Research Paper biotechnology

Studies on Sensitivity of Groundnut Cultivars to NaCl Stress

Shrimali Gaurav Department of Life Sciences, Hemchandracharya North Gujarat University, Patan – 384 265, Gujarat, INDIA

Patel Illa Assistant Professor Department of Life Sciences, Hemchandracharya North Gujarat University, Patan – 384 265, Gujarat, INDIA

Trivedi Devanshi Department of Life Sciences, Hemchandracharya North Gujarat University, Patan – 384 265, Gujarat, INDIA

ABSTRACT

Groundnut (*Arachis hypogaea L.*),is a very valuable cash crop of Leguminaceae family. Several abiotic stresses including salinity alter the growth and development of this sensitive crop. The effects of salinity on ten groundnut cultivars (GG-2, GG-4, GG-6, GG-7, GG-20, TG-37A, TMV-13, DRG-17, TPG-41, Girnar-2) were investigated. Seeds of all the cultivars treated with 40mM NaCl, 80mM NaCl, 120nM NaCl and 160 mM NaCl along with control (DW) were kept for germination at room temperature up to 120 hr. Physiological parameters viz. shoot length, root+hypocotyls length, no. of secondary root, germination percentage and seed vigor index were measured. Salinity tolerant and susceptible cultivars were identified.

KEYWORDS Groundnut (*Arachis hypogaea L.*), Salinity tolerance, seed vigor index.

INTRODUCTION

Groundnut is a leguminous crop grown in most tropical, sub tropical and warm temperate region of the world between 40ºN and 40ºS latitudes and is one of the principal oil seed crop grown on near 25 million ha around the world (FAO, 2003). Soil or water salinity is one of the major problems that alters growth and production of groundnut. About 8.56 m ha in India is affected by salt (Singh, 1992). Salt stress elicits a broad range of physiological expression response in plant (Siddiqui *et al*., 2008). But so far neither any specific salinity management practice nor suitable groundnut genotype have been recommended for this area (Singh AL. *et al*., 2008). The objective of present study was to evaluate groundnut cultivars for sensitivity to NaCl stress during germination and early seedling growth under laboratory conditions before testing them at field condition.

METHODOLOGY

The laboratory experiment was conducted on ten Groundnut cultivars viz. GG-2, GG-4, GG-6, GG-7, GG-20, TG-37A, TMV-13, DRG-17, TPG-41 and Girnar-2, obtained from National research center for Groundnut, , Junagadh Gujarat. The treatments constituted different concentrations of NaCl solution (viz. 40 mM, 80mM, 120mM and 160mM) as salinity dosages and distilled water as control. 10 seeds of each cultivar in each treatment and replicated thrice were kept for germination in Petri plates containing whatman filter paper No. 1 to study germination after surface sterilization with 0.2% HgCl2 for 15 seconds at room temperature (Rukam singh *et al*., 2007). As the germination begins from 24 hr in all the cultivars, the data on germination percentage was recorded in all the treatments along with control after 24 hr to 120 hr. 1 to 2 ml of respective treatment solution was applied depending on requirement, Physiological parameters viz. germination percentage, shoot length, root+hypocotyl length, number of secondary root, fresh weight and dry weight of seedling were recorded up to 120 hr of germination (ISTA, 1999).

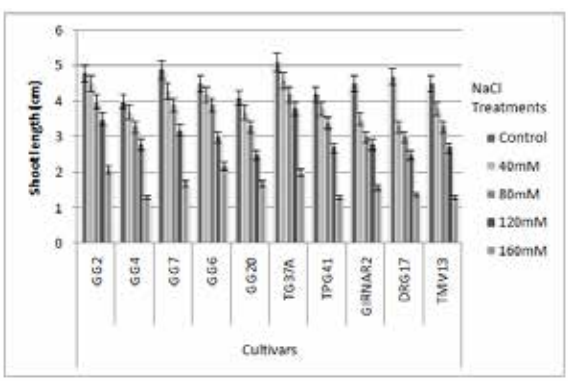
Seed Vigor Index (S.V.I.) = [Germination percentage x Root Length (cm)] + Number of Secondary root (Abdul Baki and Anderson, 1973).

