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Effect of soil conditioners on nutrient uptake by *kharif* rice under coastal soil of South Gujarat condition

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Abstract
An experiment was conducted at Coastal Soil Salinity Research Station, NAU, Danti, during *kharif* season of 2020 and 2021 to study the effect of soil conditioners on nutrient uptake by *kharif* rice under coastal soils. The field experiment consisted of different treatments *viz*., T_1: Control without biocompost (BC) and gypsum (Gyp), T_2: Biocompost @ 10 t/ha, T_3: Gyp @ 50% GR, T_4: Gyp @ 50% GR + BC @ 10 t/ha, T_5: Gyp @ 75% GR, T_6: Gyp @ 75% GR + BC @ 10 t/ha, T_7: Gyp incubated BC @ 50% GR (BC @ 10t/ha) and T_8: Gyp incubated BC @ 75% GR (BC @ 10t/ha) were applied to *kharif* rice. These treatments were tested in randomized block design with three replications. The results revealed that the total nutrient uptake (grain and straw) by rice were recorded significantly higher with treatment T_8 (Gyp incubated BC @ 75% GR) followed by treatment T_7 (Gyp incubated BC @ 50% GR) during 2020, 2021 as well as in pooled results.

Keywords: Soil conditioners, rice, nutrient uptake, coastal soil

Introduction
Rice (*Oryza sativa* L.) is the staple food consumed by over 65 percentage of the population and it provides employment and livelihood security to 70 percentage of Indian population. In India, rice is grown in highly diverse conditions starting from below sea levels to hill as high as > 2000 meters. Majority season of rice growing is *kharif*. India produces most of its rice depending on monsoon rainfall and rice area under guaranteed irrigation is 59 percentages. In India, area under rice cultivation is 43.79 million ha with first position and second position in production with 116.42 million tonnes with 2659 kg/ha average yields (Anon, 2020). In the state of Gujarat, rice makes up about 14 percentage of all food grain production and 7 to 8 percentage of the state's gross cropped area. On average, 6.5 to 7.25 hectares of land are used to cultivate it, with nearly 55 to 60 percentage of that land being low land (transplanted) and 40 to 45 percentages being upland (drilled) rice. In Gujarat state, the total production of rice is about 9.0 to 10.5 lakh tonnes with a productivity of 1500 - 1800 kg/ha (Anon, 2020). A nutrient-dense staple food is rice that gives instant energy because it mostly consists of important component *viz*., carbohydrate (starch). However, rice has a low amount of nitrogenous elements (average composition of these components is only 8 percentage), and a negligible amount of fat (1 percentage), or lipids. For this reason, rice is considered as a complete food for eating.

South Gujarat's coastal regions have saline and saline-sodic soil in nature. Because of these poor physical conditions of the soils have a negative impact on the production of crops. In order to increase rice's nutrient uptake and restore the physico-chemical properties of coastal soil, the current study aimed to develop a practically viable management strategy through the incubation of gypsum with organic soil conditioner, *viz*., biocompost, an industrial by product that is abundantly available and hasten the solubilization of gypsum through organic acids formed during organic matter decomposition (Rangaraj *et al*., 2007; Jamil *et al*., 2008; Muhammad and Khattak, 2009) [10, 6, 9].

Furthermore, biocompost supply of primary, secondary and micronutrients for proper growth and development of the plants and increase activity of soil microbes through providing energy. It acts as thermo regulation in soil, improves buffering and exchange capacities of soil. It also improves the nutrient uptake by crop. The most widely used amendment/conditioner is gypsum due to its low cost and readily availability. The reclamation of salt-affected soils was found to benefit from the combined use of gypsum and farm yard manure, according to Joachim *et al*. (2007) [7]. Being sparingly soluble in nature, to increase the efficiency of applied gypsum in the absence of sufficient moisture either through irrigation or rainfall becomes a

challenging task. In these conditions, use of organic sources as amendments/conditioner has dual role, it increases the solubility of gypsum by releasing organic acids during decomposition and it helps to improve the soil physico-chemical properties (Wahid *et al.*, 1998; Sardina *et al.*, 2003; Tajada *et al.*, 2006) [15, 11, 14].

Therefore an attempt has been made to study the effect of soil conditioners on nutrient uptake by *kharif* rice under coastal soils of south Gujarat.

