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Evaluation of Salt Tolerance of Different Groundnut (*Arachis hypogaea*) Genotypes

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ABSTRACT

A green house experiment in big galvanized pots (75 cm × 60 cm × 30 cm) containing 120 kg calcareous black clay soil was conducted to evaluate the salt tolerance of four spreading (GAUG-10, GG-11, Punjab-1 and M-13), two semi spreading (Robaurt G-201) and four bunch (GAUG-1, GG-2, JL-24 & J-11) genotypes of groundnut using four levels (ECe 2, 4, 8 and 12 dSm^{-1}) of salinity.

The results showed that as the salinity levels increased the germination count, plant height and pod and haulm yield decreased significantly but reverse was true in case of Na/K ratio. The varieties JL-24 (bunch), Robaurt (semi spreading) and GG-11 (spreading) showed better performance at all salinity levels than the other varieties in their respective groups.

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INTRODUCTION

Groundnut is the most important oil seed crop in Gujarat in general, and in Saurashtra in particular with 66 per cent of salt affected soils of the State (Patel *et al.*, 1988). Groundnut crop has been reported to be salt sensitive (Bhumbla *et al.*, 1968), however the limit of salt tolerance would depend on nature of ionic species, crop species, stage of growth, environmental factors and physico-chemical properties of a soil. Some farmers in the region do grow groundnut in the salt affected soils. Information on relative performance of commonly cultivated varieties of groundnut in respect to their such tolerance is lacking. This paper reports the results of a green house study on this aspect.

MATERIALS AND METHODS

A green house study in big galvanized iron pots (75 cm x 60 cm x 30 cm) containing 120 kg calcareous medium black clay soil (vertisol) was conducted during kharif 1985 to evaluate the relative salt tolerance of four spreading (GAUG-10, GG-11, Punjab-1 and M-13), two semi spreading (Robaurt, G-201) and four bunch (GAUG-1, GG-2, JL-24 and J-11) genotypes of groundnut usnig four levels of salinity (ECe viz., S_0=2.0, S_1=4.0, S_2=8.0 and S_3=12.0 dSm^{-1}) in a completely randomized design with two replications. The soil was clay in texture having pH=8.0, ECe=1.05 dSm^{-1}, $CaCO_3$=19.5%, Organic carbon=0.75%, Olsen's available P=12.4 kg/ha and available K=323 kg/ha. The saline

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waters 4.0, 8.0 and 12.0 EC dSm^{-1} were prepared by dissolving sulphate and chlorides of Na: Mg and Ca so as the ratio of Na : Mg : Ca was maintained at 15:2:1 and of Cl. : SO_4 at 2:1. The calculated amount of N and P as urea and diamonium phosphate was applied in furrow per pot as basal @ 25 kg N and 50 kg P_2O_5/ha. Following this, 20 seeds of each varieties were sown in line (60 cm) in each pot and they were covered with the soil. Fourty two litres of solution of different salt concentrations as per the treatments were applied uniformly in each pot in order to attain slightly at higher moisture (35%) than that of field capacity. The soil was allowed to attain equilibrium for 48 hours and then it was checked whether the desired salinity (EC) of the soil was attained or not. The soil moisture content in the pots was maintained within 80-100% of available water through out the growth period by adding distilled water. However, soil salinity levels (2, 4, 8 & 12 ECe dSm^{-1}) of the pots as per treatments were maintained constant throughout the crop growth by irrigating them with respective saline waters whenever required. The cultural practices like hand weeding and digging were also carried out uniformly to all the pots as and when required. A week after sowing, the daily germination count was recorded but the final count was considered fifteen days after sowing. Finally 10 seedlings for bunch and 7 for spreading and semi-spreading varieties were allowed to grow up to maturity. Plant hight and pod and haulm yield at harvest were recorded. The soil analysis was carried out by the sandard methods as described by Richards (1954) whereas, plant analysis for Na and K was performed as per the methods described by Jackson (1973).

RESULTS AND DISCUSSION

Effect on Germination : The periodic germination count showed that the germination of groundnut seed started from 6th day and continued up to 15th day. As salinity increased, the germination decreased drastically. The germination was almost 85% with non-saline pots (2 ECe dSm^{-1}) and 53% with highest salinity level (ECe 12.0 dSm^{-1} after 15th day of sowing (Table-1). The salt concentration at 8 dSm^{-1} and above showed inhibitory effect and markedly decreased the germination. The results are in accordance with those reported by Shalhevet *et al.* (1969) and Paliwal and Maliwal (1982). Significantly the highest final mean germination percentage of 72.5 was recorded with three varieties viz. JL-24 > GAUG-10 and Punjab-1, over the rest varieties except GG-11 and J-11 which were at par.

