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YIELD AND QUALITY OF DIFFERENT RICE (*ORYZA SATIVA* L.) VARIETIES AS AFFECTED BY SOIL SALINITY

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Abstract

A pot experiment was conducted using six rice varieties viz., NR-1, IR-6, NIAB-6, KS-282, Basmati-370 and Basmati-385 to determine their yield potential and quality under non-saline (1.7 dS m^{-1}) and saline condition (10 dS m^{-1}) by adding appropriate amount of NaCl salt. Basal dose of NPK and $ZnSO_4$ respectively was applied. On an average, the grain yield of rice varieties was reduced by 30% with salinized soil over the normal soil whereas, protein content in rice grain was greater on salinized soil. Among the varieties, NIAB-6 gave better performance with improved grain yield as well as protein contents of both straw and grain.

Introduction

Rice is the number two staple food in Pakistan, grown over an area of two million hectares. The annual production of rice is about 3.2 metric ton (Anon., 1996). It earns the highest foreign exchange contribution, about 20% of the total export of the country. But under extreme saline conditions, growth and yield of both Basmati rice and coarse grained IRRI varieties is much lower as compared to that obtained from productive lands which may be due to cultivation of rice susceptible to salinity. Successful rice crop production with good grain quality on moderately salt-affected soils demands the suitable variety selection particularly with better salt tolerance. Quick screening procedure has been used by many workers to different crops in the early growth phases (Narale *et al.*, 1969; Qureshi *et al*,, 1990; Aslam *et al.*, 1993). In this study efforts were made to select the best salt tolerant variety which could produce satisfactory yield under saline soil conditions before any recommendation could be made for their general cultivation in salt-affected lands.

Materials and Methods

An experiment was conducted during rice growing season 1992 in the glass house to compare different rice varieties for their yield and quality on normal (1.7 dS m^{-1}) and saline (10 dS m^{-1}) soils. Thirty six glazed pots (30 x 30 cm) were filled with 10 kg of normal soil (ECe= 1.7 dS m^{-1} pH = 7.8 and N = 0.06%). The required soil was salinized by adding appropriate amount of NaCl salt to obtain 10 dS m^{-1}. The following six rice varieties were used:

V_1 = NR-1 V_2 = IR-6
V_3 = KS-282 V_4 = NIAB-6
V_5 = Basmati-370 V_6 = Basmati-385

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Fig. 1a: *Effect of salinity on productive tillers (pot^{-1}) of six rice varieties*

