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Effect of Different Amendments on Properties of Soils Irrigated with High RSC water

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ABSTRACT

A Pot culture experiment was conducted during *rabi* 2009-10 at fields of Saline Water Scheme, Bapatla using gypsum, pyrite, FYM, pressmud cake and aluminium sulphate to reduce ill effects of RSC waters on physico-chemical properties of the soil. Results indicated a reduction in soil pH, ECe, ESP and increase in available N, P_2O_5 and K_2O with soil application of different amendments. Gypsum was found superior to pyrites, FYM, pressmudcake and aluminium sulphate in miniming the adverse effect of sodic waters on soil properties.

Key words : Aluminium sulphate, FYM, Gypsum, High RSC water, Pressmud cake, Pyrite.

In arid and semi arid regions, the indiscriminate use of poor quality irrigation water has rendered many soils unproductive. The water containing RSC (Residual Sodium Carbonate) more than 2.5 me L^{-1} has been considered unsatisfactory for irrigation. The continuous and indiscriminate use of high RSC water without suitable amendments ultimately renders the soil unfit for cultivation (Dhankar *et al*., 1990). Degradation of soils with the use of alkali ground waters constitutes a major threat to irrigated agriculture in semi-arid parts especially south Asia (Minhas and Bajwa, 2001). The survey of ground water quality in Andhra Pradesh revealed that the alkali (RSC) water problem ranged from 10-52 per cent in different districts and use of these high RSC waters not only decline the crop yield but also make the soil alkali, which demands reclamation of the soils with soil amendments viz., gypsum, pyrites *etc*. Hence, it is better to use poor quality waters through proper amendments. To study effect of amendments, a vegetable crop (cluster bean) is choosen as test crop, which is moderately tolerant for alkalinity.

MATERIAL AND METHODS

A pot experiment was conducted at fields of Saline Water Scheme, Bapatla, Andhra Pradesh (5.49 m above mean sea level, 15^0 54^1 North latitude, 80^0 25^1 East longitude) using sandy loam soil. The initial status of physico-chemical characteristics of experimental soil are shown in table 1. Three sodic waters with varying residual alkalinity of RSC 5, 10 and 15 meq L^{-1} were used. Finely ground gypsum, pyrites, well-decomposed FYM, pressmud cake and commercially available aluminium sulphate were incorporated and mixed thoroughly one month before sowing. Phosphorus and potassium were applied @ 30 kg ha^{-1} and 60 kg ha^{-1}, respectively as basal dose in the form of SSP and MOP. Nitrogen was applied @ 30kg ha^{-1} in four splits at 10 days interval starting from 10^{th} day after sowing. A short duration variety of clusterbean (*Cymopsis tetragonoloba* var. komal) was selected as test crop. Seeds were sown on 22^{nd} October 2009 at the rate of six seeds in each pot. Thinning was done to maintain 3 plants per plot. The recommended package of practices were followed to raise the crop. Sixteen irrigations were given. Soil samples were collected after harvest and air-dried soil samples were ground to pass through a 2 mm sieve and then analysed for pH, eletrical conductivity of saturation extrient (ECE) and exchangeable sodium percent (ESP) available nutrients (N, P_2O_5 & K_2O) in soil using standard procedures (Jackson, 1973).

RESULTS AND DISCUSSION

pH of the post-harvest soil

The irrigation with sodic water of RSC 5, 10 and 15 meq L^{-1} in clusterbean crop led to the development of maximum soil pH i.e. 7.9, 8.35 and 8.60 with increase in RSC water pH of the soil increased (Table 2) significantly. There was a significant effect of different amendments used to mitigate the ill effects of RSC waters on soil pH. Low soil pH was reported in pots amended with gypsum (7.71) followed by pyrites (7.80), FYM (7.82), when irrigated with RSC water of 5 meq L^{-1}. Gypsum treatment showed the lowest pH followed by pyrite in all the increasing levels of RSC waters. The interaction between RSC water and amendments was non-significant. The beneficial effect of gypsum in lowering pH of the soil is due to the downward movement of Na owing to its replacement by Ca as a result of solubilization of gypsum. Similar results were reported by, Bajwa and Josan (1989) Bajwa *et al.* (1992) and Ashok Kumar (2002). The treatmental effect on reduction of pH might be due to the fact that application of gypsum enhanced the availability of soluble calcium. The calcium thus released adsorbed sodium from the exchange complex and removal of soluble Na^+ with other salts (CO_3^-+ HCO_3^-) through leaching which reduced the pH of soil.

ECe of the post-harvest soil

Electrical conductivity of the soil increased significantly with increase in RSC of the irrigation water. Maximum ECe values were observed with RSC of 15 me L^{-1} followed by 10 me L^{-1} and least under 5 me L^{-1} with increase in RSC of water ECe increased irrespective of the amendments (Table 2). Soil application of different amendments decreased the ECe of the soil significantly when compared with control. Soil application of gypsum decreased the ECe of the soil (1.71 dSm^{-1}) followed by pyrite (1.73 dSm^{-1}), FYM (1.91 dSm^{-1}), pressmudcake (1.97 dsm^{-1}) and aluminium sulphate (2.17 dsm^{-1}) when irrigated with 5 meq $L^{-1}$of alkali water. Among different amendments highest ECe value was observed with soil application of aluminium sulphate and least with gypsum. The interaction between sodic water and amendments were significant. Several research workers also observed similar findings like Joshi and Bohra (2008) and Chauhan *et al*. (1988), when gypsum and FYM were used as amendments, the decrease in ECe might be due to the fact that the CO_3^- and HCO_3^- ions received through irrigation water react with Ca^{++} and Mg^{++} and precipitate them as their carbonates and bicarbonates thus reducing the soluble ion concentration in the soil.

