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YIELD PERFORMANCE OF RICE TO SOIL AMENDMENTS IN COASTAL SALINE SOIL

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Abstract

Grain yield of three HYV of rice, namely BR3, BR15 and Iratom 24 showed significant response to application of lime, gypsum, cow-dung and straw irrigated with brackish water having EC of 0.7, 2.5 and 5.0 ds/m grown in Gopinathpur coastal saline soil of Satkhira. Grain yield decreased significantly with the increase of salinity of irrigation waters irrespective of treatments. The cultivars of rice did not vary widely among themselves, However, BR3 has produced better yield compared to other cultivars. Use of cow-dung, straw, gypsum and lime produced significantly higher yield irrespective of varieties and grades of irrigation water. Gypsum proved its superiority over lime. Similarly cow-dung showed better performance than straw in all grades of irrigation water. The reduction of grain yield due to brackishness of irrigation water was resisted to some extent in presence of cow-dung and straw resulting higher yield. However, addition of gypsum in presence of cow-dung and straw influenced more yield subjected to irrigation with medium brackish water.

Introduction

About 1 m ha of coastal saline soil covers approximately 52.8% of the net cultivable area of the southern 13 districts of Bangladesh.[1,2] These lands are generally low, flat and as such frequently inundated with saline tidal waters from nearby estuaries and therefore soil salinity is in rampant. The entire cultivable area is almost traditionally monocropped during monsoon under rained with local rice having poor yield. Due to the scarcity of quality irrigation water during winter and summer the cultivation of boro rice is not practically possible and the lands remain fallows. Application of manure[3] and gypsum/lime adjunct to proper irrigations has focused on the bright prospects of reclamation and amendments of such saline soil.[4-7] The supplement of Ca in the form of gypsum and lime has improved the soil situation resulting higher yield when coupled with salt resistant variety.[5] With these views in mind, a field experiment was designed to evaluate the effect of organic matter, gypsum and lime on grain yield of three HYV of rice in salt affected soil irrigated with different grades of brackish water.

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Materials and Methods

An experiment with rice, namely BR3, BR15 and Iratom24 was conducted in Gopinathpur saline soil, Satkhira under field condition in boro season. The land was divided into three sub blocks for irrigation with brackish water. Each sub block was further subdivided into three plots for with and without gypsum and lime. These split plots were again subdivided into three strips for three varieties of rice. The size of each strip plot was $4m^2$. A total of 81 treatments were arranged according to 3^4 factorial split strip plot design with two replications. Each sub block was separated by 2m buffer zone and each plot was surrounded by a 1m wide ridge. The treatment combinations used were as follows. Brackish irrigation water: low, medium and high representing EC iw of 0.7, 2.5 and 5.0 dS/m, respectively. EC was measured by EC meter.

Cow-dung and straw (0 t/ha), decomposed cow-dung (10 t/ha) and decomposed straw (10 t/ha), gypsum (G) = 0, 0.5 t/ha and lime (L) = 0, 0.5 t/ha.

Due to unavailability of salt resistant cultivars, three non salt resistant varieties of rice namely, BR3, BR15 and iratom 24 were used. The organic matters were added on the plots seven days prior to transplantation and kept at field moisture condition. Gypsum and lime were applied on the surface soil at the time of final land preparation. P_2O_5: K (80: 60 kg/ha) and one third of the N (90 kg/ha) were applied as basal dose and the rest two third of N was top dressed in two splits; one at active (30 days after transplatation, DAT) and the other at maximum tillering (60 DAT) stage of growth. Thirty five days old healthy seedling were transplanted as three seedling in each hill spaced at 20 cm × 20 cm. The blocks were irrigated with water (EC 1.2 ds/m) during land preparation and also a 10 days more after transplantation (survival stage), following by submergence of 2-5 cm standing water as per treatment. Some physicochemical properties of the soil before initiation of the experiment were determined by standard methods (Table 1). Grain yield was recorded at maturity (Tables 2-3).

Results and Discussion

The grain yield of rice decreased significantly with the increase in salinity of irrigation water irrespective of treatments and varieties (Table 2). The yield of grain decreased roughly by about 20 and 65% due to medium and high salinity of irrigation waters, respectively as compared with low brackish irrigation water. Gupta and Gupta [5] reported that 25 and 50% yield reduction of rice to be expected at EC 2.6 and 4.7 dS/m, respectively. The decline might be to the Na stress in plant impairing panicle initiation, pollen grains formation, fertilization of florete, spikelet formation and retardation of ear head growth.[8-9] The application of cow-dung and straw alone

Table 1. Some physicochemical properties of soil before initiation of the experiment.

Depth (cm)	ECe (dS/m at 255°C)	pH	Organic C (%)	Total N (%)	Exchangeable bases (meq/100g)					Available Nutrients							Active	ESP
					CEC	Na	K	Ca	Mg	N (mg/100g)	SO4 (meq/l)	Olsen's P	B	Zn	Cu	Fe (%)	Mn (mg/kg	
												mg/kg						
0 - 15	15.3	8.2	0.91	0.08	23.8	3.6	0.5	10.4	9.2	6.2	23.9	9.5	1.45	0.6	0.2	0.48	558	15.1
15 - 30	6.6	8.3	0.84	0.07	24.6	3.9	0.5	12.2	8.1	4.8	25.2	7.8	1.30	0.6	0.1	0.46	550	15.8
30 - 60	5.9	8.4	0.77	0.06	25.5	4.0	0.6	10.8	10.0	3.6	18.2	7.0	1.30	0.7	Trace	0.46	520	15.7

Table 2. Grain yield response of rice to brackish water, organic matter, gypsum and lime.

