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Lime and Gypsum to Mitigate Soil Problems in Rice Cultivation in The Bahour Commune of Union Territory of Puducherry

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A field experiment was conducted in farmer's holding located in Kanniakoil village of The Bahour Commune, during the *samba* season (2007 -2008) with paddy variety Improved White Ponni as test crop. The grain yield of paddy was found to be the highest in the plots which received lime @ 2 t ha^{-1} with leaching and the next best was gypsum @ 2 t ha^{-1} with leaching. The per cent yield increases due to the imposed treatment were found to be 52.72 in lime applied plots with leaching, 33.59 in gypsum applied plots with leaching, 22.42 in lime applied plots, 15.70, 14.61 and 6.69 respectively in the plots which received FYM, gypsum with leaching and compost. As regards the different soil properties, the imposed treatments did not modify any of the parameters studied. Though the available nutrient status was significantly influenced by the different treatments, there were only marginal differences between the different ameliorants.

Keywords: Gypsum, lime, rice.

In Puducherry region, the Bahour commune is considered to be the rice bowl of Puducherry, wherein paddy is being cultivated continuously over centuries. In the present investigation, an attempt has been made to suggest management practices for overcoming the ill effects of poor quality water on crop growth. While formulating the different management strategies that are available for managing poor quality water, it was also kept in mind that the soils of Bahour region were being continuously irrigated with such a poor quality water over years resulting in the significant rise in the salinity of the soil also. The work conducted by Baskar *et al*. (2003) had further revealed that the soils of the study area are not only saline but also potential acid sulphate soils.

Materials and Methods

A field trial was laid out in randomized block design with three replications at Bahour Commune in the Union Territory of Puducherry to mitigate the ill effects on poor quality water and soil on crop growth. The gypsum and lime were applied basally with leaching and without leaching at the rate of 2 t ha^{-1} and also farm yard manure and compost. The poor quality water used for experimentation was also analysed for their chemical composition, the pH and the EC were 8.32 and 2.13 dS m^{-1}. Among the cations, Na^+ was dominant followed by Ca^{2+}, Mg^{2+} and K^+. Similarly, Cl^- was predominant followed by SO_4^{2-}, HCO_3^- and CO_3^{2-}. The texture of the soil was clayey, taxonomically *Vertic Ustropept.* The EC of the soil in 1:2 soil water extract was 1.86 dS m^{-1} and pH was 7.67. The organic carbon was 3.60 g kg^{-1}, available N 168 kg ha^{-1}, available P 59.7 kg ha^{-1} and available K 402 kg ha^{-1}. There were seven treatments *viz.,* T_1 – Control, T_2 – FYM – 12.5 t ha^{-1}, T_3 – Compost – 5 t ha^{-1}, T_4 – Gypsum @ 2 t ha^{-1} with leaching , T_5 – Gypsum 2 t ha^{-1} without leaching , T_6 – Lime 2 t ha^{-1} with leaching and T_7 - Lime 2 t ha^{-1} without leaching . Gypsum / Lime was applied in the last plough, then flooded with water and puddled. After 2 days, the water was drained out of the field. Half of N and K and full dose of P fertilizers (150:50:50 N, P_2O_5 and K_2O kg ha^{-1}) were applied basally, remaining half of N in two splits at active tillering and also half of the K applied at panicle initiation stage. The seedlings were transplanted in the main field with the spacing of 20 x 15 cm. Soil samples were also collected from individual plots after the harvest of the crop. The collected samples were shade dried, gently maletted and sieved through 2 mm sieve and preserved for further analysis (Jackson, 1973; Piper 1966; Stanford and English, 1949; Subbiah and Asija,1956 and Olsen *et al.,* 1954). The data obtained from the field experiment were also statistically scrutinized by following methods suggested by Gomez and Gomez (1976).