Materials and Methods

The field experiment was carried out in the *kharif* season of 2020-2021 at the Coastal Soil Salinity Research Station, Navsari Agricultural University, Danti in South Gujarat near the Arabian Sea, India which is located at latitude of 20° 83′ N and longitude of 72° 50′ E at an elevation of 2.5 m above the mean sea level on the western coastal belt of India. This region has a humid and warm monsoon, a rather hot summer, and a moderately cold winter. Rainfall in this area on an average 1200 mm annually, with the majority occurs between the second week of June and the last week of September. The mean minimum and maximum temperatures vary from 12.1 °C to 26.5 °C and 21.8 °C to 34.6 °C, respectively. The soil of the experiment field was clayey in texture, having pH_s (8.67 and 8.61), Electrical conductivity (6.39 and 5.93 dS/m), medium in organic carbon (0.50 and 0.52%) low in available nitrogen (233 and 246 kg/ha), medium in available phosphorus (45.8 and 43.3 kg/ha) and high in available potassium (1106 and 1023 kg/ha) during 2020 and 2021, respectively.

The rice variety used in the experiment was GNR-7. These treatments were tested in randomized block design with three replications. The field experiment consisted of different treatments *viz*., T_1: Control without biocompost (BC) and gypsum (Gyp), T_2: Biocompost @ 10 t/ha, T_3: Gyp @ 50% GR, T_4: Gyp @ 50% GR + BC @ 10 t/ha, T_5: Gyp @ 75% GR, T_6: Gyp @ 75% GR + BC @ 10 t/ha, T_7: Gyp incubated BC @ 50% GR (BC @ 10t/ha) and T_8: Gyp incubated BC @ 75% GR (BC @ 10t/ha) were applied to *kharif* rice. During the land preparation, gypsum, biocompost, and gypsum incubated biocompost were applied. The materials were evenly spread and mixed in that specific bed. 25 days old seedlings of rice were transplanted with two to three seedlings per hill at a spacing of 20 cm x 15 cm in both the years.

The recommended dosage of fertilizers (120:30:00 NPK kg/ha) was applied to the rice crop. Nitrogen was applied using ammonium sulphate (20.6 percent N), while phosphorus was applied using single superphosphate (16 percent P_2O_5). At the time of transplanting, the full dose of phosphorus and 25 percentage of nitrogen were applied. Then, 50 percentage of the nitrogen was applied at the maximum tillering stage and the remaining 25 percentage of the nitrogen was applied at the panicle initiation stage. *Kharif* rice was cultivated during the south-west monsoon rains, although protective irrigations were provided as needed.

To estimate the N, P, and K content of grain and straw separately, representative samples from each plot of the rice crop were taken individually. After being dried in an oven at 65 ºC for 24 hours, the samples were ground into a powder using a mechanical grinder and their nutrient content was determined using the methods below.

Table 1: Effect of soil conditioners on nutrient uptake

Sr. No.	Particular	Analytical method applied
1	Nitrogen (%)	Micro kjeldahl's method (diacid) (Warnke and Barber, 1974) [16]
2	Phosphorus (%)	Vanadomolybdo phosphoric acid yellow colour method (Jackson, 1967) [5]
3	Potassium (%)	Flame photometric method (Jackson, 1967) [5]

The following formula was used to determine the nutrients (N, P, and K) uptake by rice crop

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)}}{100} \times \text{Yield(kg/ha)}$$

The total amount of the corresponding nutrient uptake was calculated by adding the nutrient uptake by rice grain and rice straw. But in addition, more emphasis was given to total uptake of nutrients (N, P and K).

Results and Discussion

Effect of soil conditioners on nutrient uptake

During the year 2020, 2021 and in pooled results, the data shown in Table 1 showed that soil conditioners had a significantly impact on the uptake of nitrogen, phosphorous and potassium by the rice crop (grain and straw).

The data of nitrogen uptake by rice crop (grain and straw) showed significant differences among various treatments. Significantly maximum nitrogen uptake of rice crop (grain and straw) was recorded 116.52, 119.78 and 118.15 kg/ha with application of gypsum incubated BC @ 75% GR (T_8) in the year 2020, 2021 and in pooled analysis, respectively which was comparable to application of gypsum incubated BC @ 50% GR (T_7) during the year 2020, 2021 and in pooled results as well as with application of gypsum @ 75% GR + BC @ 10 t/ha (T_6) during the year 2021. The lowest content of nitrogen uptake 65.70, 70.79 and 68.24 kg/ha in control treatment (T_1) without BC and gypsum in each of the years and the pooled analysis, respectively.