Significant interacting effect between salinity and variety in respect to germination was absent.

Effect on Plant Height : The data in Table-1 showed that as the salinity levels increased, the plant height decreased significantly. Similar observations were also made by Reddy *et al.* (1982) and Paliwal and Maliwal (1982). Among all the varieties, the maximum plant height (25.8 cm) was recorded with the variety JL-24, however, the minimum plant height was of GG-2 (18.9 cm) variety. GAUG-10 variety was at par with JL-24 for plant height.

The plant height was significantly affected by interaction of salinity and variety. The highest plant height of 35.5, 33.0 and 16.0 cm was recorded with variety JL-24 in control, 4.0 and 12.0 ECe dSm^{-1} levels respectively, however GAUG-10 recorded significantly highest height at salinity levels of dSm^{-1}. Among all the combinations, the lowest plant height of 10.5 cm was noted with variety G-201 at highest salinity level (ECe 12.0 dSm^{-1}).

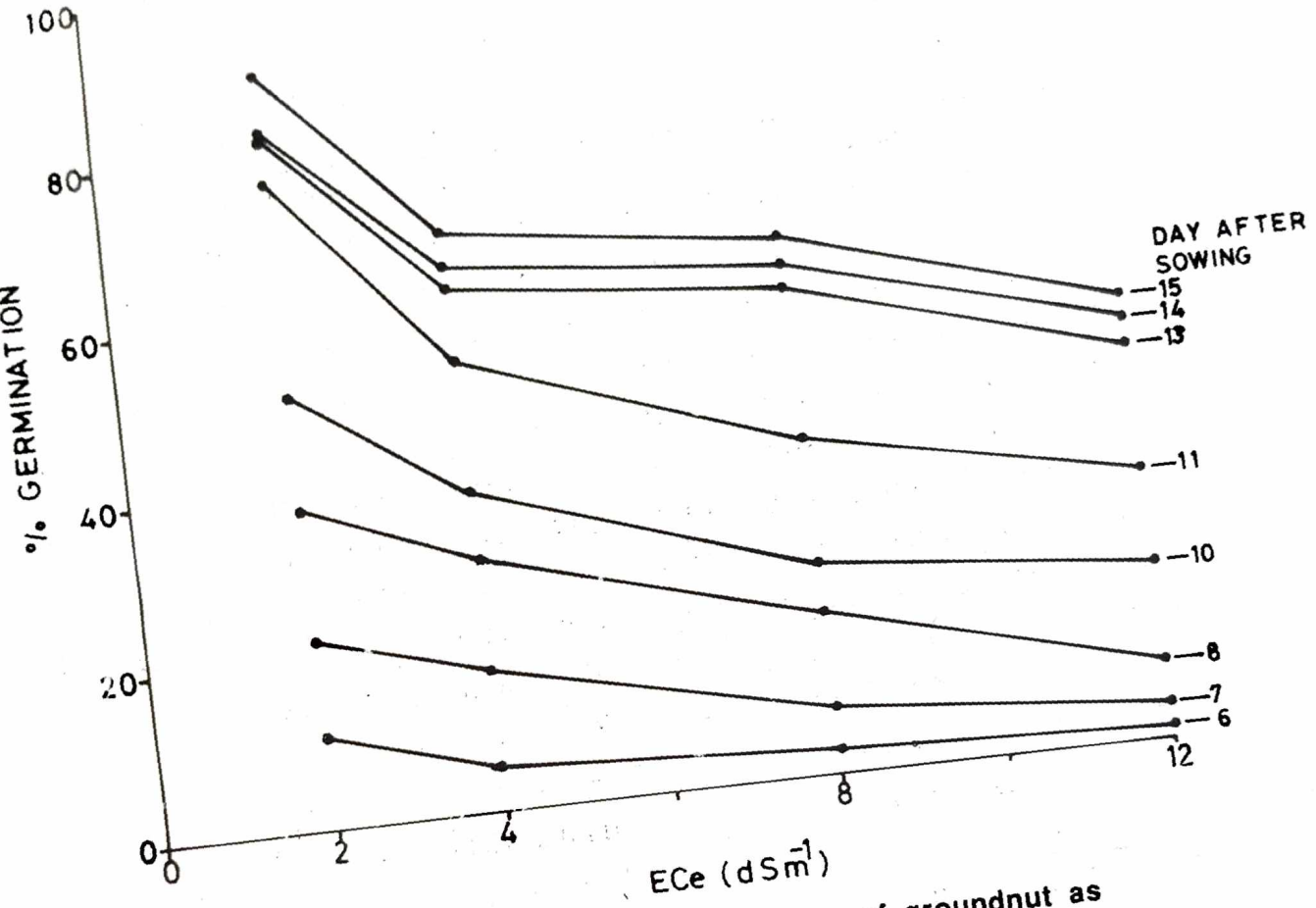


Fig. 1 : Periodic germination of groundnut as influenced by salinity levels

Effect on pod and haulm yield: Irrespective of varieties, as the salinity increased (4, 8 and 12 ECe dSm^{-1}) the pod (28, 66 ad 83%) and haulm(18, 51 and 68 per cent) yield also decreased significantly. The similar results were also reported by Reddy *et al.* (1981). Irrespctive of salinity, the highest mean pod yield was recorded with Robaurt (4.12 g $plant^{-1}$) followed by JL-24 (4.10 g $plant^{-1}$) and GG-11 (4.07 g $plant^{-1}$). These three varieties were at par with each other in their performance, but were significantly superior to the rest of the varieties. The highest haulm yield was recorded with variety GAUG-10 (11.0 g $plant^{-1}$), followed by M-13 (10.9 g $plant^{-1}$) and GG-11 (10.7 g $plant^{-1}$) which were at par with each other but were significantly superior to the rest of the cultivars. Reddy *et al.* (1982) reported a significant reduction in groundnut yield when the crop was irrigated with water having EC of 4 dSm^{-1} and no yield with water of EC 16 dSm^{-1}.

