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Comparative Performance of Brassica Varieties/Lines Under Saline Sodic Condition

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Abstract: To investigate a suitable and more tolerant brassica variety/line for salt affected soil, a field experiment was conducted for three consecutive years (1997-1999) at soil salinity research institute, Pindi Bhattian. Performance of seven brassica varieties/lines i.e., peela raya, SPS-23-1, SPS-23-2, ORI-56-6, P-8-2, RL-18 and brown raya were studied in ameliorated and non-ameliorated soils. A field having EC_e 13.43 d sm^{-1}, pH 9.69 and SAR 65.97 (m mol l^{-1}) ^{½} was selected, half of which was ameliorated by applying gypsum @ 100 % G.R. and brassica varieties/lines were sown. All cultural practices were applied to the crop. The results showed that germination percentage, plant height, 1000 grain weight and grain yield were maximum in ameliorated than non-ameliorated soil during all the three years. Among varieties/lines, grain yield was in order of P-8-2, OR1-50-6. It is clear from the results that P-8-2 variety gave the highest grain yield (511.68 kg ha^{-1}) among all other varieties/lines in ameliorated/non-ameliorated soils.

Key words: Brassica varieties, yield and ameliorated/non-ameliorated soils

Introduction

Presence of excessive amount of salts in soil restricts crop productivity. In saline sodic soils, high exchangeable sodium and high pH impart adverse soil physical health, leading to poor soil air-water-plant-relationships. Seed germination, mortality of young seedling and poor tillering of crop plants are serious problems of these soils. Saline and sodic soils occur naturally in arid and semi arid climate conditions (Szabolcs, 1994). Salinity causes reduction in crop yield on about 10 m ha of worlds irrigated land (Rhoades and Loveday, 1990). In Pakistan 6.2 m ha are affected with salinity (GOP, 1996). The chemical amendments like gypsum, sulphur, sulphuric acid etc. are recommended and applied to reclaim these soils. These amendments lowered the soil pH, reacted with soluble carbonates and replaced the exchangeable sodium with calcium (Muhammad, 1990; Sharma *et al.*, 1996). Gypsum has been successively used in different ways to reclaim the salt affected soils (Ahmad *et al.*, 1988). Kumar (1993; 1995) and Sinha (1991) reported that germination and seedling growth stage is the most sensitive stage of brassica to salinity. Chauhan *et al.* (1988) found that germination %age decreased with increasing salinity level of rape and mustard crop. Islam *et al.* (2001) studies that the varieties of *Brassica compestris* (Sonali, Sampad and Doli) were found to be more tolerant to salinity while Tori-7 and Kallyarria were recorded to be the most susceptible varieties under Bangladesh conditions. 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 moderately salt affected land is to grow salt tolerant crop varieties. Singh (1994) reported that oilseed crops like sunflower, mustard, linseed, groundnut, rapeseed, toria, taramira and sesamum were tested in alkali soils. Mustard, rapeseed and Toria can grow in alkali soil by the application of 12.5 Mg ha^{-1} gypsum. Mustard produced highest yield (1170 kg ha^{-1}) followed by rapeseed (910 kg ha^{-1}). Yaduvanshi (1999) investigated the effect of fertilizer and organic manure on gypsum amended alkali soil and reported that both rice and wheat crops responded significantly in yield. This study was conducted to sort out the variety/line of brassica tolerant to salinity/sodicity.

Materials and Methods

A field study was conducted at Agricultural Research Farm of Soil Salinity Research Institute, Pindi Bhattian to sort out suitable brassica variety/line for getting better yield on saline sodic soil during the years 1997 to 1999. The experiment was sown according to split plot design with plot size of 6 X $10m^2$ having three replications. Main plots were ameliorated and non-ameliorated. Amelioration was done by applying gypsum @ 100 % G.R. followed by subsequent leaching before sowing the crop. Brassica varieties/lines i.e. peela raya, SPS-23-1, OR1-50-6, P-8-2, RL-18, SPS-23-2 and brown raya were sown in sub plot in the month of October and harvested in the month of March in each year. Thinning was done to maintain the required population. Fertilizer @ 115-75-62 NPK kg ha^{-1} was applied at sowing. All other agronomic practices were kept uniform. Grain yield and yield components were recorded and analyzed statistically using Fisher's (1958) analysis of variance techniques and LSD was applied to compare the treatments means (Steel and Torrie, 1984). The physio-chemical characteristics of the representative field are given in Table 1.

