

Original Research

Morpho-physiological change in growth characteristics of four varieties of *Cicer arietinum* (L.) seedlings in response to salt stress

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ABSTRACT:

The effect of presoaking salinity stress of 0.1%, 0.5% and 1% Sodium Chloride (NaCl) on germination potential, radicle length and plumule length after different intervals of time was studied in four varieties of *Cicer arietinum* i.e. PBG1, PBG 5, BG 1053 and GPF2. Various physiological parameters like fresh weight, dry weight, moisture content, relative growth rate and vigour index of seedlings were also significantly influenced by various salt concentrations.

Key words: Salinity stress, germination potential, vigour index, relative growth rate, seed size.

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INTRODUCTION

The genus *Cicer* belongs to the monogeneric tribe *Ciceraceae* and includes about 40 species. Seed germination occupies a unique position in plant life as the physiological processes occurring in it have a profound effect upon growth and development of plant during its adult life. Germination starts with imbibition of water and ends with the protrusion of embryonic roots. The different varieties of *Cicer* produce heteromorphic seeds, varying in size and germination potential. The crop raised from heteromorphic seeds comprises the plants exhibiting greater variations in morpho-physiological characters and yield potential (Sharma A and Setia et al. 2001). It has been shown that for several crop plants, seedling vigour is directly correlated to seed size (Ahmed and Zuberi 1973; Reddy et al 1994) but contrasting results have also been reported by many workers (Black 1958, Twamley 1967). Therefore, our understanding of this relationship remains incomplete. Various external and internal factors also affect the morpho-physiological characteristics of plant. Among these factor salinity stress have been shown to have profound effect on various morphological and physiological parameters of seedlings. The objective of the present investigation is to study the influence of various concentration of sodium chloride i.e. (0.1%, 0.5% and 1.0%) on germination potential and seedling

growth behaviour in four varieties of *Cicer arietinum* i.e. PBG1, PBG5, BG1053 and GPF2.

MATERIALS AND METHODS

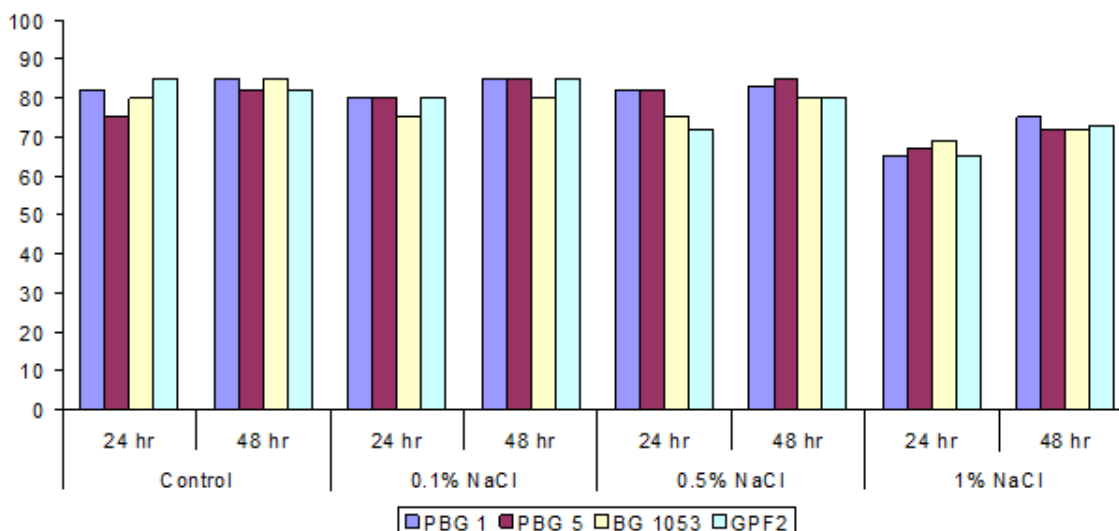
The seeds of four varieties of *Cicer arietinum* i.e. PBG1, PBG5, BG1053 and GPF2 were procured from department of Plant breeding, Punjab Agriculture University, Ludhiana (Punjab) and the experiment was conducted in P.G. Department of Botany, Desh Bhagat University, Mandi Gobindgarh (Punjab). Seeds were hand separated and graded uniform seeds were surface sterilized with 0.1% mercuric chloride for one minute followed by thorough washing with distilled water. The sterilized seeds were germinated in glass petridishes lined with filter paper moistened by adding distilled water for controls, and solutions and 0.1% NaCl, 0.5% NaCl and 1% NaCl using three replicates for each treatment seeds of all the four varieties were presoaked for 24 hrs in appropriate culture solution, before keeping for germination at 25±2°C. Germination count was made after (24-192hrs) of incubation and data was recorded on radicle length, plumule length, fresh weight, dry weight and moisture content of radicle and plumule of all the four varieties of *cicer*. Various parameters like vigour index (VI) (Abdulbaki and Anders 1973) and relative growth rate (RGR) were also determined in all the four varieties.

