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Influence of Increased Salt Stress on Correlations between Different Attributes of Rice

MOHAMMAD SIDDIQUE SAJJAD
Nuclear Institute for Agriculture & Biology,
P. O. Box No. 128 Jhang Road,
Faisalabad, Pakistan.

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ABSTRAK

Dua puluh empat genotip padi telah ditanam di bawah keadaan tegasan garam, iaitu dalam bekas yang mengandungi garam. Hubungan di antara ciri-ciri yang berbeza telah ditafsirkan secara berasingan bagi tiap-tiap tegasan garam. Hubungan yang berbeza telah dapat diperhatikan di mana kenaikan tegasan garam akan mempengaruhi sifat hubungan tersebut. Ciri beberapa bijian bagi tiap-tiap panikel dan kesuburan panikel menunjukkan hubungan positif yang bererti dengan hasil tiap-tiap tanaman, dalam keadaan tegasan garam yang tertinggi. Ciri-ciri seperti ini boleh digunakan sebagai penunjuk pilihan bagi toleransi garam.

ABSTRACT

Twenty four rice genotypes were grown under salt stress conditions, in the artificially salinized cemented field basins. The correlations between different attributes were computed separately for each salt stress. Different inevitable correlations were observed, but increased salt stress affected the magnitude of these correlations. The attributes of number of grains per panicle, total florets per panicle and panicle fertility showed very highly significant positive correlations with yeild per plant under the highest salt stress. Such attributes may be utilized as the selection indices for salt tolerance.

INTRODUCTION

Studies pertaining to influence of increased salt stress on yield and yield components will enhance our understanding of plant growth and development under saline environmental niche. Such information may be helpful in the work to harness the saline and saline sodic soils for economical crop production. Several workers have discovered that salt stress (Bhattacharyya, 1981; Campbell *et al.*, 1980; Giriraj, 1980; Shakoor *et al.*, 1978) and different environments (Adam, 1967; Guartero and Cubero, 1982; Rasmusson and Cannel, 1970) may have significant control on component relationships in crop plants (rice, barley, wheat, field bean and tomatoes). The information regarding the influence of increased salt stress on correlations between different plant attributes is very scanty in rice (Bhattacharyya, 1981). Keeping this objective in view, the present study was conducted to observe any influence on correlations among plant attributes under increased salt stress.

MATERIALS AND METHODS

Twenty four rice strains both of exotic and local origin (Table 1) were grown in normal as well as under four saline-sodic conditions during 1981 – 82. Saline-sodic levels were developed artificially by mixing four commercial salts i.e. magnesium sulphate, sodium chloride, calcium chloride and sodium sulphate in the ratio of 1:4:5:10 respectively. These salts are predominantly present in the saline sodic soils of

TABLE 1
The rice genotypes with their origins used in the study

S. No.	Genotypes/crosses	Country of origin	S. No.	Genotypes/crosses	Country of origin
1.	Basmati 370	Pakistan	13.	Getu mutant	India
2.	Jhona 349	Pakistan	14.	H33	India
3.	NIAB Rice 1	Pakistan	15.	Giza 159	Egypt
4.	NIAB Rice 3	Pakistan	16.	IR4711-34-2-3 IR1905-72/ IR1561-288// IR2061-464	IRRI, Philippines
5.	CSR 1	India	17.	IR4432-28-5 IR2061-125-37/ CR94-13	IRRI, Philippines
6.	KI 9-1	India	18.	IR4462-22A-2-10 Pokkali/IR2061-464-2	IRRI, Philippines
7.	KI 14-1	India	19.	IR5853-162-1-2 Nam Sagui 19/ IR2071-88// IR2061-214	IRRI, Philippines
8.	Getu	India	20.	IR8608-125-3-3 IR2061-465-1-5-45/ IR2071-625-1	IRRI, Philippines
9.	C23-3-1	India	21.	IR9732-119-3 BG34-8/IR2071-625// IR2071-625-1-252	IRRI, Philippines
10.	Pattambi 25333	India	22.	IR1529-430-3 IR305-3-17-1-3/ IR661-1-140-3	IRRI, Philippines
11.	Pattambi 25335	India	23.	IR4630-22-2-5-1-2 Pelita 1-1/ Pokkali/IR2061-464-2/ IR1820-52-2	IRRI, Philippines
12.	Pattambi 25336	India	24.	IR6	Pakistan

