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Screening of Chickpea Genotypes for Salinity Tolerance During Germination and Early Seedling Growth

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ABSTRACT

Fifty-eight genotypes of chickpea were evaluated in laboratory under two simulated environments created by applying Hoagland solution (EC 1.8 dSm^{-1}) for normal condition and Hoagland solution + NaCl (Ec 8.0 dSm^{-1}) for salinity condition. The genetic differences were highly significant for all characters under both conditions. Grouping of genotypes on the basis of reduction in germination and seedling growth traits under salinity revealed that the genotypes JCP 27, K 850, AKG 46, DGM 1044, JCP 125, BDNG 154, ICCC 4, BKG 45, NDG 861, H-89-11-1, EC 5183, JCP 89 and GNG 752 were salinity tolerant and genotypes RSG 514 was sensitive and performed poorly under salinity condition.

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INTRODUCTION

Early stages of plant growth are most critical as later development and crop production depends on effective germination and early seedling growth. Thus, it could be ideal to study the decrease caused in these parameters due to salinity in comparison to normal conditions. Legumes as a group are very sensitive to salinity and chickpea (*Cicer arietinum* L.) is one of the most sensitive crop to salinity (Johansen, 1984). However, the present study was conducted to generate informations of the relative tolerance of different genotypes of chickpea to salinity. Selection models based on the existance of variability may be proposed even in a susceptible crop like chickpea.

MATERIALS AND METHODS

Fifty-eight genotypes of chickpea were selected for the present study. Genotypes were evaluated at two levels of salinity namely control (EC 1.8 dSm^{-1}) and salinity (EC 8.0 dSm^{-1}) created by the addition of 0.0 g NaCl and 3.621 g NaCl to a litre of Hoagland solution, respectively. The composition of Hoagland solution as suggested by Johnson *et al.*, (1957) was used. The genotypes were germinated and maintained as per the following procedure.

The germination sheets were used for germination of the genotypes. The sheets which had folds of 2.5 cm to form ridges and furrows were first sterilized in oven at 60°C for

24 hours. One sterilized germination sheet was spread on each of 16 enamal trays (46 x 30 x 7 cm) which were previously sterilized with 70% ethanol. The seeds were surface sterilized with 0.2% mercuric chloride for 30 minutes followed by thorough washing with sterile distilled water. Twenty-five sterilized seeds of each genotype were placed in the forrows of the germination sheet treating as one replication. Whole set was replicated thrice, using CRD.

For complete germination, trays were continuously kept covered with moistened sheets, using corresponding solutions, and were kept under darkness for the first 3 days at 25°C ± 2°C. The trays were then exposed to natural light for 10 hours duration. Each day, each tray was irrigated with respective solution of 10 ml. for first 5 days 15 ml. for 2nd 5 days and 20 ml. for remaining 6 days.

The germination count was recorded each day, upto 4th day. Only such seeds which showed redicle emergence through the protuded inner coat were taken into account for calculating per cent seed germination. After 4 days, out of 25 seeds, 15 germinated seeds from each genotype/treatment/replication were kept for studying seedling growth parameters, namely shoot length (cm), root length (cm), number of leaves/seedling, number of leaflets/seedling, root fresh weight (g) and shoot fresh weight (g) which were recorded on 10 seedlings after 20 days. Shoot dry weight (g) and root dry weight (g) were recorded after drying the seedlings at 70°C for 2 days in oven.

Fifty-eight genotypes were categorised as tolerant (0-30% reduction), semi-tolerant (30-70% reduction) and sensitive (> 70% reduction) according to the per cent decrease under salinity condition as compared to normal for different traits under study.

RESULTS AND DISCUSSION

The analysis of variance showed significant differences among the genotypes for all the characters studied under both environments. It indicated wide variation amongst chickpea genotypes under normal as well as salinity conditions. The phenotypic range of per cent decrease in salinity condition was wider for all the character except shoot length (15.4 to 74.7%) where it was moderate. The lowest and highest mean per cent decrease in salinity condition was observed for number of leaves per seedling (36.3%) and root dry weight (48.7%), respectively (Table 1). Similar findings were also reported for various traits in chickpea (Goel and Varshney, 1987; Maliwal and Paliwal, 1982 and Yadav *et al.,* 1989).

Among all the genotypes (Table 1), six genotypes viz. JCP 27, K 850, AKG 46, DGM 1044 and BDNG - 154 were found tolerant to salinity for germination percentage and all the eight growth characters, except DGM 1044 for number of leaflets per seedling; BDNG 154 for germination percentage and JCP 125 for root fresh weight.

Genotypes JCP 27, AKG 46, K 850, JCP 125 and BDNG 154 were registered as salinity tolerant for shoot length, root length, leaves/seedling (except BDNG 154), shoot fresh weight (except JCP 125 and BDNG 154), root fresh weight (except JCP 27 and JCP 125), shoot dry weight and root dry weight (except JCP 125 and DGM 1044). While DGM 1044 was observed salinity tolerant for germination percentage alongwith shoot and root length and its fresh and dry weight (except root

TABLE 1

Genotypes showing less reduction (< 30%) under salinity stress in comparison to normal environment for different characters.

