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NITROGEN MANAGEMENT FOR RICE IN A SALT-AFFECTED SOIL

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A pot experiment was conducted to study the effect of time of nitrogen application at two salinity levels (EC. 1.6 and 10 dS m-1). Salinity was developed by a mixture of salts before transplanting rice seedlings of KS 282. Various combinations of different proportions of nitrogen fertiliser was applied to nursery, at transplanting, 10 days after transplanting (10 OAT) and at panicle initiation stage. Tillering capacity, fresh panicle weight, paddy and straw yield decreased significantly at high salinity. Among the nitrogen treatments, growth and yield was maximum where 1/2 N was applied 10 OAT and 1/2 at panicle initiation stage. Application of 1/3rd N to nursery bed gave better results in terms of paddy yield at high salinity. Chemical composition of the paddy with respect to N, K+, Na+ and Cl" as well as K:Na ratio has been discussed.

INTRODUCTION

About one million hectares of the famous rice tract of Pakistan has moderate to high soil salinity, sodicity, high pH and scarcity of good quality groundwatcr (Oureshi and Aslam, 1990). These adverse conditions (Vcrma and Ncuc, 1984) as well as inadequate and imbalance use of plant nutrients (Nianc, 1987) cause a sharp deeline in the yield of paddy on salt-affected soils. No doubt soil salinity alters the exchangeable cations on the exchange complex of soil and consequently affects the uptake of nutrients by plants but the use of fertilisers alleviates to some extent the detrimental effects of salinity, and thus improves the yield. Therefore, in addition to other agronomic practices (Patcl *et al.,* 1986) successful crop production on moderately salt-affected soils demands the judicious use of plant nutrients, particularly nitrogen fertiliser. Our soils arc deficient mainly in nitrogen and readily respond to the application of nitrogen fertilisers (Aslam *et al., 1989* b). In this study efforts have been made to increase the rice production on a saline soil through appropriate management of nitrogen fertiliser.

MATERIALS AND METHODS

A pot experiment was conducted in the Department of Soil Science, University of Agriculture, Faisalabad. Ten kg clay loam soil (EC. 1.6 as m-I, pH 7.8, ESP 9.7) was filled in each glascd pot (30 cm deep X 30 cm diameter). Soil was air dried, ground and passed through 2 mm sieve before filling. Rice seedlings of KS 282 were transplanted at two salinity levels i.e. EC. 1,6 (control) and 10 dS m-I. Salinity of 10 dS m-I was developed artificially by adding Na2S04, NaCl, CaCI2 and MgS04 in the ratio of 9:5:5:1, respectively on equivalent basis which gave a Na:Ca:Mg ratio of 14:5:1 and Cl to S04 ratio of 1:1. Nursery of KS 282 was raised in soil with and without nitrogen application. Five, 30 day-old seedlings were transplanted in each pot. Nitrogen @ 150 kg ha-I as urea was applied according to the plan given below:

T. = 1/2 N at seedling transplanting + 1/2 at panicle initiation.

T_1 = 1/2 N 10 days after seedling transplanting + 1/2 N at panicle initiation stage.

T_3 = 1/3 N to nursery + 1/3 N at seedling transplanling + 1/3 N al panicle initiation stage,

T_4 = 1/3 N to nursery + 1/3 N 10 days after seedling transplanting + 1/3 at panicle initiation stage,

T; = 1/3 N al seedling transplanting + 1/3 N 10 days after seedling transplanting + 1/3 N al panicle initiation stage.

A basal dose of phosphorus, potassium and zinc was applied (((180,50 and 5 kg ha'l, respectively as SSP, SOP and zinc sulphate, One week after seedling lransplanling, thinning was done to three plants per pal. Cornpletcly randomiscd design with faclorial combination of treatments was followed with three repeats. Data regarding yield components were collected. Paddy samples from differenl treatments were analysed for N, K+'Na+ and cr.

