Integrated use organic and inorganic amendments for management of calcareous sodic soils in eastern India

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INTRODUCTION

In Bihar, a state of India, out of total 92.83 lakh hectares, about 4.0 lakh ha arable area falls under salt-affected soils (Singh et al., 2011, Sharma et al., 2011). The nature of some of sodic soils is calcareous in nature and calcium is present as insoluble calcium carbonate thus pyrite (FeS_2) is good source for its reclamation (Chaudhary, 1980) but due to non/less availability of pyrite, response of the other alternate amendment, natural gypsum ($CaSO_4.2H_2O$), along with locally available sulphitation pressmud was evaluated under rice-wheat cropping system in farmer's field.

Fig 1. Location of experimental sites

METHODOLOGY

A field experiment was conducted in calcareous sodic soils in farmers' field of Bihar (eastern India). The different treatments T1 – Control, T2 - 50% of GR (gypsum requirement), T3 – Sulphitation Press Mud (SPM) @10 Mg ha^{-1}, T4 - 50% of GR + PM @10 Mg ha^{-1} , T5 - 50% of GR + Dhaincha and T6 - 50% of GR + PM @ 10 Mg ha^{-1} + Dhaincha were applied in randomized block design. After application, amendments were mixed in surface soil and fields were irrigated for leaching the salts followed by dhaincha cultivation (fig 2). In all treatments, recommended dose of fertilizers were applied as per the crop requirement. The salt-tolerant rice (Usar Dhan-3) was selected as first crop to grow after reclamation of soils. The wheat crop (HD 2824) was sown after harvest of rice.

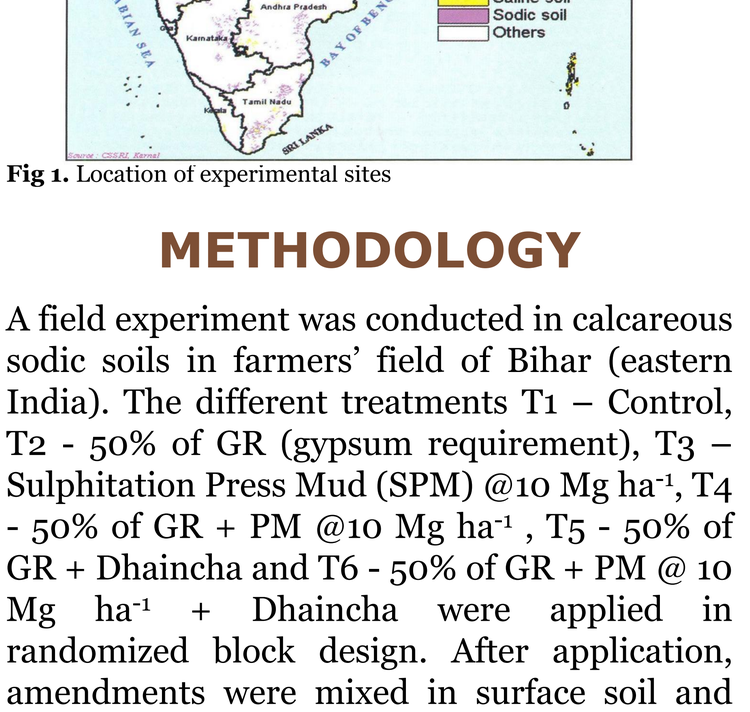

Fig 2. (a) Application of gypsum, (b) Incorporation of Dhaincha, (c) Puddling of the field (d) Rice transplanting

RESULTS

Significant increase in the grain and straw yield of rice and wheat was recorded in all the treatments over control (no amendment). The mean grain yield of rice increased from 18.7 - 37.9 q ha^{-1} under control and treatments received Gypsum @4 t ha^{-1} + Pressmud @10 t ha^{-1} + *Dhaincha,* respectively. The mean grain yield of wheat, varied from 19.2 to 45.2 q ha^{-1}. The increase in grain yield treated with amendments was significantly higher under all treatments over control (table 1). The application of different treatment increased the yield as well as improves the economic condition of farmers. The benefit: cost (B:C) ratio after two cropping cycle was recorded highest in treatment T_6 (1.29) followed by T_5 (1.20), T_4 (0.87), T_3 (0.84), T_2 (0.70) and T_1 (0.40) and comparative cost of amendments and other inputs were highest in T_6 followed by T_4, T_5, T_2 and T_3. Application of different amendments also improves the physico-chemical properties of soils (fig 3).

Treatment	Rice	Wheat
T1: Untreated Control	18.7	34.3
T2: Gypsum at 4 Mg ha^{-1}	23.3	41.9
T3: Sulphitation Press Mud (SPM) at 10 Mg ha^{-1}	25.6	45.8
T4: Gypsum at 4 Mg ha^{-1} + SPM at 10 Mg ha^{-1}	29.0	48.3
T5: Gypsum at 4 Mg ha^{-1} + Dhaincha	32.3	51.5
T6: Gypsum at 4 Mg ha^{-1} + SPM at 10 Mg ha^{-1} + Dhaincha	37.9	57.7
LSD (p ≤ 0.05)	2.1	2.5

Table 1. Effect of different amendments on average grain yield of rice and wheat (Mg ha^{-1})

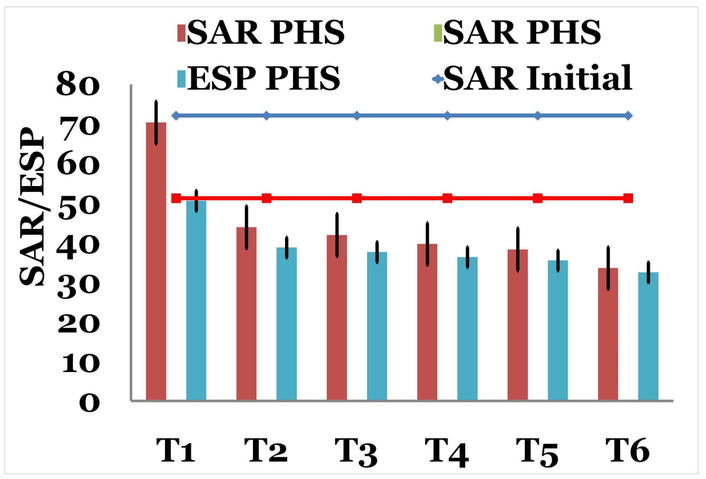

Fig 3. Effect of different amendments on percent changes in SAR (sodium adsorption ratio) and ESP (exchangeable sodium percentage) of the post harvest soil (0-15 cm)

CONCLUSIONS

Application of the chemical amendments i.e. gypsum gave more pronounced result in increasing grain and straw yield of both rice and wheat as well as soil properties in presence of organic manures *viz.* pressmud and Dhaincha because organic amendments enhanced the chemical reactions. During chemical reaction, the exchangeable Na^+ ions are replaced by Ca^{2+} from the exchange sites of the soil clay and thus improved soil aggregation, structure, water infiltration and nutrient availability (Brady and Weil, 2002).

The present study indicates that the calcareous soils could be managed with the alternate source of amendment i.e. gypsum which is also economical for the farmers. The integrated application of gypsum (@4 Mg ha^{-1}) along with SPM (@ 10 Mg ha^{-1}) and *Dhaincha* was found the best management practice for reclamation of calcareous sodic soil in Bihar (eastern India).

Fig 4. Field visits for awareness among farmers through field

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