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IMPROVEMENT IN SALT TOLERANCE OF RICE

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Five presowing seed treatments were given to seed and nursery of IR-6 and transplanted into glazed pots having four levels of salinity Le., EC 1.6, 5, 10 and 15 dS m- , produced by adding Nae S04' NaCI, $CaCl_2$ and $MgS0_4$ in the ratio of 9:7:3:f respectively.There was a significant reduction in plant height, tillering, grains per panicle, paddy and straw yields with increasing salinity. Grain yield was more affected than the straw yield. Presowing seed treatments increased significantly the tillering capacity, grains per panicle, 1000-grain weight, paddy and straw yields. Maximum increase was found in I T 1 i.e; $CaS0_4 \cdot 2H_20$ application @0.15 t acre -1 3" to nursery after soaking the seed in 20 me 1 $CaS0_4.2H_20$ for four hours.

INTRODUCTION

Various agrotechnical methods can be used to raise sucessful crops in saline areas. Presowing seed treatment is a promising technique based on the assumption that plants adapt most readily to their environments in initial phase of their development. Presowing treatment of seed induces marked changes in the physiologyof embryo and increases its resistance to the harmful effects of salts (Strogonov, 1964). Also induction of salt tolerance in various crops has been reported by seed and seedling treatments (Chaudhri and Wiebe, 1968; Rauf and Mian, 1969). In the present study we aimed to investigate the effect of presowing seed treatments on restricting the adverse effect of soil salinity on rice.

MATERIALS AND METHODS

a) Presowing seed treatments

Seedlings of rice variety IR-6 were raised in normal soil (EC 1.6 dS m-1) and following treatments were given to

T1 = Control (seed soaked in distilled water for 4 hours).

T2 = Seed soaked in 20 me l-1 $CaSO_4 \cdot 2H_2O$ for 4 hours.

T_3 = T2 + $CaSO_4 \cdot 2H_2O$ application @ 0.15 tons per acre to soil before sowing the nursery and incorporated to 3" depth.

T4 = T2 + $CaSO_4 \cdot 2H_2O$ application after germination in solution form (1, 2 and 3 me l-1, each in two irrigations).

T5 = T2 + $CaSO_4 \cdot 2H_2O$ and $MgSO_4$ (3:1) application after germination in solution form (1, 2 and 3 me l-1, each in two irrigations).

b) Soil salination

Normal clay loam soil (EC 1.6 dS m-1) was taken and salinity levels, i.e. 5, 10, and 15 dS m-1 were developed by adding a mixture of Na_2SO_4, NaCl, $CaCl_2$ and $MgSO_4$ in the ratio of 9:7:3:1 respectively, on equivalent basis to give Na: Ca: Mg 16:3:1 and that of Cl and SO4 1:1. Ten kg of salinized soil was filled in each glazed pot and forty days old seedlings were transplanted to form five hills, which were thinned out to three after twenty days. A basal dose of N, P, and K fertilizers (50-90-90 kg ha-1) was applied and canal water was used for irrigation. At maturity, observations were recorded and analysed statistically according to Completely Randomised Design with factorial combination of treatments (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

1) Effect of salinity

The data presented in the following Table show a decrease in number of tillers with increasing salinity. A similar reduction pattern was also observed in the case of plant height with increasing salinty (data not shown). Such effects can be explained by the findings of Ayers (1952) and (Aceves-N et al., 1975).

Increasing salinity caused more reduction in number of gr~ins per panicle than in number of tillers e.g. at EC 15 dS m reduction in number of grains was 51 % compareij to 28 % decrease in number of tillers. Similarly, paddy yield ~1s reduced upto 42.4 % as compared to control at EC 15 dS m • This indicates that effect of salinity is different eaccording to the developmental stages of inflorescence (See Yoshida, 1967). The reduction in these parameters, presumeably the result of physiological disorder after the emergence of panicle or due to toxic effects of salintiy during very early panicle formation (Akbar et al., 1972).

Considering the averages of salinity' levels,, straw yield was decreased with increasing salinity but this reduction was less (18 %) when compared to paddy yield (42.4 ~). In vegetative growth, salinity affected the tillers and straw yield less as compared to number of grains and paddy yield. It is now generally accepted that rice is least tolerant to salinity during early growth stages and its tolerance increases during later stages of growth (Kaddah and Fakhry,1961).

2. Effect of presowing treatments

The increase in grain yield in the case of treated seedlings over the yield from the control was considered to be a criterion for induced salt tolerance. In general, there was areduction in yield ranging from 6.5 to 42 % due to increasing salinity. Different presowing treatments gave promising results and yield was significantly increased over those of the control. The best results were obtained with $CaS0_4.2H_20$ application to the nursery soil before sowing (T3)' There was 17.3 % increase in paddy yield over control. Similar trend was observed in the case of number of tillers and grains, where increase due to T3 was

Table *Effect of presowtni; seed treatments* on *rice*

(A verage of 3 repeats)

Treatments	EC_e (dS m^{-1})				
	1.6	5	10	15	Mean
	(a) Number of tillers pot^{-1}				
T_1	36.3	32.0	31.0	27.6	31.7C
T_2	34.6	35.0	30.3	26.3	31.5C
T_3	42.0	42.3	33.6	30.0	37.0A
T_4	38.6	39.3	33.3	25.6	34.2B
T_5	33.0	29.6	31.0	23.3	29.20
Average	36.9 a	35.6 a	31.5 b	26.5 c	
	(b) Number of grains panicle^{-1}				
T_1	93.5	70.5	57.6	45.6	66.8C
T_2	96.2	80.2	65.3	45.3	71.8BC
T_3	104.1	85.3	70.0	50.1	n.4A
T_4	100.2	80.3	64.9	48.6	73.5B
T_5	90.1	75.8	60.5	42.5	67.2C
Average	96.9 a	7~4	63.6 c	46.4 d	
	Cc) Paddy yield (g pot^{-1})				
T_1	51.2	51.4	41.1	31.1	43.70
T_2	56.2	52.6	42.7	31.0	45.6C
T_3	65.4	56.5	48.3	34.2	51.1A
T_4	57.4	53.2	44.9	33.7	47.3B
T_5	50.9	49.0	43.7	30.8	43.80
Average	56.2 a	52.5 b	44.1 c	32.1 d	
	(d) Straw yield (g pot^{-1})				
T_1	~1.9	48.7	47.5	39.1	46.8B
T_2	52.4	48.6	47.7	43.0	47.9B
T_3	58.7	55.2	50.4	47.5	52.9A
T_4	50.3	50.0	48.9	46.9	49.0B
T_5	58.9	48.1	46.9	46.6	50.1AB
Average	54.4 a	5%1	4~2	44.6 c	

Means following by same let'ter(s) in rows and columns are statistically non-significant with each other (P=0.5).

16.5 and 18.4 %, respectively. This increase, as a result of pre-sowing seed treatments might be due to calcium, as it is known to maintain the integrity of plant cell membrane and, hence to prevent the free diffusion of potentially toxic ions present in saline environment, into the cytoplasm. Besides, calcium improves the physical characteristics of cell membrane and is essential for cellular development (Chaudhri and Wiebe, 1968; Rains, 1972; Gerard and Hinojosa, 1973).

The calcium taken up by the seedlings during the treatment may help to maintain the integrity of the root cell membranes and also to prevent the quick accumulation of sodium in the plant system and at the same time, to promote the uptake of potassium, which may help to maintain the chemo-osmotic potential of the cells. These two factors may give initial advantages to the seedlings over the control seedlings in saline soils, leading to better crop growth and higher grain yields (Qadar et al., 1980).

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