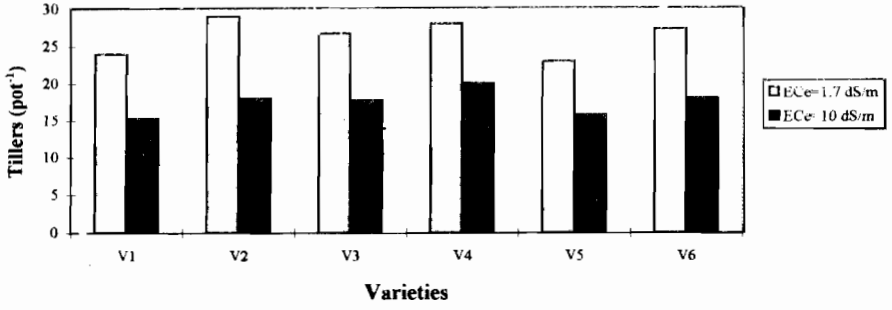

Fig. 1b: *Effect of salinity on straw yield (g pot^{-1}) of six rice varieties*

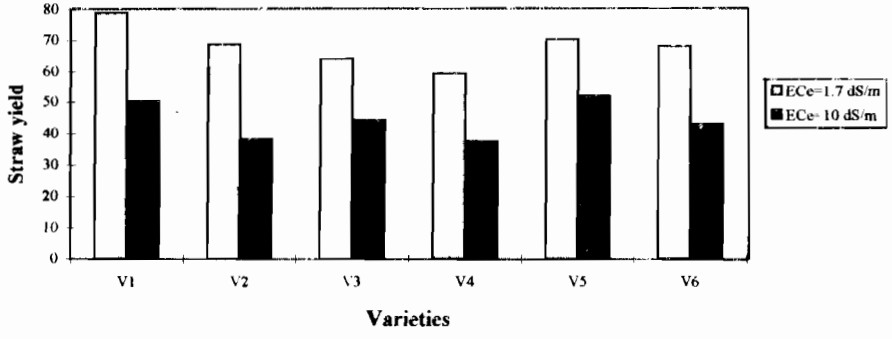

Fig. 1c: *Effect of salinity on grain yield (g pot^{-1}) of six rice varieties*

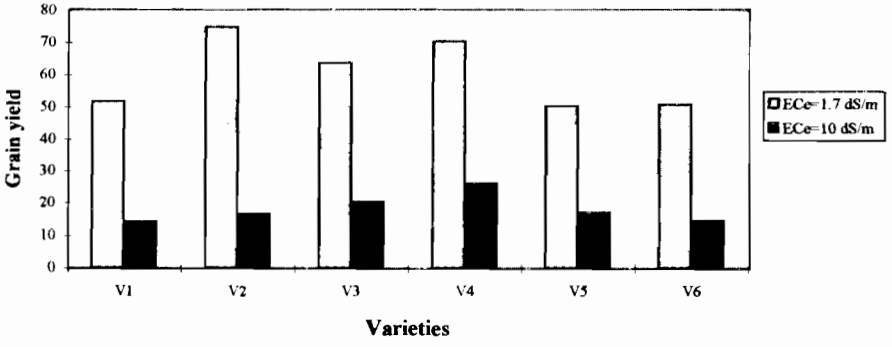

Fig.1a. Effect of salinity on productive tillers (pot^{-1}) of six rice varieties.

Fig.1b. Effect of salintiy on straw yield (g pot^{-1}) of six rice varieties.

Fig.1c. Effect of salinity on grain yield (g pot^{-1}) of six rice varieties

Six, 30-day old, seedlings of each rice variety were transplanted in each pot containing saline soil (10 dS m^{-1}). Experiment was laid out in CRD factorial with three replications. A basal dose of NPK and Zn @ 75, 50, 25, and 5 mg per kg of soil as Urea, SSP, SOP and $ZnSO_4$ was applied respectively. All the PK and Zn and half of the N was applied at the time of transplantation of seedlings and the remaining half of N was added at panicle initiation. Canal water was used for irrigation throughout the growth period. Data on the productive tillers was recorded at maturity, grain and straw yields were recorded at the time of harvesting in terms of dry straw and grain yield. Nitrogen from ground samples of straw and grain was determined by Gunning and Hibbard's method of sulphuric acid digestion using Kjeldhal flask and protein content was calculated by multiplying % N with the factor 6.25. Statistical analysis was done following the ANOVA technique (Steel & Torrie, 1980).

Results and Discussion

Data regarding the number of productive tillers, straws and grain yield obtained under both the conditions are given in Fig. 1(a, b & c). Maximum number of productive tillers per pot was produced by the variety NIAB-6 and IR-6 closely followed by KS-282, while this number was minimum in the case of NR-1, Basmati-385 and Basmati-370 under both the conditions. The highest straw yield was obtained from NR-1 followed by Basmati-370, whereas under saline soil condition, NIAB-6 produced the maximum grain yield closely followed by KS-282 as compared to rest of the varieties included in this study. Varieties NR-1, Basmati-385 and Basmati-370 produced comparatively lower grain yield. These varieties were exceptionally sensitive to salinity at the panicle initiation stage due to which reduction in grain yield occurred (Giriraj *et al.*, 1976; Verma & Neue, 1984; Aslam *et al.*, 1994; Naeem *et al.*, 1996). On an average a 30% reduction in grain yield occurred on saline soil as compared with non-saline soil. The reason might be the presence of toxic ions in the root zone that impaired plant growth and thus resulted in poor yield. Crops grown on saline soils invariably suffer serious yield reductions (Qadar, 1995). Similar results have been documented by Sinha (1983), Munns (1993) and Aslam *et al.*, (1995). NIAB-6 produced more grains than all other varieties followed by IR-6 and KS-282 and thus proved to be the most salt tolerant. Qureshi *et al.*, (1990) and Aslam *et al.*, (1993) have reported similar conclusions.

