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Effect of Brackish Water, Organic Matter, Lime and Gypsum on Grain Yield of Wheat in Salt Affected Soils of Bangladesh

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In a study conducted in green house, grain yield of wheat on salt affected soils decreased significantly with the increase in salinity from EC 0.7 to 12.0 dS/m in irrigation water. Use of cowdung, straw, lime and gypsum produced significantly higher yield irrespective of the varieties and soils. Liming showed better results in acid saline soil whereas gypsum proved its superiority in saline and saline sodic soils. Application of all these ingredients could reduce the salinity resulting in higher yield. Cowdung and straw were almost equally effective to modify the salinity. Wheat CV. Kanchan showed the best performance as compared to CV. Akbar and Agrani.

Problem soils of Bangladesh mainly include coastal saline soil. Saline sodic and acid saline soils are also found in limited areas. The productivity of these soils is very low. Management of such soils with organic matter, lime and gypsum together with internal drainge has been found to be beneficial to improve crop yield (Poonia and Bhumbla, 1974, Bandyopadhyay and Bandyopadhyay, 1984, Shivakant and Rajkumar, 1992). During November to Mid March, the water salinity generally remains between EC 3 to 12 dS m^{-1}, and its influence on the growth and yield of wheat should be of immense practical importance in Bangladesh, on which no report is available in this country. Thus, an experiment was designed to evaluate the effect of brackish water, organic matter, lime and gypsum applications on grain yield of three cultivars of wheat grown in salt affected soils.

MATERIALS AND METHODS

Green house experiments were coducted during 1990-91 in *rabi* season at Benerpota Salinity Rdsearch Station, BWDB, Satkhira. Pots (35 cm × 30 cm) were filled up with 15 kg air dried soil passed through 2mm sieve collected from 0-15 cm depth soil profile in three sites at Satkhira, designated as S_1, S_2 and S_3, in each. The potted soils were treated with irrigation water of three different EC, organic matter (decomposed cowdung and straw), gypsum and lime in all possible combinations. P, K (80 and 60 kg/ha) and half of N (90 kg /ha) were applied at basal, while the rest half of N was equally divided between crown root and booting stage of growth. The treatment combinations used were as follows, viz. Brackish water : W_0, W_1, W_2 represent ECiw 0.7, 6.0, 12.0 dS/m, respectively ; organic matter (OM) : OM_0, OM_1 and OM_2 represent nil, 15 t cowdung (C)/ha and 15t straw (st)/ha, respectively ; gypsum (G) and lime (L) : G_0L_0, G_1L_0, G_0L_1 represent both G and L nil, 0.5 t G/ha and L nil, and 0.5t L/ha and G nil, respectively. Wheat cultivars : Akbar (A), Agrani (AG), Kanchan (K) were grown for each treatment. The ingredients were added to the potted soil 7 days before the seeds were sown and field moisture condititION was maintained. Twenty wheat seeds of uniform size were sown in each pot. Slightly saline water irrigation (ECiw 1.2 dS m^{-1}) was applied for germination of seeds and thereafter irrigation was given as per the treatment and need of the crop. At maturity grain yield of wheat was recorded. Relevant physico-chemical properties of the soils at initial stage were determined following standard methods (Table ± 1).

RESULTS AND DISCUSSION

The grain yield of wheat decreased significantly due to increase in salinity of irrigation water in all the soils. Yield of grain (g/pot), arranged in the order of ECiw 0.7, 6.0 and 12.0 dS/m, was recorded as 65.10, 46.15 and 33.57 in S_1, 75.18, 50.01 and 37.85 in S_2, and 68.75, 45.38 and 34.11 in S_3 (Table 2). Similar results were also reported by other investigators (Tripathi and Pal, 1979, Eshan *et al.*, 1986, Ojha and Bhargava, 1981, Maftoun and and Sepaskhah, 1989, Aich *et al.*, 1993).

Application of lime, gypsum and organic manure produced significantly higher yield over the controls (G_0L_0 and OM_0). Cowdung and straw produced similar grain yield in S_1 and S soils, whereas in S_2 soil, addition of straw produced significantly lower yield than cowdung. Influence on wheat yield in saline soils due to the addition of FYM/organic matter (Maliwal and Paliwal, 1972, Singh and Singh, 1989, Shivakanta and Rajkumar, 1992) and gypsum (Mahajan *et al.*. 1989) and that on barley in saline alkali soils (Poonia and Bhumbla, 1974) have been reported. CV. Kanchan produced the highest yield as compared with CV. Akbar and Agrani in each soil. However, CV. Akbar and Kanchan produced identical yields in S_3 soil. The superiority of lime was found in S_2 soil and that of gypsum in S_1 and S_3 soils though these were not significant.

Significant interaction between brackish water × variety, brackish water × lime/gypsum, organic matter × gypsum/lime, gypsum/lime × variety was found not to be significant (data not shown). CV. Agrani and Kanchan showed similar yields when irrigated with sweet (W_0) and moderately saline water (W_1). However, at the highest salinity (W_2), all

Table 2. *Effect of brackish water, organic matter, gypsum and lime on grain yield (g/pot) of three wheat cultivars grown in saline soils*

