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EFFECT OF INCREASED SALT STRESS ON YIELD AND YIELD COMPONENTS IN RICE

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Six genotypes previously identified as relatively salt tolerant were grown under five saline sodic condition in the artificially salinized cemented field basins. The basins were provided with the automatic drainage system at their bases. Both the genotypes and their yield and yield components reacted differently to salt stresses. Although all the plant attributes were afflicted by the harmful effects of saline sodic conditions, yet yield per plant were affected to the maximum. The salt tolerance limits of genotypes are also presented.

INTRODUCTION

The modern cultivars of rice have been nurtured to be grown in the normal environmental niche and hence have narrow genetic base for salt stress. Consequently the cultivars completely lack the property of genetic plasticity for the new environmental niche of salt stress. The genotypes of crop plants of wide geographic origin have been considered to possess genetic platicity for salt stress[1,2]. For widening the genetic base of local, high yielding and well adapted cultivars there is an ample need to identify the salt tolerant genotypes of exotic origin. Such a task could be accomplished by studying salt tolerance limits of genotypes. Information regarding the salt tolerance limits of different genotypes of rice is rather scanty. Therefore, to achieve the objective of finding the limit of salt tolerance, behaviour of some rice genotypes under varying levels of saline sodic conditions was studied.

MATERIALS AND METHODS

Six salt tolerant genotypes of exotic (Giza 159, Getu, C23-3-1, K-1-14-1, H-33) as well as one variety of local origin NR-I (NIAB-Rice-I, developed at NIAB), were grown in five saline sodic conditions during 1980-81. The saline sodic conditions in the cemented field basis (6x6x1m) were artificially created by mixing four commercial salts of magnesium sulphate, sodium chloride, calcium chloride and sodium sulphate in the ratios of 1:4:5:10 respectively. Six soil analyses from an equal interval of a month were taken from the cemented field basins andwere analysed. The average of these analyses has been presented in Table 1. The desired salt stress in the field basins was further achieved by irrigating the basin, with tubewell water (saline-sodic) containing T.S.S. 35, HCO_3 17.5, Ca^{++}+Mg^{++} 4.8, Na^+ 30.2 meq./L with 19.5 SAR value. Six-week old seedlings grown on the normal field were transplanted into the field basin. The design of the experiment, was spilt plot with four replications. Single seedling per hill in 6 m long row were transplanted with plant to plant and row to row distance of 20 cm. Twenty guarded plants per replication for each genotype were selected for recording various observations. Data on plant height and number of productive tillers per plant were recorded in the field at the maturity of the crop. Data on various spike characters were recorded on the main panicle from each guarded plant in the laboratory. The data were satistitically analysed. The LD50 (the salt stresses in ESP corresponding to 50% reduction in yield as compared to that of control) for the genotypes under test were calculated.

RESULTS AND DISCUSSION

The data on various plant attributes under varying saline sodic conditions are presented in Tables 2 and 3. The differences between different genotypes and ESP levels were highly significant with regard to plant height, no. of productive tillers per plant, panicle length, no. of primary branches per panicle, panicle fertility % and yield per plant. The interaction between genotypes and ESP levels were also highly significant for all the plant attributes of genotypes under study. Increased ESP levels afflicted yield and yield components in increasing order, irrespective of genotypes (Table 2 and 3). But the magnitude of deterioration caused by harmful effects of salt stress, varied not only with genotypes but also with the plant attribute studied. Such results have also been reported in rice [3, 4, 5]. The per cent reduction in grain yield from the normal

Table 1. Different saline sodic levels and other chemical properties of field basins.

Saline Sodic Levels	ECx10^3	T.S.S	pH	Ca^{++}+Mg^{++} meq/L	Na^+ PPM	E.S.P
S_1 Control	2.2	22.0	8.1	7.6	571.2	15.0
S_2	4.8	47.9	8.8	.4.	1782.6	44.0
S_3	6.6	65.6	8.8	5.7	2192.2	46.0
S_4	8.4	83.3	9.0	4.3	2859.5	53.0
S_5	9.2	92.2	9.0	4.8	2925.3	56.0

Table 2. Influence of varying saline sodic levels on different plant attributes in rice varieties.