RESULTS AND DISCUSSION

Growth and yield: Soil salinity and N application at different times had a significant effect on paddy and straw yield, fresh panicle weight and number of tillers por' (Table 1). All these parameters were adversely and significantly affected at high salinity (EC_c 10 dS m-I). Maximum mean paddy yield of 65.6 g por' was obtained in the case of control whereas it was 44.6 g por! al high salinity. The reduction in mean paddy and straw yields, fresh panicle weight and tillcring capacity was 27.5, 32.8 , 35.0 and 15.8% respectively at high salinity compared with the conlrol (EC. 1.6 dS nrì). There were a number of reasons as 10 why yield decreased under saline conditions (see Verma and Ncue, 1984; Aslam *et al.,* 1989 a; Aslam *et al.,* 1991). From the data it is clear that due to salinity reduction in paddy yield was more severe compared to tillering and straw yield indicating that vegetative phase was less affected than the reproductive phase (see also Akbar *et al.,* 1985; Muharnrncd *et al.,* 1987; Aslam *et al., 1988).*

Big difference were observed by changing the nilrogen application strategy under saline environment. All the above mentioned growth and yield parameters gave maximum yield in the case of T_1 i.e. where nilrogen was applied in 2 splits; 1/2 N 1'0 DAT and 1/2 N at panicle initiation stage, followed by T_4 and TI, respectively, Nevertheless, differences between T_2 and T_4 were significant in the case of paddy yield and lillering capacity, Treatments T, and T_3 were at the botlom in all the cases and were slatistically similar to each other. Better results produced by T_1 may be due to the application of nitrogen at appropriate time. Generally, lillering in rice begins 10-15 days after Iransplanting when seedlings have recovered from transplanting shock and this results in increased uptake of N (Meelu and Gupla, 1980; Patcl *et al.,* 1986). Aslam *et al.* (1989 b) reported that depressive effect of "salinity could be avoided by improving the fertility status of the soil. Encouraging perfprmance of T_4 where part of N was applied to nursery might be due to virgorous and healthy seedlings which superbly tolerated to saline environment (Raghavaiah *et al.,* 1989).

Chemical components of Paddy: Average N concentration in paddy increased significantly from 1.57% at control to 1.72% at high salinity (Table 2). The increase in N under salinity may be attributed to reduction effect (Aslam *et al.,* 1989 b). As regards the time of nitrogen application, T_2 was superior lo all the other treatments included in the

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Table 2. [illegible]

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study. This could be due to the N application at a time when the requirement of plant for N were the highest (Tanaka *cl al., 1964).*

Maximum K+ concentration in paddy was found in the case of control and it decreased steeply under high salinity. Decrease in the K+ concentration with increase in salinity may be due to competition between Na+ and K+ and a resultant increase in the uptake of Na+ at the cost of K+ (Aslam *cl al.,* 1989 b). Differences in the concentration of K+ in paddy were also found statistically significant with the application of N at different times. Minimum K+ concentration was recorded in the paddy with T_2 treatment which was statistically at par with T_4 whereas the paddy from T_3 had the highest K+ concentration. Low concentration of K+ in T_2 may be attributed to the dilution effect However, it is interesting to note that the K:Na ratio was the highest in the case of paddy obtained from T_2 (Fig. 1) indicating that though the absolute concentration of K+ was the lowest, yet relative concentration of K+ (K:Na); essential for physiological processes was better in the case of T';

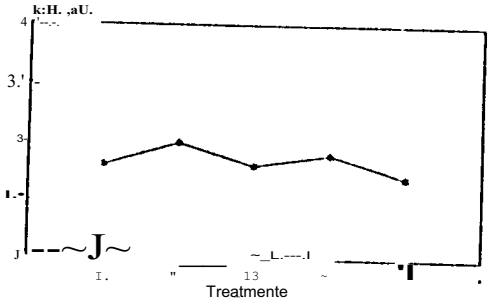

Fig. 1. K:Na ratio as affected by nitrogen application in saline soil (EC_e 10 dS rrr"),

Average Na+ and Cr concentrations in paddy had significant and positive relationship with the increasing salinity (Table 2). The high concentration of Na+ and Cr in paddy grown at EC_e 10 dS m-I was obviously due to excessive Na+ and Cr in the rooting medium added to develop desired salinity level. Similar conclusions were drawn by Verma and Neue (1984), Muhammed *cl al.* (1987) and Aslam *cl al.* (1989 b). Time of N application also significantly affected the concentration of Na+ and Cr in paddy. The minimum concentration of these ions was found in the case of T_2. Perhaps this may be due to more rapid growth and high yield produced by T_2 and resultant less accumulation of these ions in plant tissues including paddy. Concentration of these ions was maximum in the case of T,I which in turn had also the lowest yield and poor growth (tillering capacity),

From the study it can be concluded that application of partial N dose at tillering initiation stage not only tended 10 maintain lower concentration of saline ions (Na+, Cr) and a better K:Na ratio in plant tissues (an important physiological trait for the measurement or induction of sail tolerance in plants) but also ameliorated growth and paddy yield in a salt-affected soil.

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