Protein Contents: Maximum protein in straw and grain was obtained from plants grown on saline soil (Fig.2 (a & b) as compared to those on normal soil. Since salt stress is considered for the elevation of ionic concentration in plant shoot and root which ultimately play an important role by activating enzymes known to be related with exessive uptake of nutrients. Perhaps a similar situation has prevailed that increased protein contents under stress condition. This is supported by the investigation of yan & Wang (1992). Verma & Nenue (1984) and Rashid (1996) also reported similar re-results. In the saline soil NIAB-6 had maximum protein contents in straw closely followed by KS-282 and IR-6, while minimum protein was observed in the case of NR-1 showing poor performance under saline environment. Basmati-385 and Basmati-370

Fig. 2a: *Effect of salinity on protein content (%) in straw of six rice varieties*

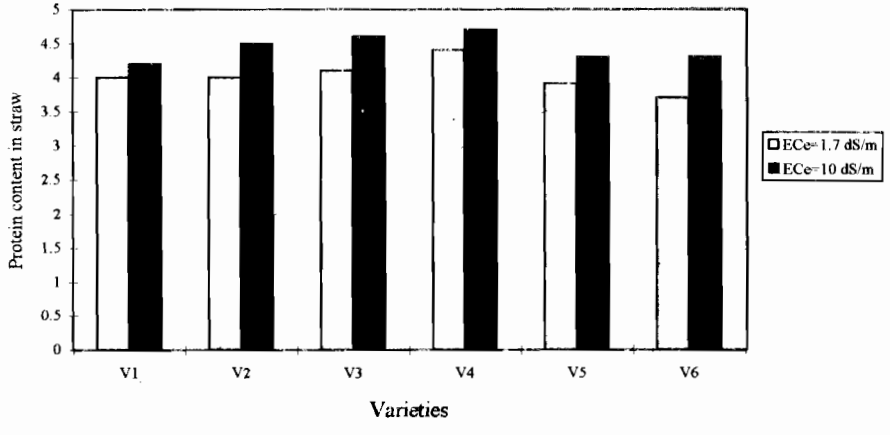

Fig. 2b: *Effect of salinity on protein content (%) in grains of six rice varieties*

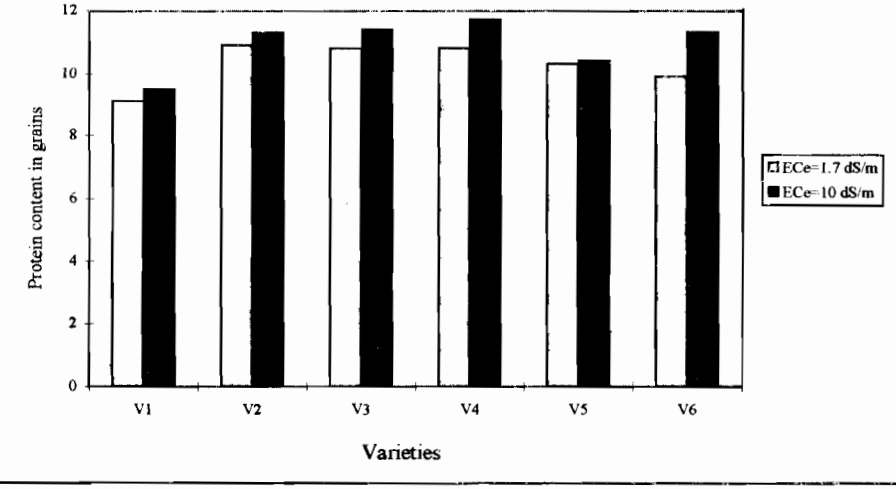

Fig.2a. Effect of salintiy on protein content (%) in straw of six rice varieties.
Fig.2b. Effect of salintiy on protein content (%) in grains of six rice varieties.

were at par for the protein contents in straw and were next to NR-1. Maximum protein content in grains was observed in NIAB-6 followed by KS-282 and IR-6. NR-1 had the lowest protein in grains. However, better performance of NIAB-6 improving protein content may be due to its more nitrogen uptake ability and consequently being the best salt tolerant variety (Giriraj *et al.*, 1976; Verma & Neue, 1984; Aslam *et al.*, 1996; Rashid, 1996).

Better growth and paddy yield of all the varieties under test were obtained from the non-saline soil while maximum protein content of both straw and grain was obtained from saline soil. Among the varieties NIAB-6 produced significantly higher grain yield and protein content in both straw and grain. Hence, it can be inferred that NIAB-6 is more salt tolerant variety with better quality grain production as compared to rest of the varieties included in this study.

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