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Salt Tolerance of Gram (*Cicer arietinum*) Genotypes at Germination and Seedling Stage

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The early stages of plant growth are most critical as later development and crop production depend of germination and seedling emergence. Soluble salts beyond a certain limit affect growth adversely depending upon the stage of growth, plant species and variety (Maliwal and Paliwal, 1982, Hassonporath *et al.* 1982, Sheoran, 1980). Recently significant information on the germination capacity of seed in graded salinity has been reviewed for many varieties of field and vegetable crops (Maliwal and Paliwal, 1969 and Gupta, 1979). Results of experiment conducted to find out the most salt tolerant genotypes of gram are presented herein.

Germination study on 32 genotypes of gram was conducted at four salinity (EC 3, 6, 9 and 12 dsm^{-1}) levels alongwith control in three replications at room temperature. The solutions were prepared in 1/5 Hoagland nutrient solution of the following composition in milliequivalents (me) per litre. $Ca(NO_3)_2$, 5; KNO_3, 2.5; $MgSO_4$, 2; KH_2PO_4, 1.5; and 1 me/l of iron as ferric citrate, copper as $CuSO_4$, zinc as $ZnSO_4$, manganese as $MnSO_4$ and boron as H_3BO_3. In all these solutions chloride salts of sodium, calcium and magnesium in the ratio of 65:15:25 were taken and desired conductivity was adjusted on solu bridge. The experiment was conducted in using blotting paper in petredishes. The germination percentage was recorded after every 24-hours till the 10th day of the sowing. Height of seedling from each replicate was recorded on the last day of germination count. Salt tolerance limit of each variety was worked out on the basis of critical difference over control. Arc sine values were used for statistical analysis of data.

The observation on the germination count made after every 24 hours of sowing revealed that the germination was initiated in the control and lower salinity levels within 48 hours. In the higher salinity levels, the initiation of germination begin on the 3rd day. The maximum germination was observed within four days in control and in lower salinity levels while in higher salinity levels, the period for the maximum germination was extended and in some varieties it prolonged till the last day of the observations. In general, the process of germination was delayed linearly with the increase of salt concentration (Table 1) with slight differences amongst the varieties (Yadav *et al.* 1989). The adverse effect of salinity on plant growth may be due to (a) the osmotic effect of

TABLE 1

Effect of salinity levels on the germination (%) of gram genotypes.

Sr. No.	*Genotype*	*EC ds m^{-1}*					*Mean*
		Control	*3*	*6*	*9*	*12*	
1.	JCP-2	99	99	99	99	98	99
2.	JCP-6	99	98	99	99	99	99
3.	JCP-11	99	99	99	99	99	99
4.	JCP-13	99	99	99	99	99	99
5.	JCP-21	99	99	99	99	99	99
6.	JCP-22	99	94	98	92	90	95
7.	JCP-23	99	99	98	99	99	99
8.	JCP-27	99	98	96	96	96	97
9.	JCP-28	90	82	88	86	58	82
10.	JCP-29	96	94	90	82	52	87
11.	JCP-30	90	92	91	70	23	76
12.	JCP-31	96	94	80	38	2	64
13.	JCP-32	85	91	70	20	10	56
14.	JCP-33	77	98	52	40	12	58
15.	JCP-34	92	84	85	56	4	64
16.	JCP-35	96	90	82	58	33	75
17.	JCP-36	92	86	72	36	24	64
18.	JCP-37	95	92	84	77	55	82
19.	JCP-38	85	88	76	61	32	70
20.	JCP-39	91	61	44	40	12	50
21.	JCP-40	78	76	86	38	12	58
22.	JCP-41	83	92	85	58	16	69

1.	2.	3.	4.	5.	6.	7.	8.
23.	JCP-42	88	68	66	58	22	61
24.	JCP-43	76	86	72	64	39	68
25.	JCP-44	99	99	99	99	98	99
26.	JCP-45	90	87	86	86	76	85
27.	JCP-46	96	94	94	87	88	92
28.	JCP-47	82	76	70	46	52	66
29.	JCP-49	99	98	99	94	92	97
30.	JCP-50	98	99	99	99	96	98
31.	JCP-52	96	92	92	92	90	93
32.	JCP-57	98	92	98	92	99	96
	Mean	94	93	89	79	63	

	S. Em ±	C. D. at 5%	C.V. %
Genotype (G)	2.113	5.856	
Solution (S)	0.835	2.315	
G X S	4.724	13.095	9.95

rooting medium (b) the accumulation of toxic ions ($C1^-$ and Na+) in plant issues (Hayward and Wadleigh, 1958, Bernstein, 1962 and Allison, 1964).