	GIZA-159			GETU			C23-3-1			K1-14-1			H-33			NR-1		
ESP (pH)	No. of primary branches/ panicle	Panicle fertility %	Yield/ plant (g)	No. of primary branches/ panicle	Panicle fertility %	Yield/ plant (g)	No. of primary branches/ panicle	Panicle fertility %	Yield/ plant (g)	No. of Primary branches/ panicle	Panicle fertility %	Yield/ plant (g)	No. of primary branches/ panicle	Panicle fertility %	Yield/ plant (g)	No. of primary branches/ panicle	Panicle fertility %	Yield per plant (g)
15.0	11.5	80.1	32.1	10.8	82.2	11.8	13.0	70.6	13.6	11.5	82.4	41.4	11.3	81.3	37.5	10.5	92.2	27.2
(8.1)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
44	11.3	74.2	14.0	10.0	60.6	11.8	12.3	54.4	9.4	11.5	82.2	17.4	10.8	81.3	11.4	11.3	88.2	11.2
(8.8)	(1.7)	(7.4)	(56.4)	(7.4)	(26.3)	(0.0)	(5.4)	(23.0)	(30.9)	(0.0)	(0.2)	(58.0)	(4.4)	(0.0)	(69.6)	(7.6)	(4.3)	(58.8)
46	10.0	69.7	9.8	9.3	59.8	6.9	12.0	42.7	7.9	11.3	58.2	12.8	10.3	55.1	10.8	9.8	74.1	7.8
(8.8)	(13.0)	(13.0)	(69.5)	(13.9)	(27.3)	(41.5)	(7.7)	(39.5)	(41.9)	(1.7)	(29.4)	(69.1)	(8.9)	(22.7)	(71.2)	(6.7)	(19.6)	(71.3)
53.0	9.8	23.5	6.5	9.3	58.9	5.1	11.3	40.9	7.9	11.3	52.7	11.4	10.0	68.1	8.4	8.3	63.9	7.1
(9.0)	(14.8)	(70.7)	(79.8)	(13.9)	(28.4)	(56.8)	(13.1)	(42.1)	(41.9)	(1.7)	(36.0)	(72.5)	(11.5)	(16.2)	(77.6)	(21.0)	(30.7)	(73.9)
56.0	8.5	14.0	1.4	7.5	53.6	4.5	8.5	34.3	6.7	10.0	46.8	6.1	9.8	64.6	7.8	7.0	59.5	5.9
(9.5)	(26.0)	(82.5)	(95.6)	(30.6)	(34.8)	(61.9)	(34.6)	(51.4)	(50.7)	(13.0)	(43.2)	(85.3)	(13.3)	(20.5)	(79.2)	(33.3)	(35.5)	(78.3)

ISD at P = 0.01: No of primary branches/ plant 0.727, panicle fertility 0.732; Yield per plant 0.709.
The upper figures indicate values of the charaeters; figures in parentheses indicate percentage reduction from normal values.
N.B. Figures indicating value of characters are the mean of 20 observations/replicate.

* * * * *

Table 3. Influence of varying saline sodic levels on different plant attributes in rice varieties.