ESP of the post-harvest soil

The ESP buildup after the harvest of cluster bean crop was maximum with water of RSC 15 meq L^{-1} (14.91) followed by 10 me L^{-1} (14.09) and 5 me L^{-1} (12.86). The addition of different amendments decreased the ESP of the soil (Table 2) significantly. The addition of gypsum to the soil decreased the ESP significantly followed by pyrite, FYM, pressmud cake and aluminium sulphate. Low ESP (12.10) was observed with soil application of gypsum @ 300 kg ha^{-1} when irrigated with 5 meq L^{-1} followed by 10 meq L^{-1} (13.52) and 15 meq L^{-1} (14.32) (Sultan Singh *et al*., 2005). The decrease in ESP due to gypsum might be due to the replacement of exchangeable Na by Ca. The decrease due to FYM and pressmud cake might be due to the evolution of carbondioxide (CO_2) and production of organic acids during microbial decomposition which helps in solubilization of calcium carbonate ($CaCO_3$). It helps in decreasing, soil ESP through supplying calcium (Ca) to replace exchangeable sodium from the colloidal complex.

Available nutrient content of the post-harvest soil

The available N, P_2O_5 and K_2O contents decreased with increase in RSC of the irrigation water. Available nitrogen was higher (159 kg ha^{-1}) with soil application of FYM @ 12.5 t ha^{-1} followed by soil application of press mud cake (148 kg ha^{-1}) @ 300 kg ha^{-1} (Table 2). Available P recorded least in control plots and increased in amended plots. The highest phosphorus content (25.43 kg ha^{-1}) was observed with soil application of gypsum irrigated with 5 meq L^{-1} of RSC waters, where as the lowest phosphorus content was recorded in control plots irrigated with 15 me L^{-1} (14.83kg ha^{-1}) of RSC waters (Ramalinga Swamy and Veerabhadra Rao, 1991). The highest soil available K (500 kg ha^{-1}) was recorded under gypsum followed by pyrite and FYM irrigated with 5 me L^{-1} of RSC water, whereas lowest was recorded under control in all the three levels of increasing RSC waters. Similar findings were reported by Yadav and Chippa (2007). The increase in nitrogen content of the soil due to the addition of FYM could be attributed to the mineralization of native as well as applied nutrient content. Due to the application of gypsum the pH of the soil was decreased and the soil available P and K increased significantly.

It is concluded from the above study that the sodic waters of RSC 5,10 and 15 me L^{-1} significantly

Table 1. Initial characters of the experimental soil.

pH	ECe (dSm^{-1})	OC (%)	Avail.N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Ex.Na (me100^{-1}g)	Ex.K (me 100^{-1}g)	Ex.Ca (me 100^{-1}g)	Ex.Mg (me 100^{-1}g)	CEC (me 100^{-1}g)	ESP
7.9	2.23	0.70	119	17.07	458	1.35	0.40	5.50	2.50	10.00	13.5

Table 2. Effect of different amendments in mitigating the effect of RSC water on physico-chemical properties of the soil.

Treatment	Amendment	pH	ECe (dS m^{-1})	ESP	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
5 meq L^{-1}	Control	7.9	2.26	13.50	119	17.07	458
	Gypsum	7.6	1.71	12.10	145	25.43	500
	Pyrite	7.7	1.73	12.54	143	23.67	477
	FYM	7.8	1.91	12.85	159	21.57	469
	Pressmud cake	7.8	1.97	13.00	148	19.63	468
	Aluminium sulphate	7.9	2.17	13.20	133	18.43	459
	Mean	7.7	1.96	12.86	141	20.96	472
10 meq L^{-1}	Control	8.4	2.23	14.57	117	16.53	420
	Gypsum	7.9	1.77	13.52	137	24.57	486
	Pyrite	8.0	1.79	13.82	135	21.63	472
	FYM	8.1	1.92	14.00	150	20.67	456
	Pressmud cake	8.2	2.06	14.23	138	18.80	450
	Aluminium sulphate	8.3	2.19	14.47	128	18.33	437
	Mean	8.1	2.00	14.09	134	20.08	453
15 meq L^{-1}	Control	8.6	2.32	15.36	116	14.83	415
	Gypsum	8.0	1.85	14.32	128	20.20	452
	Pyrite	8.1	1.98	14.63	126	18.70	450
	FYM	8.2	1.98	14.92	130	17.57	447
	Pressmud cake	8.3	2.15	15.00	129	17.37	424
	Aluminium sulphate	8.4	2.21	15.26	120	16.43	422
	Mean	8.2	2.08	14.91	125	17.52	435
CD	RSC	0.026	0.022	0.002	1.48	0.15	3.21
	Amendment	0.037	0.031	0.003	2.09	0.21	4.54
	RSC X Amendment	0.070	0.053	0.007	3.62	0.36	7.87

reduced the available N, P_2O_5 and K_2O. Application of different amendments for neutralization of RSC of water above 5 me L^{-1} significantly increased the available N, P_2O_5 and K_2O and maintained the pH, ECe and ESP of the soil. Gypsum as amendment with RSC water of above 5 me L^{-1} was found to be superior. Therefore, in the light textured soils, the sodic water upto RSC 15 me L^{-1} can be successfully used with gypsum for cluster bean crop.

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