The germination percentage decreased with the increase in salt concentration in all the genotypes except JCP-2, 6, 11, 13, 21, 23, 44 and 57. The genotypes JCP 2, 6, 11, 13, 21, to 23, 27, 44 to 46, 49, 50, 52 & 57 tolerate highest salt concentration of 12 dsm^{-1} EC in irrigation water while JCP 29, 30, 34, 37, 38, 40, 41, 43 & 47 tolerate up to EC of 6 dsm^{-1}. JCP 28 and 45 tolerate EC of 9 dsm^{-1}. JCP 39 and 42 tolerate less than 3 dsm^{-1} while others are tolerate to EC of 3 dsm^{-1}.

The height of the seedlings of each genotype decreased with the increase in salt concentration (Table 2). In general more tolerant genotypes showed more height of seedlings and the relative decrease was also less with the increase in salt concentration while reverse was the case for less salt tolerant

TABLE 2

Effect of salinity levels on the height (cm) of seedlings of gram genotypes.

Sr. No.	Genotype/ Solution	EC, ds m^{-1}					Mean
		Control	3	6	9	12	
1.	JCP-2	5.5	4.3	3.1	1.9	0.4	3.0
2.	JCP-6	11.1	8.8	8.1	6.3	1.1	7.1
3.	JCP-11	11.5	5.6	3.7	1.4	0.3	4.6
4.	JCP-13	6.4	6.1	3.3	2.3	1.1	3.8
5.	JCP-21	5.5	4.5	2.9	2.2	0.7	3.2
6.	JCP-22	6.2	1.8	1.8	1.0	0.2	2.2
7.	JCP-23	7.8	4.9	2.7	2.6	0.6	3.7
8.	JCP-27	3.5	2.5	2.1	1.8	0.4	2.1
9.	JCP-28	10.3	5.9	5.7	0.4	0.2	4.5
10.	JCP-29	12.5	12.2	7.3	0.4	0.2	6.5
11.	JCP-30	7.7	9.3	4.3	0.2	0.0	4.3
12.	JCP-31	6.2	9.7	1.5	0.2	0.0	3.5
13.	JCP-32	2.5	2.4	0.0	0.0	0.0	1.0
14.	JCP-33	2.1	1.9	0.2	0.0	0.0	0.9
15.	JCP-34	5.0	3.2	0.2	0.0	0.0	1.7
16.	JCP-35	4.3	1.5	0.7	0.0	0.0	1.3
17.	JCP-36	8.0	4.6	3.7	0.0	0.0	3.3
18.	JCP-37	5.7	2.9	0.4	0.0	0.0	1.8
19.	JCP-38	6.1	1.1	0.4	0.0	0.0	1.5
20.	JCP-39	6.4	1.0	0.0	0.0	0.0	1.5

1.	2.	3.	4.	5.	6.	7.	8.
21.	JCP-40	1.6	1.4	0.2	0.0	0.0	0.6
22.	JCP-41	2.2	1.1	1.1	0.0	0.0	0.9
23.	JCP-42	2.5	1.9	1.0	0.0	0.0	1.1
24.	JCP-43	3.2	3.4	0.5	0.2	0.0	1.5
25.	JCP-44	3.1	4.9	2.9	1.4	1.0	2.6
26.	JCP-45	2.9	3.0	2.6	1.3	1.1	2.2
27.	JCP-46	2.7	3.2	2.6	1.5	0.9	2.2
28.	JCP-47	2.3	1.7	1.3	1.0	0.8	1.4
29.	JCP-49	3.8	3.6	2.6	1.6	1.1	2.6
30.	JCP-50	3.6	3.3	2.3	2.0	1.9	2.6
31.	JCP-52	5.4	4.2	3.0	2.1	1.2	3.2
32.	JCP-57	3.5	4.2	2.1	1.8	1.2	2.6
	Mean	5.3	4.1	2.3	1.1	0.50	

	S. Em. ±	C.D at 5%	C.V.%
Genotype (G)	0.320	0.887	
Solution (S)	0.127	0.351	
G X S	0.716	1.984	38.33

genotypes. In some cases, the height of seedlings seemed to be influenced by the growth rate of the genotype and salt, concentration.

Results obtained clearly show that germinating capacity of the seeds in adversely affected with the increase in salinity in all the genotypes of gram. Besides this, increased osmotic pressure near the root zone seem to adversely affect growth rate and ultimately the height of the seedlings. Genotypes show significant difference both in relation to their duration of germination, germinating capacity and the height of the seedlings. The varietal differences have been observed for gram varieties by Maliwal and Paliwal (1982). The salt tolerant genotypes can be used for breeding programme in salt affected soils.

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