At salinity levels of 8.0 and 12.0 dSm^{-1} ECe, the reduction of 36.5 and 56.6 per cent in haulm was observed with M-13, of 40.0 and 54.0 per cent with JL-24, of 43.0 and 64.4 per cent with Robaurt and of 44.0 and 65.0 p

TABLE 1

Effect of salinity levels on germination percentage, plant height and pod and haulm yield of different groundnut varieties.

Varieties	Salinity level (dSm^{-1})					Salinity levels (dSm^{-1})				
	Control	4.0	8.0	12.0	Mean	Control	4.0	8.0	12.0	Mean
	Germination (%)					**Plant height (cm)**				
GAUG-10	87.5	82.5	65.0	55.0	72.5	29.5	29.5	25.0	13.0	24.3
GG-11	87.5	72.5	67.5	55.0	70.6	26.5	26.5	20.5	14.0	22.1
Punjab-1	90.0	72.5	70.0	57.5	72.5	31.5	29.5	21.0	12.5	23.6
M-13	82.5	67.5	65.0	52.5	67.5	26.5	21.5	16.0	12.5	19.1
Robaurt	80.0	62.5	57.5	47.5	61.8	27.0	27.5	19.0	13.5	21.8
G-201	77.5	62.5	55.0	50.0	61.3	28.0	25.0	16.0	10.5	19.9
GAUG-1	80.0	60.0	55.0	50.0	61.3	29.0	26.5	14.0	12.0	20.4
GG-2	85.0	65.0	62.5	52.5	66.3	23.0	23.5	17.5	11.5	18.9
JL-24	90.0	75.0	72.5	52.5	72.5	35.5	33.0	18.5	16.0	25.8
J-11	90.0	72.5	70.0	52.5	71.2	29.0	30.0	16.0	15.0	22.5
Mean	85.0	69.3	64.3	52.5	-	28.7	27.3	18.4	13.1	-
C. D. @ 5%	S=2.5	V=4.0	S x V=NS			S=0.5	V=2.0	V x S=3.5		
	Pod yield g. plant^{-1}					**Haulm yield g. plant^{-1}**				
GAUG-10	7.03	5.37	2.05	1.00	3.86	16.9	14.1	8.1	4.8	11.0
GG-11	7.20	5.22	2.50	1.36	4.07	15.2	13.6	8.5	5.3	10.6
Punjab-1	6.30	5.02	1.90	0.90	3.54	15.3	12.9	7.3	5.0	10.0
M-13	7.52	4.68	2.29	1.21	3.93	14.5	13.5	9.2	6.3	10.9
Robaurt	6.76	5.23	2.90	1.58	4.12	14.9	13.3	8.5	5.3	10.5
G-201	5.90	5.05	1.73	0.72	3.35	14.0	9.3	6.2	4.5	8.5
GAUG-1	6.40	3.75	1.33	0.42	2.97	14.8	8.4	4.4	1.6	6.3
GG-2	6.80	3.88	1.39	0.38	3.11	11.8	8.0	2.9	1.5	6.0
JL-24	6.00	5.00	3.50	1.90	4.10	10.5	9.5	6.3	4.8	7.8
J-11	6.25	4.65	2.95	1.50	3.84	11.3	9.0	4.8	3.8	7.2
Mean	6.62	4.78	2.25	1.10	-	13.5	11.1	6.6	4.3	-
	--	(28.0)	(66.0)	(83.0)	--	--	(18.0)	(51.0)	(68.0)	--
C. D. @ 5%	S=0.18	V=0.41	SxV=0.58			S=0.24	V=0.38	SxV=0.75		