	GIZA 159			GETU			C23-3-1			K1-14-1			H-33			NR-1		
ESP (pH)	Plant hight (cm)	Productive tiller/plant	Panicle length (cm)	Plant height (cm)	Productive tillers per plant	Panicle length (cm)	Plant height (cm)	Productive tiller/ plant	Panicle length (cm)	Plant height (cm)	Productive tillers/ plant	Panicle length (cm)	Plant height (cm)	Productive tillers/ plant	Panicle length (cm)	Plant height (cm)	Productive tiller/ plant	Panicle length (cm)
15.0	140.7	17.5	21.9	127.0	13.5	20.3	89.9	13.0	22.3	86.6	20.8	21.9	83.1	12.8	20.4	129.7	12.0	24.8
(8.1)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
Normal																		
44	115.9	14.0	20.5	111.5	12.3	19.4	83.4	11.5	21.0	77.1	13.8	20.6	84.1	10.8	20.1	127.4	11.3	24.6
(8.8)	(17.6)	(20.0)	(6.4)	(12.4)	(8.9)	(4.4)	(7.2)	(11.5)	(5.8)	(7.8)	(33.7)	(5.9)	(0.0)	(15.6)	(1.5)	(1.8)	(5.8)	(0.8)
46	106.4	11.0	20.4	108.8	12.3	18.9	77.5	10.8	20.9	75.8	11.8	21.3	78.3	9.5	19.8	124.4	7.3	21.5
(8.8)	(24.3)	(37.1)	(6.9)	(14.3)	(8.9)	(6.9)	(13.8)	(16.9)	(6.3)	(9.3)	43.3)	(2.7)	(6.7)	(25.8)	(2.9)	(4.1)	(39.1)	(13.3)
53.0	74.3	9.5	18.0	92.8	11.0	18.1	60.9	8.3	19.3	70.9	10.5	20.6	69.3	9.3	19.8	87.8	5.8	21.2
(9.0)	(47.2)	(45.7)	(17.8)	(26.9)	(18.5)	(10.8)	(32.3)	(36.2)	(13.5)	(15.2)	(49.5)	(5.9)	(17.6)	(27.3)	(2.9)	(32.3)	(51.7)	(14.5)
56.0	66.8	8.3	16.0	74.3	10.3	17.4	57.6	8.3	19.0	59.8	10.0	20.5	64.6	4.8	18.3	82.1	3.8	19.5
(9.5)	(52.8)	(52.6)	(26.9)	(41.5)	(23.7)	(14.3)	(35.9)	(36.2)	(14.8)	(28.5)	(51.9)	(6.4)	(23.2)	(62.5)	(10.3)	(36.7)	(68.3)	(21.3)

LSD at P = 0.01: Plant height 0.715, No of productive tillers 0.729, Panicle length 0.679.
The upper figures indicate values of the characters; figures in parentheses indicate percentage reduction from normal values.
N.B: Figures indicating value of characters are the mean of 20 observations/replicates.

(Fig. 1) indicated that LD50 for Giza 159, Getu, C23-3-1. K-1-14-1, H-33 and NR-1, was 40.8, 50.0, 55.5, 40.0, 35.8 and 40.0 ESP respectively. It may safely be concluded from the foregoing that C23-3-1 and Getu which show the LD50 of 55.5 and 50.0 respectively, were most salt tolerant among the genotypes under test. They may be used in crossbreeding programme as donors of salt tolerance. Such results have also been reported by different workers [6, 7].

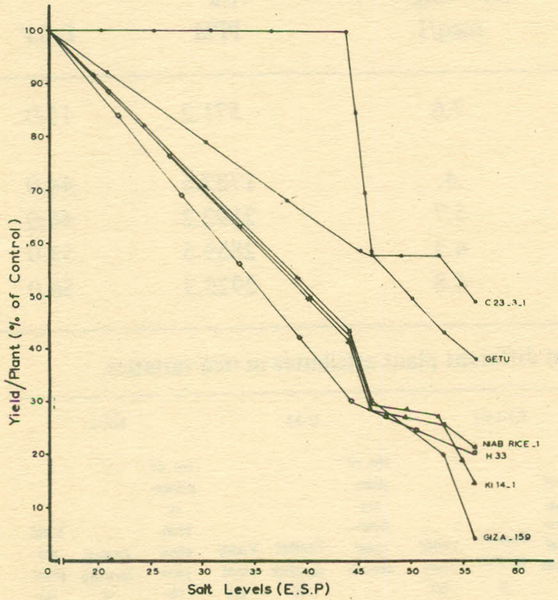

Fig. 1. Yield of different genotypes of rice under varying salt levels.

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