Table 1:- Effects of NaCl stress on germination percentage, root+ hypocotyls length, Number of secomdary roots and Seed Vigour index in groundnut.

Sr No.	Name of cultivar	NaCl Treatments	Total germinated seeds out of 60	Germination percentage	Root + hypocotyl length	No. of secondary roots	SVI
1	GG-2	Control	58	96.67	4.4	8	429.73
		40mM	50	83.33	3.8	10	320.47
		80mM	45	75.00	3.6	6	273.60
		120mM	36	60.00	3.1	2	189.10
		160mM	31	51.67	2.4	0	126.40
2	GG-4	Control	54	90.00	3.2	7	291.20
		40mM	49	81.67	2.9	3	239.73
		80mM	36	60.00	2.7	2	164.70
		120mM	29	48.33	2.2	2	108.53
		160mM	26	43.33	1.3	1	57.63
3	GG-7	Control	55	91.67	3.7	12	342.87
		40mM	42	70.00	3.3	10	234.30
		80mM	38	63.33	2.9	7	186.57
		120mM	36	60.00	2.5	4	152.50
		160mM	20	33.33	1.2	1	41.20
4	GG-6	Control	56	93.33	3.3	13	311.30
		40mM	54	90.00	2.9	10	263.90
		80mM	48	80.00	2.6	6	210.60
		120mM	41	68.33	2.2	2	152.53
		160mM	32	53.33	1.9	1	103.23
5	GG-20	Control	58	96.67	3.3	16	322.30
		40mM	49	81.67	2.8	10	231.47
		80mM	42	70.00	2.3	6	163.30
		120mM	34	56.67	2	3	115.33
		160mM	24	40.00	1	2	41.00

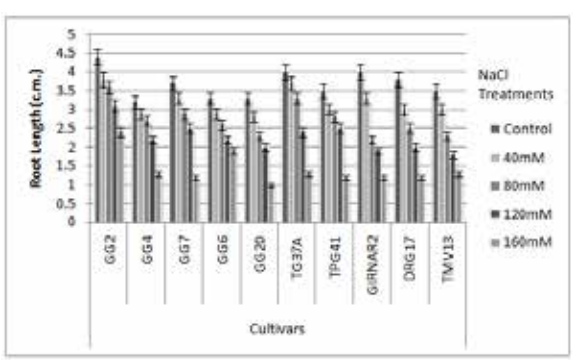
6	TG37A	Control	56	93.33	4	11	377.33
		40mM	47	78.33	3.7	7	293.53
		80mM	40	66.67	3.3	6	223.30
		120mM	29	48.33	2.4	2	118.40
		160mM	26	43.33	1.3	1	57.63
7	TPG 41	Control	54	90.00	3.5	8	318.50
		40mM	41	68.33	3	6	208.00
		80mM	33	55.00	2.8	3	156.80
		120mM	30	50.00	2.5	1	127.50
		160mM	27	45.00	1.2	0	55.20
8	Girnar 2	Control	59	98.33	4	16	397.33
		40mM	50	83.33	3.3	8	278.30
		80mM	32	53.33	2.2	3	119.53
		120mM	28	46.67	1.9	2	90.57
		160mM	22	36.67	1.2	1	45.20
9	DRG 17	Control	56	93.33	3.8	15	358.47
		40mM	50	83.33	3	7	253.00
		80mM	42	70.00	2.5	3	177.50
		120mM	30	50.00	2	3	102.00
		160mM	25	41.67	1.2	0	51.20
10	TMV 13	Control	59	98.33	3.5	16	347.67
		40mM	52	86.67	3	10	263.00
		80mM	29	48.33	2.3	4	113.47
		120mM	26	43.33	1.8	2	79.80
		160mM	20	33.33	1.3	1	44.63

Fig 1: Effects of NaCl on Shoot length in groundnut seedlings.