Note : Figures in parentheses indicate the percentage over control.

TABLE 2

Relative salt tolerance of groundnut varieties based on the pod yield.

Varieties	*Mean pod yield (g plant^{-1})*	*Reduction at ECe 12.0 dSm^{-1} over control (%)*	*Mean salinity index (%)*	*Critical limits of salinity levels for yield reduction*			*Regression of yield (y) on salinity (x)*
				25(%)	*50(%)*	*75(%)*	
				--------(EC dSm^{-1})----------			
GAUG-10	2.80	85.8	39.92	4.9	7.5	10.1	Y=7.88-0.618X (r= - 0.964)
GG-11	3.04	80.5	42.22	4.9	7.8	10.6	Y=7.84-0.580X (r= - 0.970)
Punjab-1	2.60	85.7	41.27	4.6	7.3	10.0	Y=7.18-0.561X (r= - 0.973)
M-13	2.73	83.9	36.20	4.7	7.5	10.2	Y=7.83-0.600X (r= - 0.947)
Robaurt	3.20	76.6	47.37	5.1	8.2	11.4	Y=7.47-0.516X (r= - 0.985)
G-201	2.50	87.8	42.37	4.6	7.2	9.9	Y=6.94-0.553X (r= - 0.974)
GAUG-1	1.83	93.4	28.61	4.4	6.8	9.2	Y=6.70-0.574X (r= - 0.947)
GG-2	1.88	94.4	27.70	4.4	6.8	9.2	Y=7.08-0.612 X (r= - 0.946)
JL-24	3.47	68.3	57.77	5.7	9.3	13.0	Y=6.72-0.403X (r= - 0.991)
J-11	3.05	76.9	46.66	5.2	8.4	11.7	Y=6.82-0.459X (r= - 0.979)