Table 1: Soil status of field before sowing the brassica crop

Soil Texture	Sandy loam
EC_e	13.43 d Sm^{-1}
Phs	9.69
SAR	65.97 (m mol l^{-1}) ^{½}
G.R.	3.06 t $acre^{-1}$

Results and Discussion

Gypsum application in soil having noticeable quantities of sodium counters the harmful effects of salts and helps to improve the soil physical health. Gypsum application in the soil decreases the soil pH, EC_e and SAR as well as to supports the crop growth.

In ameliorated plots the brassica crop condition was significantly better than non-ameliorated plots. The results (Table 2) indicated that gypsum application had significant effect on germination percentage of brassica crop. The highest germination percentage (62.32 %) was recorded in ameliorated plot and lowest from non-ameliorated plots (39.00%). Among all the brassica varieties/lines maximum germination percentage (55.74%) was recorded in plots of cultivar, P-8-2, followed by OR1-50-6 (52.63%). Where as the lowest germination was recorded of SPS-23-1 (47.80%). The results are in line with Kumar (1993; 1995), Sinha (1991) and Chauhan *et al.* (1988). Ameliorated soil also significantly affected the plant height of the brassica crop. The tallest plant of brassica (2.42 m) was produced in ameliorated plots and the lowest (1.80 m) in non-ameliorated plots. It may be due to easy and more availability of nutrients to the plant in the soil ameliorated with gypsum. Among the brassica varieties P8-2 cultivar showed the maximum plant height (2.62 m) followed by ORI-56-6 (2.19 m) and RL-18 (2.18 m).

The maximum 1000-grain weight (4.42 g) was obtained in plots where gypsum was applied as soil amendment. As regard the brassica varieties/lines, P-8-2 and RL-18 gave the maximum 1000-grain weight (3.99 g) and (3.65 g), respectively. It is evident from the results (Table 2) that all the brassica varieties/lines performed better in ameliorated plots (540.55 kg ha^{-1}) than non-ameliorated plot (285.62 kg ha^{-1} grain yield). The difference of production between both types of soils was statistically significant but all the brassica varieties/lines showed comparable grain yield. However maximum grain yield (511.68 kg ha^{-1}) was produced by the P-8-2 line followed ORI-50-60 line (489.63 kg ha^{-1}) and the lowest grain yield was produced by SPS-23-1 (314.87 kg ha^{-1}) brassica line. The results are supported by the work of Singh (1994). The interactions between soils and varieties/line were found non-significant in all the parameters i.e. germination percentage, plant height, 1000-grain weight and grain yield.

Table 2: Comparative performance of brassica varieties/lines in salt affected soils.

Soil amendments	Peela raya	SPS-23-1	ORI-50-6	P-8-2	RL-18	SPS-23-2	Brown raya	Average
Germination percentage								
Ameliorated	58.21	57.00	64.60	68.74	61.02	56.60	58.10	62.32 a
Non - ameliorated	38.32	38.60	40.65	42.75	38.42	36.41	37.85	39.00 b
Average	48.65d	47.80d	52.63b	55.74a	49.72c	46.51e	47.98 d	---
Plant height (M)								
Ameliorated	2.31	2.32	2.37	2.97	2.34	2.32	2.34	2.42 a
Non - ameliorated	1.14	1.19	2.00	2.26	2.05	1.97	1.96	1.80 b
Average	1.72e	1.75d	2.18b	2.62a	2.19b	2.14c	2.15 c	---
1000-Grain weight (g)								
Ameliorated	4.15	4.20	4.21	4.98	4.56	4.45	4.41	4.42 a
Non - ameliorated	2.30	2.39	2.43	2.99	2.75	2.61	2.51	2.71 b
Average	3.22b	3.30b	3.32ab	3.99a	3.65a	3.53ab	3.46 ab	---
Grain yield (kg ha^{-1})								
Ameliorated	459.97	401.60	662.97	769.71	572.70	425.20	492.14	540.55 a
Non- ameliorated	203.22	228.14	316.29	253.65	326.11	306.09	265.87	285.62 b
Average	331.60f	314.87g	489.63b	511.68a	449.40c	365.64e	379.00 d	-----

These results lead to conclude that application of gypsum @ 100 % G.R. improved soil physical soil health as well as the crop growth. Brassica cultivar P-8-2 proved the best tolerance to salinity/sodicity among varieties/lines tested in salt affected soil.

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