Treatments	Yield (t/ha)	Treatments	Yield (t/ha)	Treatments	Yield (t/ha)	Treatments	Yield (t/ha)
Brackish irrigation waters (dS/m)		Cow-dung and straw		Gypsum and lime		Vareities	
(i) Low (0.7_	2.80	(i) Cowdung and Straw (0 t/ha)	1.71	C. Gypsum and lime (0 t/ha)	1.86	(i) BR3	2.11
(ii) Medium (2.5)	2.09	(ii) Cowdung (10 t/ha)	2.12	(ii) Gypsu (0.5 t/ha)	2.00	(ii) BR15	1.86
(iii) High (5.0)	0.97	(iii) High (10 t/ha)	2.02	(iii) Lime (0.5 t/ha)	1.99	(iii) Iratom 24	1.88
LSD (0.05)	0.06						

produced significantly higher yield of rice and the yield increased roughly by about 24 and 18%, respectively as compared with untreated plots (Table 2). Lime or gypsum alone also produced significantly higher yield resulting an increase roughly by 7.5 and 6.9% over control irrespective of varieties and qualities of irrigation waters (Table 2). BR3 performed better yield (11% higher than other varieties) (Table 2).

In low brackish water, application of lime or gypsum produced significantly higher yield in BR3 and no impact on Iratom 24 though the later gave better yield than BR3 and BR15 in absence of any treatments (Table 3). Addition of cow-dung alone increase the yield of three varieties of rice but cow-dung in conjunction with lime or gypsum showed sporadic results. However, BR3 and BR15 bound significantly different from Iratom 24. In case of Iratom 24, lime and gypsum rather surpassed the effectiveness of organic matters. Due to addition of straw alone in low brackish water in saline soil, all the varieties produced more or less same yield. However, BR3 produced highest yield (3.05 t/ha) due to addition of straw in presence of gypsum.

Table 3. Influence of organic matters, gypsum and lime on the grain yield (t/ha) of rice in Gopinathpur none drained soil irrigated with brackish waters.

Brackish irrigation water (ECiw dS/m)		Low (0.7)			Medium (2.5)			High (5.0)		
(t/ha)	Varieties	G_0L_0	$G_{0.5}$	$L_{0.5}$	G_0L_0	$G_{0.5}$	$L_{0.5}$	G_0L_0	$G_{0.5}$	$L_{0.5}$
CD_0Str_0	BR3	2.43	2.95	2.88	1.66	1.67	1.88	0.80	0.96	0.90
	BR15	2.37	2.63	2.46	1.68	1.80	1.35	0.64	0.75	0.80
	Iratom 24	2.75	2.72	2.65	1.70	2.08	1.60	0.65	0.74	0.77
CD_{10}	BR3	3.10	3.35	3.54	2.24	2.94	2.62	1.15	1.12	1.22
	BR15	2.85	2.75	3.08	1.89	2.09	2.14	1.10	1.16	1.22
	Iratom 24	2.95	2.29	2.54	1.91	2.60	2.01	1.08	1.08	1.15
Str_{10}	BR3	2.97	2.05	2.95	2.14	2.86	2.50	0.88	1.06	1.17
	BR15	2.75	2.70	3.00	1.72	2.30	2.18	0.75	0.98	1.16
	Iratom 24	2.85	2.54	2.88	2.25	2.40	2.12	0.80	0.92	1.12

LSD: (P = 0.05), 0.14 CD_0Str_0 = Cow-dung and straw 0 t/ha; CD = Cow-dung and Str = Straw; G = Gyposum and L = Line; G_0L_0 = Gypsum and lime (0 t/ha).

In the medium brackish water (2.5 dS/m), the yield of the varieties did not differ significantly from each other irrespective of treatments. Nevertheless, Iratom 24 gave highest yield (2.08 t/ha) when gypsum was applied and BR3 responded moderately (1.88 t/ha) but not significantly. When lime was added BR15 followed the same tend as in low brackish water treatment. Addition of cow-dung also increased the yield of all the varieties significantly over the control. Cow-dung together with

lime or gypsum increased the yield of all the varieties significantly with BR3 at the top (2.94 t/ha). The results are in accord with the finding of Saravanan *et al.*[10] where they found higher yield of rice in saline soil due to addition of straw alone. Similar views were also reported by other investigators [11-13]. Application of straw alone or in combination with gypsum and lime exhibited more or less same pattern of data as the cow-dung alone and in combination with lime and gypsum.

In high brackish water (5.0 dS/m), BR3 produced increased yield (0.80 t/ha) in absence of lime or gypsum as compared with other varieties. All three varieties gave higher yield when the soil was incorporated with lime and gypsum. It is notable that in high salinity irrigation water BR3 has more salt resistance than BR15 and Iratom 24. All varieties responded equally, but the result was significantly higher than that of without cow-dung under the same condition. Cow-dung treated plots produced considearably higher yield in all the varieties. It is obvious that addition of gypsum or lime was of no use in high brackish water condition but the cow-dung. All cultivars of rice have responded equally when straw alone was used. Straw with lime influenced three cultivars equally and produced significantly higher yield. Gypsum with straw also played almost equally well.

Summarization of the results suggest that in the medium brackish water irrigation, the yield although is much lower than in low brackish water irrigation in all varieties but it is still not unfavorable. In contrast, high brackish water gave divesting yield and the marginal return is meager. Though not profitable, the soil may possibly be irrigated with high brackish water; if there is no alternative. The farmer may reap the return though marginal as they could make use of their off time and the fallow land. Similar views were also proposed by many researchers notably Kumer,[7] and Gupta and Gupta.[5] Addition of amendments may help in reducing the yield decline due to brackishness of irrigation water considerably.

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