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Comparative Performance of Rice Varieties/Lines in Ameliorated and Non-Ameliorated Soils

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ABSTRACT

A field experiment was conducted to study the comparative performance of four rice varieties (Shaheen Basmati, P.B. 95, Basmati 385 and Super Basmati) in ameliorated and non-ameliorated soils. A saline sodic field having EC_e 6.7 dS m^{-1}, pH_s 9.2, SAR 31.3 (mmol $L^{-1})^{1/2}$ and G.R. 3.8 t $acre^{-1}$ was selected, half of which was reclaimed by gypsum application @ 100% and rice varieties were transplanted in both ameliorated (reclaimed) and non-ameliorated (un-reclaimed) soils. Uniform cultural practices were applied to all the varieties up to maturity. The results indicated that paddy yield and 1000-grain weight was more in ameliorated than in non-ameliorated soil during all the three years (1995-97); whereas, sterile tillers per plant were more in non-ameliorated soil. Among the varieties, maximum paddy yield and 1000-grain weight were recorded from Shaheen Basmati, which was followed by P.B. 95, Basmati 385 and Super Basmati, respectively. Sterile tillers per plant were recorded maximum of Super Basmati followed by Basmati 385, P.B. 95 and least in Shaheen Basmati. It was concluded that Shaheen Basmati and P.B. 95 gave higher paddy yield than Basmati 385 and Super Basmati under both ameliorated and non-ameliorated soil.

Key Words: Rice; Gypsum; Saline-sodic soils

INTRODUCTION

One of the major reasons of low productivity of crops grown under saline sodic soil conditions is the salt toxicity. The salt affected soils in Pakistan have a predominance of sodium salts with varying levels and mixture of salts of other cations. Many parts of the world are also facing the associated problem with salinity and waterlogging. Salinity causes reduction in crop yield on about 10 m ha of worlds irrigated land (Rhoades & Loveday, 1990).

In Pakistan, 6.2 m ha are affected with salinity (GOP, 1996). The problem soils can successfully be cultivated by removing excessive soluble salts and exchangeable sodium through reclamation techniques. Various amendments like gypsum, sulfur and acids may be used for amelioration of these soils (Muhammad, 1990; Sharma *et al.*, 1996; Biggar, 1996). Being easily available and cheap source of calcium, gypsum is commonly used in Pakistan. Because of low solubility of gypsum and calcareous nature of soils, its efficiency is reduced. The alternative approach for economic utilization of the moderately salt affected land is to grow salt-tolerant crop varieties alongwith suitable management of cultural practices. Being moderately salt tolerant, rice is being recommended for cultivation during the reclamation of salt affected soil. Verma and Abrol (1980) while comparing gypsum and pyrite at equivalent rates of 25, 50, 75 and 100% GR for rice-wheat rotation on sodic loam soil, showed gypsum to be four fold better than pyrite at all rates of application. They also observed that rice variety IR-8-68 gave more yield than others. Singh *et al.* (1981), reported that surface application of gypsum @ 25 or 50% GR before transplanting of rice gave higher grain yield. Siddique *et al.* (1988) investigated that effect of gypsum @ 75% GR and 67 kg ha^{-1} fertilizer application gave maximum yield of rice and followed 50% GR treatment at same fertilizer dose on saline sodic soil. Chhabra (1999) reported that in Rice-Wheat cropping sequence, gypsum application to alkaline soil increased the yield of rice and wheat up to significant level. Yaduvanshi (1999) investigated the effect of fertilizer, organic manure on gypsum amended alkali soil and reported that both rice and wheat crops responded significantly. Keeping all above in view, the present study was carried out to see the effect of gypsum as soil amendment on different rice varieties.

MATERIALS AND METHODS

A field experiment at Agricultural Research Farm, Soil Salinity Research Institute, Pindi Bhattian was conducted to select the most suitable rice variety/advance line for obtaining optimum yield in sandy loam salt affected soil during the period 1995 to 1997. The experiment was laid out in split plot design with three replications having plot size of 6 m x 10 m. Gypsum @ 100% GR was applied as per treatment followed by subsequent leaching before transplanting of rice crop. Thirty-five days old seedling of rice varieties Basmati 385, Super Basmati, P.B. 95 and Shaheen Basmati were transplanted at a distance of 25 cm x 25 cm in rows and plants. Fertilizer NPK @ 100-50-50 kg ha^{-1} was applied. All the PK and ½ N fertilizer was applied at the time of land preparation and remaining ½ N was applied 35 days after transplanting of crop. All other agronomic and plant protection measures were adopted uniformly for all the treatments. Paddy yield and yield components were recorded and analyzed statistically using Fisher's analysis of variance techniques and LSD was

applied to compare the treatments means (Steel & Torrie, 1984). The physico-chemical characteristics of the representative field were: Soil texture = Sandy Loam; EC_e = 6.7 dS m^{-1} ; pH_s = 9.2; SAR = 31.3 (mmol $L^{-1})^{1/2}$; GR = 3.8 t $acre^{-1}$