Results and Discussion

The data on biometric observations, nutrient availability, uptake, yield and dry matter production were recorded and analysed statistically. All these yield attributes, were significantly influenced by the imposed treatments. Numerically higher number of tillers and number of productive tillers were recorded by the application of lime with leaching, whereas

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Table 1. Effect of different treatments on biometric observations of rice

Treatment	Number of tillers per plant	Number of productive tillers per plant	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1- Control	13.30	10.80	4019	5669
T_2 - FYM-12.5 t ha^{-1}	13.50	12.00	4650	6169
T_3 - Compost -5 t ha^{-1}	11.80	9.50	4287	5900
T_4 - Gypsum with leaching – 2 t ha^{-1}	13.80	11.50	5369	5725
T_5 - Gypsum without leaching – 2 t ha^{-1}	13.00	11.00	4606	5975
T_6 - Lime with leaching – 2 t ha^{-1}	14.50	13.30	6138	6013
T_7 - Lime without leaching – 2 t ha^{-1}	14.50	11.50	5081	5313
S.Ed.	0.50	0.60	203	216
C.D (P=0.05%)	1.20	1.30	427	454

the panicle weight and panicle length were found to be higher in the treatment where gypsum was applied followed by leaching. Higher number of grains were recorded by the lime applied plots with leaching and FYM applied plots. The per cent fertility was higher in the plots which received lime followed by leaching, whereas per cent sterility was higher in the plots which received gypsum without leaching. The above trend of result is quite possible, since the imposed treatments were aimed to reduce the salinity of the soil so that the crop growth is favoured.

Similar results of number of tillers per plant, number of productive tillers per plant, per cent fertility and sterility, filled grains per panicle and unfilled grains per panicle (Tables 1 and 2) were observed by Khatun *et al*. (1995), who had inferred that decreased salinity would favour higher values of above parameters. It was also true that the final yield is determined by the above yield parameter which was revealed by Gonzales and Ramirez (1998) by path analysis in which the plant height, panicle weight and filled grains per panicle had direct effect to the grain yield of the crop. Similar

Table 2. Effect of different treatments on the biometric observations of rice

Treatment	Total number of grains $panicle^{-1}$	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	Per cent fertility	Per cent sterility
T_1- Control	109.5	88.0	21.5	80.12	19.94
T_2 - FYM-12.5t ha^{-1}	134.3	113.0	21.3	84.19	15.81
T_3 - Compost -5 t ha^{-1}	115.8	98.8	17.0	85.18	14.83
T_4 -Gypsum with leaching – 2 t ha^{-1}	111.5	89.0	22.5	79.81	20.19
T_5 - Gypsum without leaching – 2 t ha^{-1}	103.8	83.0	20.8	79.54	20.41
T_6 - Lime with leaching – 2t ha^{-1}	125.3	106.8	18.5	85.21	14.54
T_7 - Lime without leaching – 2 t ha^{-1}	105.5	86.5	19.0	81.92	18.08
S.Ed.	7.2	7.3	1.6	1.96	1.96
C.D (P=0.05%).	15.1	15.4	3.4	4.12	4.13

observations were recorded by Govindaraju and Balakrishnan (2002).

The grain yield of rice was significantly influenced by different treatments imposed which had revealed that the highest grain yield of 6138 kg ha^{-1} was obtained in the plots which received lime with leaching.This treatment was followed by gypsum with leaching (5369 kg ha^{-1}) and lime without leaching (5081 kg ha^{-1}), which were comparable but inferior to lime with leaching treatment. The possible reason for low yield due to application of gypsum followed by leaching as compared to addition of lime and leaching may be due to the higher amounts of sodium in the soil (4.10 cmol (p+) kg^{-1}) and higher quantities of sodium in the irrigation water (13.94 cmol L^{-1}). The per cent yield increase due to lime addition with leaching was 52.72 and 33.59 due to gypsum addition with leaching.