Treats	Soils				Soils		
	S_1	S_2	S_3	Treats	S_1	S_2	S_3
W_0	65.10^{a}	75.18^{a}	68.75^{a}	WoxA	63.45	70.73^{b}	67.37
W_1	46.15^{b}	50.01^{b}	45.38^{b}	WoxAg	64.18	78.17^{a}	68.56
W_2	33.57^{c}	37.85^{c}	34.11^{c}	WoxK	67.40	76.65^{a}	70.36
OM_0	45.68^{b}	42.60^{c}	44.98^{b}	W_1xA	44.04	48.51^{d}	43.38
OM_1	50.60^{a}	61.84^{e}	51.20^{a}	W_1xAg	45.48	49.67^{od}	45.88
OM_2	45.46^{a}	58.61^{b}	51.66^{a}	W_1xK	48.92	52.45^{c}	45.88
A	47.02^{b}	52.38^{b}	48.39^{a}	W_2xA	33.55	37.49^{c}	34.44
Ag	47.58^{b}	54.60^{ab}	49.13^{b}	W_2xAg	33.06	36.56^{c}	32.96
K	50.14^{a}	$56.0[illegible]^{a}$	51.02^{a}	W_2xK	33.11	39.12^{c}	35.82
				L.S	NS	0.05	Ns
GoLo	45.53^{b}	51.43^{b}	46.72^{b}	OMoxGoLo	43.64	40.01	41.28^{c}
$G_1 l_0$	49.70^{a}	55.73^{a}	51.76^{a}	OMoxG$_1$Lo	46.48	44.37	47.10^{d}
$G_0 L_1$	49.51^{a}	55.73^{a}	50.07^{b}	OM_1xGoL$_1$	46.91	43.42	46.57^{d}
WoxOMo	60.04^{b}	57.47^{c}	62.04	OM_1xGOLo	47.17	57.83	48.83^{od}
WoxOM$_1$	68.36^{a}	87.11^{b}	74.91^{b}	OM_1xG_1Lo	52.41	64.09	52.51^{b}
WoxOM$_2$	66.64^{a}	80.97^{b}	69.34^{b}	OM_1xG_1oL_1	52.21	62.59	54.36^{a}
W_1xOM_0	42.71^{d}	38.89^{d}	41.60^{f}	OM_2xG_0Lo	45.77	56.46	50.04^{c}
W_1xOM_1	49.02^{c}	56.69^{c}	45.43^{e}	OM_2xG_1LO	50.00	57.73	50.61^{bc}
				OM_2xGoL_1	49.42	61.64	54.34^{e}
				L.S.	NS	NS	0.05
W1xOM_2	46.72^{c}	54.44^{c}	49.11	AxGoLo	44.32	48.86^{c}	45.23^{f}
W_2xOMo	34.28^{g}	31.44	31.31^{h}	AxG_1Lo	47.52	55.46^{ab}	46.97^{def}
W_2xOM_1	34.41^{g}	41.71^{d}	34.38	AxGoL_1	49.21	51.81^{bc}	52.92^{ab}
W_2xOM_2	32.03^{e}	40.42^{d}	36.54^{g}	AgxGoLo	44.86	51.54^{bc}	46.10^{ef}
W_0xGol_0	61.78	72.44^{b}	67.08	AgxG_1Lo	49.88	54.36^{ab}	49.16^{cde}
WoxG_1Lo	67.36	78.44^{a}	68.83	AgxGoL_1	47.99	57.89^{a}	52.14^{bc}
WoxGoL_1	65.89	74.67^{ab}	70.37	KxGoLo	47.41	53.90^{abc}	48.77^{e}
W_1xGoLo	43.31	49.61^{c}	41.01	KxG_1Lo	51.69	56.37^{ab}	54.08^{a}
W_1xG_1Lo	48.04	89.51^{c}	46.47	KxGoL_1	51.33	57.96^{a}	50.51^{bcl}
W_1xGoL_1	47.11	50.92^{c}	48.66	L.S	NS	0.01	0.01

Table 2. Contd.

Treats	Soils			Treats	Soils		
	S_1	S_2	S_3		S_1	S_2	S_3
W_2xGoLo	31.49	3?.25[e]	32.06				
W_2xG_1Lo	33.69	39.24[d]	34.72				
W_2xGoL_1	35.64	42.07[d]	36.24				

Means followed same letter(s) are not significautly different at 1% by L.S.D.

Means followed same letter(s) are not significantly different by L.S.D. LS=level of significant. NS=Not significant

the cultivars produced identical yields. Significant interaction between brackish water × gypsum/lime was also observed in S soil. Addition of lime produced comparatively higher yield under moderate (W_1) to high saline (W_2) water treatments. Bandyopadhyay (1986) stated that the application of lime increased grain yield of rice appreciably under the acid saline soil of Sunderbans. The treatments showed positive interaction on grain yield in S_3 soil.

Interaction among brackish water × organic matter × lime/gypsum were found significant in S_1 and S_3 soils. In S_1 soil, the highest grain yield (72.73 g/pot) was recorded due to the treatment of $W_0 \times OM_1 \times G_1 L_0$, which was followed by $W_0 \times OM_1 \times G_1L_1$, $W_0 \times OM_2 \times G_1L_0$ and $W_0 \times OM_2 \times G_0L_1$ treatments. However, in S_3 soil, treatment of $W_0 \times OM_1 \times G_0L_1$ produced the highest yield. Similarly at high salinity $W_2 \times OM_2 \times G_0L_1$ and $W_2 \times OM_0 \times G_0L_1$ produced significantly higher yield, i.e., 39.6 and 39.42 g/pot in S_3 and S_1 soils, respectively. Significant interaction was noticed among brackish water × variety × lime/gypsum in S_2 and S_3 soils. Significant interaction among organic matter × variety × lime/gypsum were observed in S_2 and S_3 soils. Highest grain yield of 68.83 and 56.57 (g/pot) were recorded due to $OM_1 \times Ag \times G_0L_1$ and $OM_1 \times K \times G_1L_0$ treatments in S_2 and S_3 soils, respectively. Minimum yield was obtained in $OM_0 \times A \times G_0L_0$ treatment in all the soils. However, none of the four factor interactions showed significant impact on grain yield of wheat (data not shown).

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