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EFFECT OF GYPSUM AND INTEGRATED NUTRIENT MANAGEMENT ON SOIL PROPERTIES OF PARTIALLY RECLAIMED SALT AFFECTED SOILS OF SOUTH GUJARAT

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Abstract

A field experiment was conducted on mungbean at Coastal Soil Salinity Research Station, Danti (Gujarat) to study the effect of gypsum and integrated nutrient management on soil physicochemical properties of partially reclaimed coastal salt affected soils of South Gujarat during *rabi* 2015-16. In all ten treatment combinations arising out of two levels of gypsum (G_0: No gypsum and G_1: gypsum @2 t/ha) and five levels of integrated nutrient management (F_1: 100 % RDF: 20:40:00 NPK kg/ha, F_2: 100 % RDF + Bio-compost @ 5 t/ha + Bio fertilizer : *Rhizobium* + PSB @ 1.25 l/ha, F_3: 75 % RDF + Bio-compost @ 5 t/ha + Bio fertilizer : *Rhizobium* + PSB @ 1.25 l/ha, F_4: 50 % RDF + Bio-compost @ 5 t/ha + Bio fertilizer : *Rhizobium* + PSB @ 1.25 l/ha, F_5: Bio-compost @ 5 t/ha) were tested in factorial RBD. The results revealed that application of gypsum @ 2 t/ha significantly lower down the pH, ESP and bulk density of the soil and improved the water stable aggregates. Soil salinity and pH value did not influence significantly due to addition of organics, but there was significant improvement in WSA and at the same time bulk density of soil decreased.

Key words: Gypsum, Organics, pH, EC, ESP, Bulk density, WSA

Introduction

Agriculture scenario in India is rapidly changing in response to various stresses experienced by cultivated lands. Agriculture sector cannot wait and must respond to manage the change and to meet the growing and diversified needs in the production to consumption chain. Nearly 70 million ha of agricultural land is affected by varying degree of salt problem in the country. In South Gujarat around 70,000 ha of land is salt affected and these lands are mainly situated on coastal belt. To feed the ever increasing population of India, productivity of these lands should be increased. Calcium sulphate popularly known as gypsum is one of the popular inorganic soil conditioners. It has its favourable effect on both soil physical and chemical properties. It softens and crumbles alkali hardpan, supplies calcium on low exchange capacity of soils and improves infiltration for some puddled soils (Trivedi *et al.*, 2002). Addition of organics in conjunction with soil amendment like gypsum not only hasten the process of reclamation but also improve soil physical conditions as well as yield of crops grown on salt affected soils. Hence, to study the effect of gypsum and organics on physicochemical properties of salt affected soil present experiment was conducted.

Materials and Methods

A field experiment was conducted during *rabi* season of 2015-16 to study the effect of soil conditioner and organics on soil physicochemical properties and yield of mungbean grown on partially reclaimed salt affected soils. The soil of the experimental plot was clayey in texture, medium in organic carbon (0.31 %), slightly saline sodic with pH (8.81), EC (1.83 dSm^{-1}), ESP (11.12) and low, medium and high in rating of available nitrogen (247 $kgha^{-1}$), phosphorus (27.1 $kgha^{-1}$) and potassium (2465 $kgha^{-1}$), respectively. In all ten treatment combinations arising out of two levels of gypsum (G_0: No gypsum and G_1: gypsum @2 t/ha) and five levels of integrated nutrient management (F_1: 100 % RDF: 20:40:00 NPK kg/ha, F_2: 100 % RDF + Bio-compost @ 5 t/ha + Bio fertilizer : *Rhizobium* + PSB @ 1.25 l/ha, F_3: 75 % RDF + Bio-compost @ 5 t/ha + Bio fertilizer : *Rhizobium* + PSB @ 1.25 l/ha, F_4: 50 % RDF + Bio-compost @ 5 t/ha + Bio fertilizer : *Rhizobium* + PSB @ 1.25 l/ha, F_5: Bio-compost @ 5 t/ha) were tested in factorial RBD with four replications on mungbean var. GM-4. Composite soil sample from field at 0-20 cm was drawn before the imposing the treatments to determine the initial status of the soil. Treatment wise gypsum and bio compost were applied seven days before sowing. Urea and single super phosphate were used as source of N and P_2O_5, respectively, which were applied in the previously opened furrow just before sowing as per treatments. The crop was sown on and all the recommended practices were followed. After harvest of the crop, representative soil samples were taken from each plot at 0-20 cm soil depth and analysed for pH, EC and ESP as method suggested by Jackson (1973), Gaur (1967) and Jackson (1973), respectively. The bulk soil samples were collected from –20 cm depth (four to five spots and mixed well) from each plot. A part of these samples was used for determining WSA percentage using wet sieving method (Black, 1965). Soil samples were also drawn by core sampler from each plot and bulk density was determined by core method (Black, 1965). The data so obtained were subjected to statistical analysis as per method suggested by Panse and Sukhatme (1967).

