of rice observed when bone sludge and press mud were used in combination can be attributed to the gradual release and consistent supply of nutrients in balanced quantities throughout different growth stages. This enabled rice plants to effectively assimilate photosynthetic products, leading to increased dry matter and source capacity. Consequently, there was a higher production of panicles with a greater number of fertile grains, aligning with the research findings of Mohanasundar and Saravana Perumal (2021) [12] and Pankaj Singh and Awadhesh Kumar Singh (2022) [13].

Table 1: Effect of bio digested bone sludge compost on fertility percentage of rice

Treatments	Number of spikelets panicle^{-1}	No of filled grains/panicle	Fertility percentage
T_1 - Bone sludge compost @ 2.5 t ha^{-1} + Balance N and K through fertilizers.	94	82.70	87.98
T_2 - Bone sludge compost @ 2.5 t ha^{-1} + Pressmud Compost @ 2.5 t ha^{-1} + Balance N and K through fertilizers.	100	89.20	89.20
T_3 - Bone sludge compost @ 2.5 t ha ^{1} + Poultry manure compost @ 2.5 t ha^{-1} + balance N and K through fertilizers.	97	86.00	88.66
T_4 - Bone sludge compost @ 5 t ha^{-1} + Pressmud Compost @ 5 t ha^{-1} + balance N and K through fertilizers	106	98.00	92.45
T_5 - Bone sludge compost @ 5 t ha^{-1} + Poultry manure compost @ 5 t ha^{-1} + Balance N and K through fertilizers.	104	95.20	91.54
T_6 - Bone sludge compost @ 5 t ha^{-1} + Goat manure compost @ 5 t ha^{-1} +Balance N and K through fertilizers.	102	92.30	90.49
T_7 - FYM @ 12.5t ha^{-1} + Recommended NPK ha^{-1}.	93	80.50	87.60
T_8 - Control (No nutrient supply)	89	76.70	86.18
CD (p=0.05)	0.5	2.60	0.41
S.Em±	1.5	0.86	0.13

Conclusion

Based on the present investigation, it could be concluded that application of bone sludge compost @ 5 t/ha + pressmud compost @ 5 t/ha along with Balance N and K through fertilizers (T_4) holds promise in enhancing fertility percentage of crop and crop yield which is the felt need of present-day agriculture. Hence, bone sludge is a realistic organic alternative which is agronomically efficient, ecologically desirable and economically viable which paves way for realization of higher returns from rice without affecting the soil health.

References

1. Coulibaly PJA, Sawadogo J, Ouattara B, Valea WC, Okae-Anti D, Legma JB, *et al*. Performance of sorghum (*Sorghum bicolor* L. Moench) in sub-Saharan Africa using organic and inorganic sources of materials. Intl J Agril Policy Res. 2020;8(5):124-136.
2. De Fatima Esteves G, De Souza KRD, Bressanin LA, Andrade PCC, Junior VV, Dos Reis PE, *et al*. Vermicompost improves maize, millet and sorghum growth in iron mine tailings. J Environ Mgt. 2020;264:110468.
3. Directorate of Economics and Statistics. Department of Agricultural Cooperation and Farmers' Welfare. Ministry of Agriculture and Farmers' Welfare, Govt. of India, Delhi, India; c2021.
4. FAO. Food and Agriculture Organization of the United Nations, Rome; c1974.
5. Khan I, Muhammad A, Chattha MU, Skalicky M, Chattha MB, Ayub AM, *et al*. Mitigation of Salinity-Induced Oxidative Damage, Growth, and Yield Reduction in Fine Rice by Sugarcane Press Mud Application. Front Plant Sci. 2022;13:840900.
6. Jagadeesha N, Gb S, Hosamani V, Umesh M, Reddy V. Soil properties, water use efficiency and production potential of finger millet and pigeon pea intercropping under organic production in alfisols of Karnataka. Intl J Chem Stud. 2020;8:1598-1603.
7. Patel JN, Singh RP, Alam MS. Influences of nutrient alteration by organic and inorganic sources on protein content, their yield and economics of the transplanted rice (*Oryza sativa* L.). J Pharm Innov. 2023;12(7):3523-3528.
8. Jhon DA, Babu GR. Lessons from the aftermaths of green revolution on food system and health. Front Sustain Food Syst. 2021;5:644559.
9. Kapse G, Patoliya P, Samadder SR. Characterisation of coal washery effluent and optimisation of coagulation behaviour of Moringa oleifera seed as a coagulant. Environ Monit Assess. 2017;189:133.
10. Krishnaveni A, Chinnasamy S, Elumalai J, Muthaiyan P. Sugar industry wastes as wealth of organic carbon for soil.

Ind (Ed): Environmental Factors Affecting Human Health; c2020.
11. Lency T. Formulation and evaluation of organic meals from KCPL effluent slurry. PhD thesis, Kerala Agricultural University, Vellayanikara, Thrissur, Kerala, India; c2001.
12. Mohana Sundar C, Saravana Perumal M. Comparison of different planting methods and physiological studies for yield enhancement in rice. J Pharmacogn Phytochem. 2021;10:1400-1404.
13. Singh P, Singh AK. The effect of integrated nutrient supply on growth and yield performance of rice (*Oryza sativa* L.) crop. J Pharm Innov. 2022;11(1):774-776.
14. Prakhyath KM, Prakash SS, Honnappa HM, Srinivasa N, Krishna Murthy R, *et al*. Growth and development of paddy due to different amendments and nutrient management practices in sodic soil. J Pharm Innov. 2022;SP-11(1):208-214.
15. Rahman S, Barmon B. Greening modern rice farming using vermicompost and its impact on productivity and efficiency: An empirical analysis from Bangladesh. Agric. 2019;9:239.
16. Rawat J, Saxena J, Sanwal P. Utilization of pressmud waste as a carrier for enhancing agronomic traits of finger millet. Clean (Weinh). 2020;2000260.
17. Akter S, Kamruzzaman M, Khan MZ, Amin MS. Enhanced Potassium Fertilization Improved Rice (*Oryza sativa*) Yield and Nutrient Uptake in Coastal Saline Soil of Bangladesh. J Soil Sci Plant Nutri; c2023.
18. Sivakumar G. Studies on the integrated plant nutrition management for rice in augmenting the productivity of rice – black gram under relay cropping. PhD Thesis, Annamalai Univ., Tamil Nadu; c2015.