RESULTS AND DISCUSSION

Fig. 1 and Plate I shows the percent germination of seeds in different varieties of *Cicer arietinum*. Germination occurred with all most all salt treatments in 24 hrs. 1.0% NaCl caused marked reduction in germination potential but growth occurred normally in

0.1 and 0.5% NaCl suggesting that higher salt concentration affect the seed germination. The adverse effect of salinity on germination of legumes have been reported by Sheoran and Garg (1979) and Kumar and Garg (1980).

Fig. 1: Effect of pre soaking salinity stress of 0.1%, 0.5% and 1% NaCl treatments on percent germination of seeds in different varieties of *Cicer arietinum*



The radicle length and plumule length was also significantly influenced by various salt concentrations as compared to the control in all the four varieties i.e. PBG 1, PBG 5, BG1053 and GPF2 (Fig. 2, 3, 4, 5 and Plate II). Higher salt concentration caused marked reduction in the length of radicle and plumule

(Bernstein 1995 and Alka et al 1990). Green way and Munns (1990) and Levitt (1980) have demonstrated that reduction in growth under salinity is either due to osmotic or ionic effect and or the combination of both.



Plate I: Effect of 0.5% and 1% on germination potential of seedlings



Plate II: Effect of various salt concentrations on radicle length and plumule length in different varieties of *Cicer arietinum*

Fig. 2: Effect of pre soaking salinity stress of 0.1%, 0.5% and 1% NaCl treatments on radicle length and plumule length of seedlings in PBG 1 variety of *Cicer arietinum*

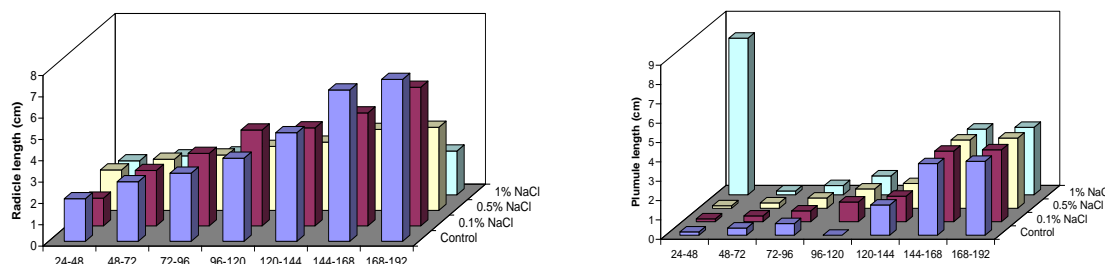


Fig. 3: Effect of pre soaking salinity stress of 0.1%, 0.5% and 1% NaCl treatments on radicle length and plumule length of seedlings in PBG 5 variety of *Cicer arietinum*