	Germination (%)	*Shoot length (cm)*	*Root length (cm)*	*Leaves/ seedlings*	*Leaflets/ seedling*	*Shoot fresh weight (g)*	*Root fresh weight (g)*	*Shoot dry weight (g)*	*Root dry weight (g)*
Overall mean	37.5	45.0	41.5	36.3	36.5	42.7	44.6	47.0	48.7
Range	03.0 to 80.0	15.4 to 74.7	04.6 to 74.7	03.2 to 65.9	00.5 to 73.3	01.0 to 74.6	005.7 to 85.7	02.8 to 83.7	02.7 to 87.0
Best 10 genotypes showing minimum reduction (< 30%)	DGM-285 (3.0)	JCP-27 (15.4)	AKG-46 (4.6)	K-850 (3.2)	BG-385 (0.5)	DGM-1044 (1.0)	EC-5183 (5.7)	JCP-125 (2.8)	BDNG-154 (2.7)
	ICCC-4 (8.8)	PG-88-6 (15.5)	JCP-27 (10.5)	JCP-89-1 (10.0)	K-850 (1.0)	JCP-141 (8.1)	GNG-752 (7.4)	PG-88-6 (6.1)	GNG-752 (8.4)
	Dohad yellow (15.6)	K-850 (19.8)	EC-5183 (10.8)	BG-385 (11.1)	JCP-27 (4.3)	JCP-27 (11.1)	K-850 (9.2)	DGM-1044 (7.1)	K-850 (10.8)
	BCP-41 (16.2)	BDNG-154 (20.1)	NDG-8601 (16.9)	H-89-11-1 (13.8)	RSG-286-1 (7.4)	AKG-46 (20.4)	AKG-46 (14.1)	JCP-27 (8.5)	JCP-27 (11.0)
	DGM-1044 (18.1)	JCP-125 (21.1)	JCP-124 (17.4)	JCP-125 (14.0)	NDG-8601 (10.7)	BKG-45 (21.0)	JCP-141 (17.3)	ICCC-4 (14.7)	NDG-8601 (11.4)
	H-89-11-1 (18.1)	Chaffa (23.5)	K-850 (18.2)	DCP-8 (14.2)	H-89-11-1 (14.9)	K-850 (22.5)	DGM-352 (18.9)	BDNG-154 (15.7)	BG-360 (15.4)
	Chaffa (18.1)	AKG-5173 (23.8)	EC-5173 (19.9)	764-594 (14.3)	PG-88-6 (17.4)	Chaffa (24.6)	JCP-271 (19.3)	AKG-46 (21.1)	JCP-188 (16.3)

Germination (%)	*Shoot Length (cm)*	*Root length (cm)*	*Leaves/ seedlings*	*Leaflets/ seedling*	*Shoot fresh weight (g)*	*Root fresh weight (g)*	*Shoot dry weight (g)*	*Root dry weight (g)*
EC-5183 (19.0)	JCP-124 (24.5)	BDNG-154 (20.6)	JCP-27 (14.4)	Saradpuri (17.9)	BM-76 (25.5)	DGM-1044 (20.5)	ICCV-10 (22.8)	AKG-46 (18.6)
JCP-89-1 (19.9)	DGM-1044 (24.6)	JCP-125 (21.4)	EC-6617 (16.6)	AKG-46 (18.7)	H-89-11-1 (27.7)	ICCV-10 (20.7)	JCP-39 (25.4)	EC-5183 (19.0)
DCP-8 (20.4)	BG-360 (26.4)	DGM-1044 (22.6)	AKG-46 (16.8)	JCP-125 (19.4)	GNG-752 (28.7)	BDNG-154 (23.1)	K-850 (25.8)	ICCC-4 (20.2)

Values in parenthesis indicate the % reduction under salinity as compared to normal condition.

dry weight). The genotype EC 5183 showed less than 30% reduction for the germination per cent, root length, root fresh weight and root dry weight under salinity condition. The other widely adapted varieties which found tolerant at germination stage were ICCC 4, Dohad yellow and Chaffa. These genotypes may perform better under salinity areas of Bhal and Ghad regions of the Gujarat State due to higher germination rate which will result in better plant population at initial stage.

In this investigation genotypes JCP 27, AKG 46, K 850, JCP 125 and BDNG 154 were found most promising for salinity tolerant on the basis of seedling growth parameters. The genotype DGM 1044 was observed salinity tolerant for the germination percentage and other seedling growth parameters. The cultivars ICCC 4, Dohad yellow and Chaffa were found better salinity tolerant at germination stage. These genotypes could be utilized in further breeding programme to develop chickpea varieties tolerant to salinity.

REFERENCES

Chandra, S. 1980. Effect of edaphic factors on chickpea. In : Prodcd of the International workshop on chickpea improvement, 28 Feb.-2 March 1979, pp. 97-105.

Goel, S. N. and Vashney, K. A. 1987. Note on seed germination and early seedling growth of two chickpea variety under saline conditions. *Legume Res.* **10** : 34-36.

Johansen, C. 1984. Mechanism of salt tolerant and their relevance. In : Adaptation of chickpea and pigeonpea to abiotic stress. Proc. of the consultants workshop held at ICRISAT Centre, India, 19-21 Dec. 1984, pp. 109-113.

Johnson, C. M., Stout, P. R., Broyer, T. C. and Carlton, A. B. 1957. Comparative chlorine requirements of different plant species. *Plant and Soil* **8** : 337-353.

Maliwal, G. L. and Paliwal, K. V. 1982. Salt tolerance of gram and linseed varieties at germination and seedling stage of growth. *Curr. Agric.* **6** : 79-83.

Yadav, H. D., Yadav, O. P., Dhankar, O. P. and Oswal, M. G. 1989. Effect of chloride salinity and boron on germination growth and mineral composition of chickpea. *Ann. Arid. Zone.* **28** : 63-78.