Pakistan. Six soil analyses from a monthly interval were taken from the saline cemented field basins and were analysed for different parameters. The average of these six analyses are presented in Table 2. The desired salt stress in the field basins was further achieved by irrigating the basins with tubewell water (saline sodic) with EC_w w3.5, containing T.S.S. 35, HCC3:17.5, $Ca^{++} + Mg^{++}$: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 saline field basins. The design of the experiment was split plot with four replications. Single seedling per hill in a 6 m long row with 20 × 20 cm ear-to-plant distance was transplanted.

Twenty plants per replication for each strain were radomly selected for recording

TABLE 2
Different saline sodic levels and other chemical properties of field basins

Salt stress	EC dS/m^2 at 25°C	T.S.S.	pH	Ca^{++} $+ Mg^{++}$ meq/L	Na^{+} meq/L	E.S.P.
S_1 Control	2.2	22.0	8.1	7.6	24.8	15.0
S_2	4.8	47.9	8.8	4.4	77.7	44.0
S_3	6.6	65.6	8.8	5.7	95.3	46.0
S_4	8.4	83.3	9.0	4.3	124.3	53.0
S_5	9.2	92.2	9.0	4.8	127.2	56.0

various observations. Data on plant height and number of productive tillers per plant were recorded in the field on maturity of the crop. Data on various spike characters were recorded on the main panicle of each plant in the laboratory. The data were statistically analysed and coefficients of correlation were computed among various plant attributes from the crop grown under different saline sodic conditions.

RESULTS AND DISCUSSION

The data pertaining to the influence of increased saline sodic conditions on the correlations between yield and yield components of different rice genotypes are presented in Table 3.

Plant Height

It is evident from the table that plant height showed highly significant negative correlations with number of productive tillers per plant under the two salt stresses of 15 and 46 ESP, while the two attributes showed very highly significant negative correlations under 44, 53 and 56 ESP salt levels. Plant height showed very highly significant positive correlations with panicle length under 15, 44, 53 and 56 ESP salt stresses, with the exception of 46 ESP, where the two traits were highly significant.

Number of Productive Tillers per Plant

Number of productive tillers per plant had no correlations with any plant attribute under all the saline environments.

Panicle Length

Panicle length showed highly significant positive correlations with number of primary branches per panicle under the salt stresses of 44, 46 and 53 ESP. However, the two attributes showed very highly significant positive correlations under normal environment and under the maximum salt stress of 56 ESP.

Number of Primary Branches per Panicle

Number of primary branches per panicle showed very highly significant positive correlations with number of grains per panicle under all the environments. Number of primary branches per panicle showed very highly significant positive correlations between number of total florets per panicle under all the environments except under the maximum salt stress of ESP 56. The attributes also showed highly significant positive correlations with yield per plant under the salt stresses of 44 and 56 ESP. The two attributes, however, showed very tight association under the salt stresses of 15, 46 and 53 ESP.

TABLE 3
Influence of different salt stress on correlations among yield and yield components in rice