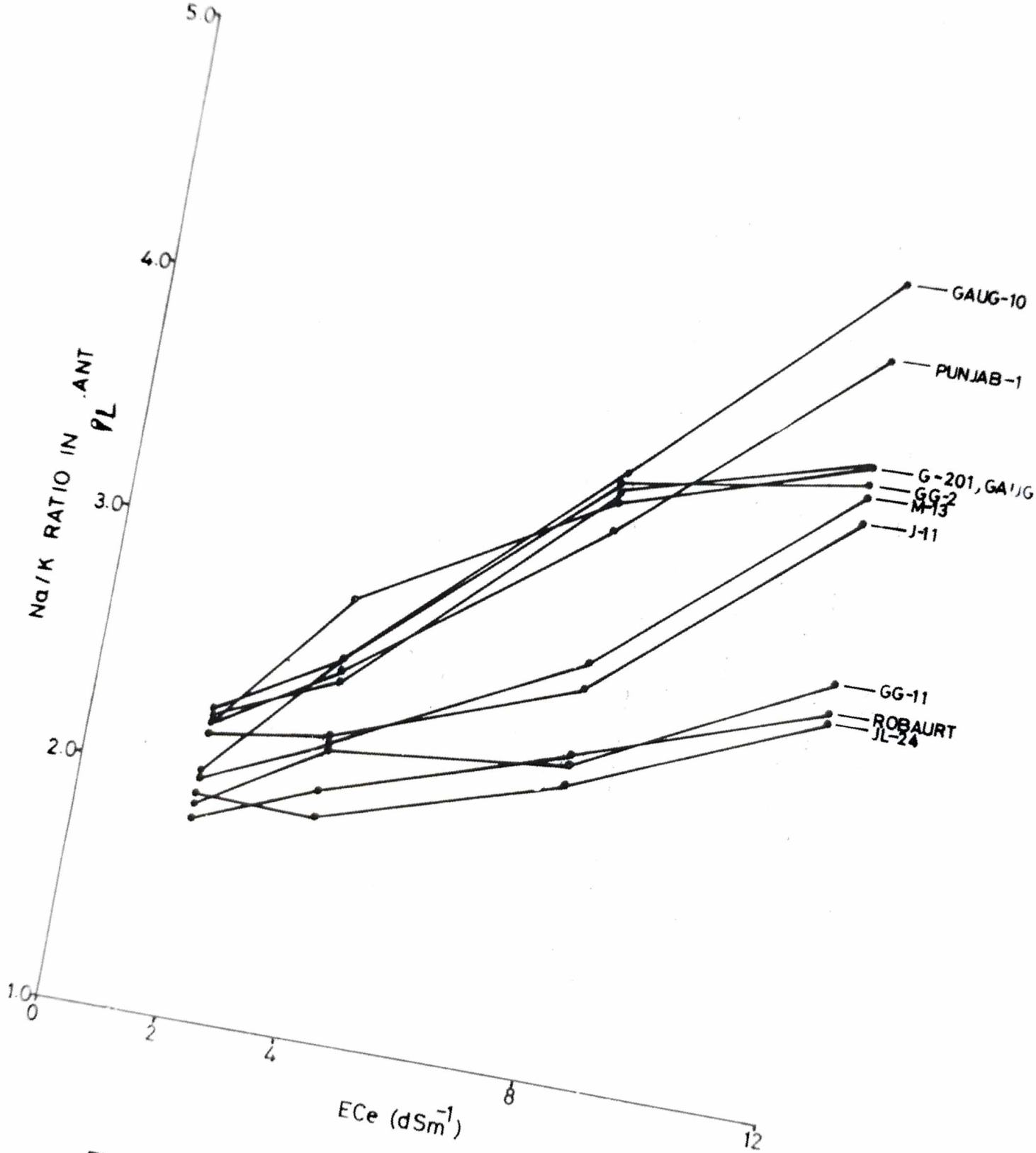


Fig. 2 Effect of salinity levels on Na/K ratio in plant.

cent with GG-11, respectively while in case of pod yield it was in the order of JL-24 > Robaurt > GG-11 at 8.0 and 12.0 ECe dSm^{-1}. The remaining varieties recorded the reduction in yield more than 80 per cent at all the salinity levels. The results are in agreement with those of Shalhevet (1969), Aljibury and Talabany (1982) and Reddy *et al.* (1982). The varieties JL-24, Robaurt and GG-11 showed the 50 per cent decline in yield at the ECe values of 9.3, 8.2 and 7.8 dSm^{-1}, respectively (Table 2). Strikingly, these varieties exhibited least magnitudes of regression slope (Table 2).

Effect on Na/K ratio : sodium to potassium ratio in haulm has been found to be sauitable parameter to adjudge relative salt tolerance. The lower the value of Na/K ratio in the crop, the higher its ability to tolerate salinity (Joshi *et al.*, 1980). The varieties JL-24, Robaurt and GG-11 have lower Na/K ratio than all the other varieties at all salinity levels (Fig. 2) However values of Na/K ratio significantly increased with increased salinity levels. These three varieties gave higher yield with low Na/K ratios.

The foregoing discussion revealed that the bunch variety JL-24 recorded values of different salt tolerance criteria like mean salinity index (57.77) yield decline in high salinity levels and ECe dSm^{-1} for 50 per cent yield decline (9.3) and minimum for the index of reduction at 12 dSm^{-1} (68.3).

The Rabourt stood second (semi spreading) and GG-11 (spreading) third in their performance in respect of these indices having values of a lower regression slope. The yields of these varieties are least sensitive to salinity levels.

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