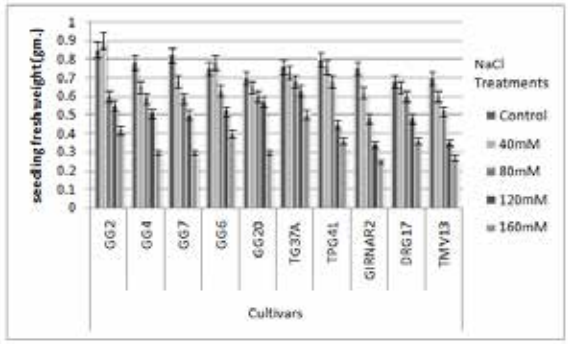
Note:- Mean values and their standard errors are presented.

Fig 2: Effects of NaCl on root length in groundnut seedlings.



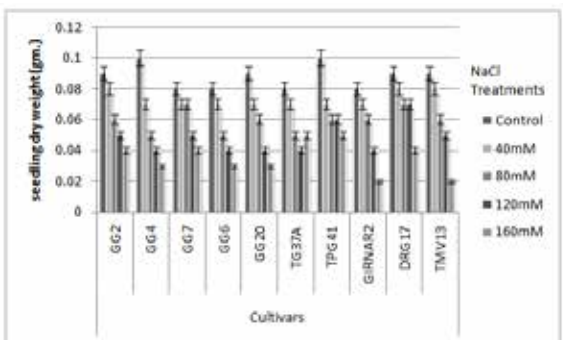
Note:- Mean values and their standard errors are presented.

Fig 3: Effects of NaCl on fresh weight of groundnut seedlings



Note:- Mean values and their standard errors are presented.

Fig 4: Effects of NaCl on dry weight of groundnut seedlings



Note:- Mean values and their standard errors are presented.

Results and discussion

Germination study:

The results observed by germination study are shown in table 1. Every genotype responded differently to the different level of salinity. As the NaCl concentration increases, germination percentage decreases compared to control seedlings. The present results agree with the reports of Manesh *et al*. (2006), where they observed a gradual decrease in germination percentage as salinity increase. The most effective concentration which decreased the germination percentage was 160 mM NaCl, however more than 50 % germination was recorded in GG2 and GG6 cultivars. TMV13 and Girnar 2 recorded the least in the different salinity treatments indicate that these two cultivars are salinity susceptible. In seeds treated with 80mM NaCl, more than 70% germination was recorded in GG2, GG6, DRG 17 and GG20 after 120 hr. indicated that these are salinity tolerant cultivars.

Seed Vigor Index (SVI) :-

Salinity tolerant and salinity susceptible cultivars can be more clearly identified by seed vigor parameters. Reduction of germination percentage and root+ hypocotyls length also decreases the SVI as the salt stress increases. In 160 m M NaCl treatments high SVI was recorded in GG2 (126.40) and GG6 (103.23). In Girnar 2 cultivar the SVI value decrease to 45.20 from 397.33 of controlled seedling. Similar results were reported by Rukan S. *et al*. (2007) in groundnut under salt stress.

Growth characteristics:

The application of NaCl significantly decreases the shoot length, root+hypocotyls length, fresh weight and dry weight. Seedling fresh and dry biomass of all the cultivars decreased due to salt stress except GG2 and GG6 cultivar at 40 m M of NaCl treatment. That indicates, low saline conditions favor the seedling growth in salinity tolerant cultivars and seeds have the ability to germinate and emerge under saline conditions because of genetic potential for salt tolerance (Tejovathi *et al*.,

1986).

Acknowledgement:-
The financial support of University Grant Commission, New Delhi, India, is gratefully acknowledged. The authors are also thankful to N.R.C.G. Junagadh, Gujarat for providing groundnut cultivars and valuable suggestions.

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