Name of character	Salt stresses	No. of productive tillers/plant	Panicle length	No. of primary branches/ panicle	No. of grains/panicle panicle	No. of total florets per panicle	Panicle fertility percent	Yield (g)
Plant height	S1	−0.401*	0.793**	0.148	0.330	0.175	0.393	0.051
	S2	0.828**	0.663**	0.024	0.263	0.004	0.227	0.068
	S3	0.407*	0.483*	0.020	0.378**	0.049	0.229	0.230
	S4	−0.530**	0.591*	0.129	0.368	0.183	0.384	0.039
	S5	−0.526**	0.648**	0.032	0.398	0.112	0.359	0.088
No. of productive tillers/plant	S1		−0.232	−0.335	0.173	−0.330	−0.035	0.023
	S2		−0.038	−0.062	0.343	−0.051	−0.008	0.299
	S3		−0.060	−0.118	0.239	−0.096	−0.012	0.031
	S4		−0.023	−0.166	0.289	−0.025	−0.014	0.015
	S5		−0.279	−0.099	0.138	−0.304	−0.002	0.358
Panicle length	S1			0.832**	0.365	0.250	0.189	0.379
	S2			0.435*	0.262	0.175	0.259	0.151
	S3			0.458*	0.034	0.312	0.363	0.030
	S4			0.460*	0.188	0.391	0.396	0.160
	S5			0.556**	0.019	0.260	0.246	0.070
No. of primary branches per panicle	S1				0.580**	0.828**	0.147	0.698**
	S2				0.585**	0.680**	0.121**	0.439**
	S3				0.709**	0.704**	0.004	0.759**
	S4				0.690**	0.730**	0.395	0.549**
	S5				0.870**	0.490*	0.088	0.417*
No. of grains/ panicle	S1					0.853**	0.635**	0.760**
	S2					0.892**	0.467*	0.622**
	S3					0.828**	0.589**	0.402*
	S4					0.926**	0.536**	0.484*
	S5					0.937**	0.555***	0.642**
No. of total florets/panicle	S1						0.845**	0.773**
	S2						0.409*	0.629**
	S3						0.464*	0.403*
	S4						0.588**	0.645**
	S5						0.412*	0.640**
Panicle fertility %	S1							0.496*
	S2							0.549**
	S3							0.538**
	S4							0.528**
	S5							0.572**

Number of Grains per Panicle

Number of grains per panicle showed very highly significant positive correlations with number of total florets per panicle under all the salt stresses. Number of grains per panicle also showed very highly significant positive correlations with panicle fertility percent under all the saline environments except under the salt stress of 44 ESP. The correlations between number of grains per panicle and yield per plant were highly significant and positive under the salt stresses of 46 and 53 ESP. However, the two attributes showed very highly significant positive correlations under 15, 44 and 56 ESP.

Number of Total Florets per Panicle

Number of total florets per panicle showed highly significant positive correlations under the salt stresses of 44, 46 and 56 ESP, and the two attributes showed very highly significant positive correlations under the salt stresses of 15 and 53 ESP. Number of total florets per panicle showed very highly significant positive correlations with yield per plant under all the salt stresses except the salt stress of 46 ESP.

Panicle Fertility Percent

Panicle fertility percent showed highly significant positive correlation with yield per plant under the minimum salt stress of 15 ESP, and the two attributes showed very highly significant positive correlations under all the remaining salt stresses of 44, 46, 53 and 56 ESP.

It is evident from the results of the present study that most of the correlations were modified by different salt levels. The sensitivity of correlations among plant attributes by different environments (Adams, 1967; Cuartero and Cubero, 1982; Rasmusson and Cannel, 1970) as well as by saline environments (Bhattacharyya, 1981; Giriraj *et al.*, 1980; Shakoor *et al.*, 1978) has also been reported. The modifying influence of salt stresses on correlations between plant attributes, did not follow any preditable or clear pattern from low to high salt stress.

The situation most favourable to stress breeder will be one in which the correlations among plant attributes and yield are positive and very highly significant under the highest salt stress. Such very highly significant positive correlations have been observed for plant attributes of number of grains per panicle, total number of florets per panicle and panicle fertility percent. Such plant attributes have been advocated to be used as selection indices for salt tolerance (Bhattacharyya 1981; Giriraj *et al.*, 1980; Shakoor *et al.*, 1978). On the contrary, the attributes showing strong association with yield per plant have been considered ineffective to improve yield under salt stress (Campbell *et al.*, 1980) and has not been utilized to accomplish selection for drought tolerance (Fischer *et al.*, 1981). However, such plant attributes have been emphasised for further weighting in overall selection index (Schwarzbach, 1976).

CONCLUSION

No consistant change of sign and value of coefficients of correlation as a function of salinity level was observed. Therefore no plant attributes may be suggested as a suitable selection index for salt tolerance.

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