The data of phosphorus uptake (Table 1) of rice (grain and straw) showed significant differences among various treatments. Significantly maximum phosphorus uptake of rice crop (grain and straw) was recorded 20.43, 24.74 and 22.58 kg/ha with application of gypsum incubated BC @ 75% GR (T_8) in the year 2020, 2021 and in pooled results, respectively, it was comparable to application of gypsum incubated BC @ 50% GR (T_7) during the year 2020 and 2021. The lowest content of phosphorus uptake 11.14 kg/ha and 13.79 kg/ha in control treatment (T_1) without BC and gypsum during 2020 and 2021 as well as 12.47 kg/ha in pooled analysis.

The data of potassium uptake (Table 1) of rice (grain and straw) showed significant differences among various treatments. Significantly maximum potassium uptake of rice crop (grain and straw) was recorded 114.36 kg/ha, 117.35 kg/ha and 115.85 kg/ha with application of gypsum incubated BC @ 75% GR (T_8) in the year 2020, 2021 and in pooled results, respectively, it was comparable to treatments (T_7) application of gypsum incubated BC @ 50% GR. Furthermore, comparable to application of gypsum @ 75% GR + BC @ 10 t/ha (T_6) and gypsum @ 50% GR + BC @ 10 t/ha (T_4) during 2021. The lowest content of potassium uptake

66.25 kg/ha, 71.40 kg/ha and 68.82 kg/ha with control (T_1) treatment without BC and gypsum during 2020, 2021 and in pooled analysis.

In treatment, gypsum incubated BC @ 75% GR (T_8) followed by gypsum incubated BC @ 50% GR (T_7) recorded a significantly higher values of total nutrients uptake by rice grain and straw (Table 1). The higher uptake of NPK in rice grain and straw may be attributed to the addition of amendments in addition to the combined advantages of gypsum and organic manures (biocompost). Gypsum and biocompost application results in increased nutritional content and uptake. This is most likely because of improved soil ecology, improved nutrient regime, and balanced nutrient distribution in the soil, which promoted the root and increased water and nutrient absorption to a greater region and depth. Similarly was also observed in the findings of Dhanushkodi and Kannathasan (2012) [2], Mohamedin (2012) [8], Hafez *et al*. (2017) [3] and Sundhari *et al*. (2018) [13].

Additionally, the favorable environment created by the combined application of biocompost and gypsum may have contributed to the improved uptake of nutrients in rice grain and straw, as well as the reduction of pH and EC. Generally, the nitrogen uptake in the biocompost might be due to the mineralized nitrogen have synchronized with nitrogen absorption. The addition of biocompost to the soil is thought to be the cause of the increased phsphorus uptake and decreased the transformation of fertilizers P into Ca-P owing to the formation of organic calcium complex and protective action. Thereby phosphorus activity has increased, which enhanced the root activity, leads to higher phosphorus content and uptake in the treatments that received biocompost than the control. Phosphorus uptake was greatly enhanced by positive effect of gypsum and biocompost. Possible causes for this include higher soil phosphorus availability due to acid production by application of biocompost in rice. Increased potassium uptake may result from the organic manures adding a significant amount of potassium to the soil and also the ammonical nitrogen and organic acid produced during the decomposition of organic matter dislocate the potassium from the clay lattices lead to higher K availability, which increased rice grain and straw potassium uptake. The outcomes support the findings of the Dhanushkodi and Kannathasan (2012) [2], Mohamedin (2012) [8], Hossain and Sarker (2015) [4], Hafez *et al*. (2017) [3], Singh *et al*. (2018) [12] and Sundhari *et al*. (2018) [13].

Table 2: Effect of soil conditioners on nutrient uptake by rice (grain and straw) crop at harvest

Treatments	Nitrogen uptake (kg/ha)			Phosphorus uptake (kg/ha)			Potassium uptake (kg/ha)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
T_1: Control (Without BC and gypsum)	65.70	70.79	68.24	11.14	13.79	12.47	66.25	71.40	68.82
T_2: BC @ 10 t/ha	76.85	78.86	77.86	13.57	15.48	14.52	78.63	77.02	77.83
T_3: Gypsum @ 50% GR	82.76	82.80	82.78	14.50	16.11	15.30	84.55	81.44	83.00
T_4: Gypsum @ 50% GR + BC @ 10 t/ha	92.66	94.88	93.77	16.06	19.01	17.53	91.15	95.34	93.25
T_5: Gypsum @ 75% GR	88.68	90.14	89.41	15.60	17.97	16.78	87.61	89.59	88.60
T_6: Gypsum @ 75% GR + BC @ 10 t/ha	99.72	103.86	101.79	17.02	20.81	18.91	100.42	101.90	101.16
T_7: Gypsum incubated BC @ 50% GR	106.78	109.75	108.26	18.65	21.99	20.32	106.18	106.61	106.40
T_8: Gypsum incubated BC @ 75% GR	116.52	119.78	118.15	20.43	24.74	22.58	114.36	117.35	115.85
SEm±	4.80	5.56	3.68	0.66	1.11	0.65	4.35	7.48	4.56
CD at 5%	14.55	16.87	10.67	2.00	3.35	1.88	13.20	22.69	13.21
CV (%)	9.11	10.26	9.75	7.19	10.22	9.18	8.27	13.99	12.16
SEm± (Y X T)	5.21			0.92			6.45		
CD at 5% (Y X T)	NS			NS			NS		