RESULTS AND DISCUSSION

Gypsum application is the proven technology for the amelioration of saline sodic soils. Gypsum application in the field reduced the pH, ESP and EC to the safe limits. In ameliorated plots, the crop condition was better than non-ameliorated soil. The results revealed (Table I) that gypsum application had significant effect on paddy yield. The highest paddy yield (4.303 t ha^{-1}) was obtained from the plots where soil was ameliorated with gypsum and the lowest from non-ameliorated soil (1.952 t ha^{-1}).

Among the Rice varieties, the maximum paddy yield (3.506 t ha^{-1}) was produced by the Shaheen Basmati followed by P.B. 95 (3.241 t ha^{-1}). However, the lowest paddy yield (2.797 t ha^{-1}) was recorded of Super basmati. It might be due to increased availability of nutrients to the plant with the application of gypsum. The results are in line with Verma and Abrol (1988), Singh *et al*. (1981) and Siddique *et al.* (1988). Ameliorated soil had also significant effect on 1000-grain weight (Table II). Maximum 1000-grain weight (22.15 g) was recorded where gypsum was applied as soil amendment. Among the rice varieties, Shaheen Basmati gave the maximum 1000-grain weight (22.18 g) followed by P.B. 95, Shaheen Basmati (20.97 g), Basmati 385 (20.43 g) and Super Basmati (19.71 g). As regard the sterile tillers, it was noted that more sterile tillers $plant^{-1}$ (1.92) were produced by plots where no amendment was applied (Table III). The maximum sterile tillers (2.33) $plant^{-1}$ were noted of Super Basmati and minimum sterile tillers $plant^{-1}$ were recorded in Shaheen Basmati (1.18).

CONCLUSION

It may be concluded from the results that gypsum application @ 100% GR restored soil health and productivity. Shaheen Basmati proved more tolerant than P.B. 95, Basmati 385 and Super basmati in saline sodic soil .

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Table I. Comparative performance of rice varieties/lines in ameliorated and non-ameliorated soils (Paddy yield t ha^{-1})

Varieties/lines	Ameliorated soil				Non-ameliorated soil			
	1995	1996	1997	Average	1995	1996	1997	Average
Basmati-385	2.110	5.710	4.536	4.119	0.714	2.070	2.637	1.807
P.B.-95	2.533	6.111	4.833	4.492	0.688	2.115	3.177	1.993
Shaheen Basmati	2.499	6.426	4.887	4.604	0.847	3.213	3.168	2.409
Super Basmati	2.188	5.121	4.680	3.996	0.514	2.034	2.250	1.599
Average	2.332	5.842	4.734		0.691	2.358	2.808	

Paddy yield (t ha^{-1})					
Soil Amendments	**Basmati 385**	**P.B. 95**	**Shaheen Basmati**	**Super Basmati**	**Average**
Ameliorated	4.119	4.492	4.604	3.996	4.303a
Non-ameliorated	1.807	1.993	2.409	1.599	1.952b
Average	2.963c	3.241b	3.506a	2.797c	

Table II. Comparative performance of rice varieties/lines for 1000-grain weight (g) in ameliorated and non-ameliorated soils (Average of three years data)

Soil condition	Basmati 385	P.B- 95	Shaheen Basmati	Super Basmati	Average
Ameliorated soil.	22.01	22.58	23.70	21.00	22.15 a
Un-ameliorated soil	18.35	19.36	20.67	18.43	19.20 b
Average	20.43 bc	20.97 b	22.18 a	19.71 c	

Table III. Comparative performance of Rice varieties/lines for sterile tillers $plant^{-1}$ in ameliorated and non-ameliorated soil

Soil condition	Basmati 385	P.B- 95	Shaheen Basmati	Super Basmati	Average
Ameliorated soil.	1.90	1.03	1.10	1.93	1.49b
Non-ameliorated soil	2.06	1.60	1.27	2.73	1.92a
Average	1.98b	1.31c	1.18d	2.33a	

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