Results and Discussion

Effect of gypsum

The results presented in table 1 revealed that pH and ESP of the soil were significantly influenced due to soil conditioner treatment. Application of gypsum @ 2 t/ha (G_1) significantly lowered down the values of pH and ESP of the soil after harvest of the crop in comparison to control (G_0). The values of pH and EC under treatment G_0 were 8.41 and 9.99, respectively. The corresponding values under G_1 were 8.15 and 9.74. It is because of replacement of Na from exchange complex by Ca ions released due to solubilisation of gypsum.. Moreover the SO_4 ions of gypsum probably have contributed towards lowering the pH. The results could be supported by study of Khattk *et al*., (1985) in wheat and rice, Raikhy *et al*., (1985) in pot culture experiment. Salinity of the soil after harvest of mungbean crop was not affected significantly due to soil conditioner treatment. However, it was decreased considerably in both the treatments, when compared with initial value. The initial value of EC was 1.83 dS/m, it came down to 1.49 and 1.51 dS/m in G_0 and G_1 treatment, respectively.

Soil conditioner treatments favourably influenced the physical properties *viz.*, bulk density and water stable

Table 1: Effect of different treatments on physicochemical properties of soil.

Treatment	Soil pH	EC (dS/m)	ESP	Bulk density (g/cc)	Water Stable Aggregates (%)		Seed Yield (kg/ha)
					0.5-1.00 mm	>1.00mm	
Initial value	8.81	1.83	11.12	1.50	20.63	45.57	
A. Soil Conditioner							
G_0: Control	8.41	1.49	9.99	1.44	21.18	45.79	938
G_1:Gypsum @ 2 t/ha	8.15	1.51	9.74	1.40	23.20	49.64	1038
S.Em±	0.08	0.03	0.08	0.01	0.23	0.47	20
CD @ 5%	0.23	NS	0.24	0.02	0.68	1.37	58
B. Integrated nutrient management (INM)							
F_1: 100% RDF	8.38	1.42	10.48	1.46	20.75	45.64	945
F_2: 100% RDF + Bio-compost @ 5 t/ha + Bio-fertilizer (Rhizobium + PSB)	8.26	1.56	9.54	1.41	22.98	48.98	1130
F_3: 75% RDF + Bio-compost @ 5 t/ha + Bio-fertilizer (Rhizobium + PSB)	8.28	1.48	9.71	1.39	22.94	46.86	1097
F_4: 50% RDF + Bio-compost @ 5 t/ha + Bio-fertilizer (Rhizobium + PSB)	8.29	1.57	9.77	1.40	22.86	48.64	968
F_5: Bio-compost @ 5 t/ha	8.22	1.49	9.82	1.44	21.41	48.45	800
S.Em±	0.12	0.05	0.13	0.01	0.37	0.75	32
CD @ 5%	NS	NS	0.38	0.03	1.07	2.16	92
CV (%)	4.22	9.51	3.82	1.99	4.73	4.43	9.10
Interaction	NS	NS	NS	NS	NS	NS	**

aggregates (Table 1). Application of gypsum @ 2 t/ha registered significantly lower value of bulk density (1.40 g/cc) of soil as compared to control (1.44 g/cc). Similarly, there was significant improvement in WSA of both the fractions due to application of gypsum. Treatment G_1 registered significantly higher values of WSA *i.e.,* 23.20 and 49.64 per cent of finer (0.5 to 1.00 mm) and coarser (>1.00 mm), respectively in comparison to control (G_0). The corresponding values for control treatment were 21.18 and 45.79 percent. These could be attributed to release of Na from exchange comples might have decreased dispersion of clay. Similarly, in present study use of organics might have further facilitated improvement in aggregation. These findings are in conformity with the work carried out at Department of Soil Science, GAU, Navsari, Gujarat (Anon., 2003).

Effect of INM

Soil reaction (pH) and salinity (EC) did not significantly influenced due to integrated nutrient management treatments, while exchangeable sodium percentage (ESP) of soil after harvest of the crop was influenced significantly due to INM treatments. Significantly lower value of ESP of soil (9.54) was registered with application of 100 % RDF + Bio-compost + Bio-fertilizer (Rhizobium + PSB) (F_2), but it was remained at par with treatment F_3, F_4 and F_5. However, irrespective of treatment, the values of pH, EC and ESP tended to decrease when compared to initial value. The decrease in ESP seems to be due to displacement of Na^+ by Ca^+ ions from exchange complex and also due to increase in solubility of $CaCO_3$ by organic acids produced during microbial decomposition of organic matter.

Soil physical properties *viz.,* bulk density decreased and WSA improved markedly due to addition of organic manures. There were remarkable improvement in both the parameters *i.e.,* bulk density and WSA in organic amended treatments *viz*., F_2, F_3, F_4 and F_5 in comparison to F_1 (Only chemical fertilizer). The decreased in bulk density could be due to better soil structure of higher amount of organic and inorganic manures, while improvement in aggregates stability of soil under organic treatment could be attributed to the humic substance formed during the course of decomposition of organic manure which bind the soil particles to form larger size aggregate. The results are in agreement with those of Trivedi *et al.,* (2002) and Desai *et al.,* (2009).

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