NS: Non-significant, S: Significant

Conclusions

It was concluded that the total nutrient uptake by rice crop (grain and straw) was higher with the application of gypsum incubated biocompost @ 75% GR followed by gypsum incubated biocompost @ 50% GR in costal soils of south Gujarat.

References

1. Anonymous. Agricultural Statistics at a Glance-2019; c2020.
2. Dhanushkodi V, Kannathasan M. Importance of industrial waste in maximizing the yield of rice and its effect on soil fertility in coastal regions. Int J Res Chem Environ. 2012;2(3):21-25.
3. Hafez WA, Abd El-Naby ZM, Mousa WME, Hassan HHM. Impact of some soil amendments application on soil properties, fodder beet productivity and quality under salt-affected soil. J Soil Sci Agric Eng. 2017;8(11):605-612.
4. Hossain MB, Sarker RR. Organic and inorganic amendments on rice (*Oryza sativa* L.) and soil in salt-affected areas of Bangladesh. J Environ Sci Nat Resour. 2015;8(2):109-113.
5. Jackson ML. Soil Chemical Analysis. New Delhi: Prentice Hall of India Pvt. Ltd.; c1967. p. 183-192.
6. Jamil M, Qasim M, Zia MS. Utilization of pressmud as an organic amendment to improve physico-chemical characteristics of calcareous soil under two legume crops. J Chem Soc Pak. 2008;3(1):145-150.
7. Joachim HJR, Makoi P, Ndakidemi A. Reclamation of sodic soils. In: KK Mann, ed. Agricultural Salinity Assessment and Management. New York: American Society of Civil Engineers; c2007. p. 113-137.
8. Mohamedin AAM. Effect of leaching with adding gypsum and rice straw compost on improving salt-affected soil and rice yield. Minia International Conference for Agriculture and Irrigation in the Nile Basin Countries, El-Minia, Egypt; c2012.
9. Muhammad D, Khattak RA. Growth and nutrients concentrations of maize in pressmud treated saline sodic soil. Soil Environ. 2009;28:145-155.
10. Rangaraj T, Somasundaram EM, Amanullah M, Thirumurugan V, Ramesh S, Ravi S, *et al*. Effect of agro-industrial wastes on soil properties and yield of irrigated finger millet (*Eleusine coracana* L. Gaertn) in coastal soil. Res J Agric Biol Sci. 2007;3(3):153-156.

11. Sardina M, Muller T, Schmeisky H, Joerensen RG. Microbial performance in soils along a salinity gradient under acidic conditions. J Appl Soil Ecol. 2003;23:237-244.
12. Singh YP, Arora S, Mishra VK, Dixit H, Gupta RK. Effect of organic and inorganic amendments on amelioration of sodic soil and sustaining rice (*Oryza sativa*)-wheat (*Triticum aestivum*) productivity. Indian J Agric Sci. 2018;88(9):1455-1462.
13. Sundhari T, Thilagavathi T, Baskar M, Thuvasan T, Eazhilkrishna N. Effect of gypsum incubated organics used as an amendment for sodic soil in green gram. Int J Chem Stud. 2018;6(1):304-308.
14. Tajada M, Garcia C, Gonzalez JL, Hernandez MT. Use of organic amendments as a strategy for saline soil remediation: influence on the physical, chemical, and biological properties of soil. Soil Biol Biochem. 2006;38(6):1413-1421.
15. Wahid A, Akhtar S, Ali I, Rasul E. Amelioration of saline-sodic soils with organic manure and their use for wheat growth. Commun Soil Sci Plant Anal. 1998;29:2307-2318.
16. Warnke DD, Barber SP. Root development and nutrient uptake by corn grown in solution culture. Agronomy Journal. 1974;66:514.