It was seen from the results that the straw yield was significantly higher in the treatments *viz.,* FYM, lime with leaching, gypsum without leaching, compost and gypsum with leaching, which were all comparable. This had indicated that the straw yield is not that sensitive to the salinity level of the soil as compared to the grain yield. Several studies have confirmed that the salinity could decrease the grain yield. Bal and Chattopadhyay, 1989 and Aich *et al*., 1997) and straw yield (Fageria, 1988 and Aich *et al*., 1997) considerably.

In the present investigation, the soil properties were measured at the time of harvest to quantify the impact of the imposed treatments on different soil properties. However, the results of the soil properties (Table 3) did not show any marked changes due to the imposed treatments. This might probably be due to the fact that the soil was under submerged

Table 3. Effect of different treatments on the properties of soil

Treatment	pH	EC (dS m^{-1})	CEC*	Ca	Mg	Na	K	ESP(%)
T_1- control	7.85	0.775	43.40	30.38	14.13	4.258	0.700	8.672
T_2 - FYM-12.5 t ha^{-1}	7.99	0.835	43.48	29.50	14.50	4.387	0.690	9.120
T_3 - Compost -5 t ha^{-1}	8.04	0.730	42.63	31.00	13.13	4.663	0.693	9.353
T_4 -Gypsum with leaching -2 t ha^{-1}	7.97	0.847	40.10	31.00	14.25	6.028	0.663	11.630
T_5 - Gypsum without leaching -2 t ha^{-1}	7.97	0.870	43.38	32.00	17.25	4.178	0.708	8.157
T_6 - Lime with leaching -2 t ha^{-1}	8.11	0.700	43.73	28.00	14.63	4.953	0.668	10.680
T_7- Lime without leaching - 2 t ha^{-1}	8.10	0.905	45.23	32.63	13.13	4.503	0.705	8.782
S.Ed.	0.12	0.090	2.613	3.081	2.93	0.828	0.035	1.639
C.D. (P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS

*cmol (p^+) kg^{-1}

condition over a period of 4 to 5 months which could have resulted in the movement of salts in different parts of the soil, thereby causing insignificant variations. It may be worth mentioning that such a contradicting trend of results between the soil properties and the grain yield, which registered marked variation due to the imposed treatments, might be due to the fact that the grain yield is a result of the favourable growth of the crop over the period of 4 to 5 months, whereas the analytical results pertains to the post harvest soil samples. This might be the possible reason for the different trend of result among the soil properties and grain yield.

The results had shown that there were variations in the available nutrient status due to the imposed treatments, (Table 4) though the treatments did not differ widely between themselves. Such a trend of result is possible since, the plants take up the nutrients in accordance with the dry matter accumulation. Higher the dry matter, higher will be the nutrient uptake and hence, there can be differential depletion in the soil which may result in variations in the available nutrient status at harvest. In the present investigation, the imposed treatments were aiming at the reclamation of saline soil and to mitigate the ill effects of poor quality of irrigation water and hence, it is quite understandable that there were no marked variations in the nutrient availability at the time of harvest.

Table 4. Effect of different treatments on the available nutrient status

Treatments	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T_1- Control	156	60	357
T_2- FYM-12.5 t ha^{-1}	163	61	357
T_3- Compost -5 t ha^{-1}	142	58	374
T_4- Gypsum with leaching - 2 t ha^{-1}	120	51	312
T_5- Gypsum without leaching - 2 t ha^{-1}	152	49	355
T_6- Lime with leaching - 2 t ha^{-1}	168	30	339
T_7- Lime without leaching - 2 t ha^{-1}	165	44	346
S.Ed.	14	4	16
C.D (P =0.05%)	30	8	33

Among the different treatments, application of lime at the rate of 2 t ha^{-1} was found beneficial in recording higher grain yield. Though there were no marked variations due to the imposed treatments on the nutrient availability, the study highlighted the favourable influence of addition of lime, gypsum, FYM and compost on the above parameters. It was also opined that leaching should be followed after the addition of ameliorant for effective removal of soluble salts and sodium.

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