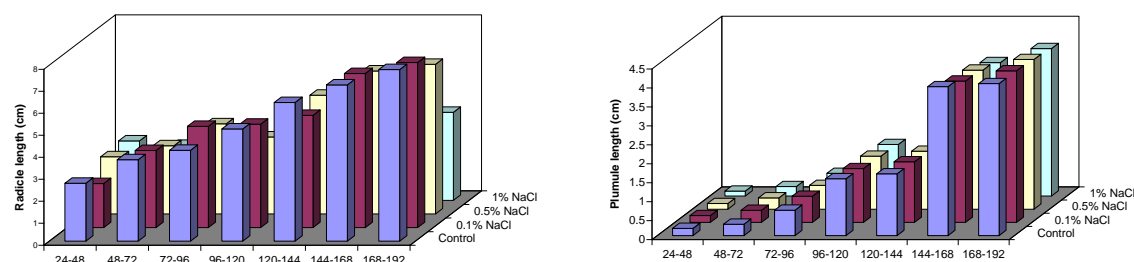


Fig. 4: Effect of pre soaking salinity stress of 0.1%, 0.5% and 1% NaCl treatments on radicle length and plumule length of seedlings in BG1053 variety of *Cicer arietinum*

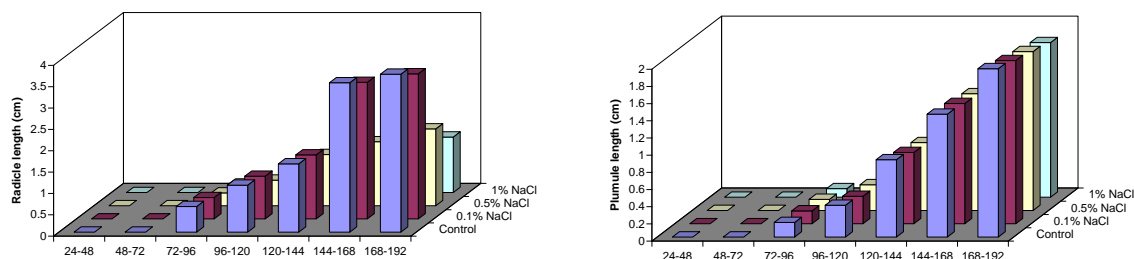
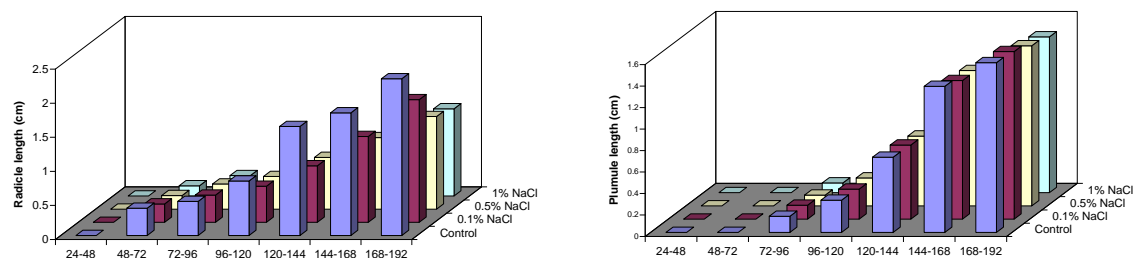


Fig. 5: Effect of pre soaking salinity stress of 0.1%, 0.5% and 1% NaCl treatments on radicle length and plumule length of seedlings in GPF2 variety of *Cicer arietinum*



Likewise the data regarding fresh weight, dry weight and moisture content of radicle and plumule was also influenced in all the four varieties of *Cicer arietinum* following different salt concentrations. Table 1 and 2 shows that fresh weight, dry weight and moisture content of radicle and plumule showed marked variations with various salt concentrations.

Table 1: Effect of presoaking of seeds of different varieties of *Cicer arietinum* in different salt concentrations on fresh weight (g), dry weight (g) and moisture content (%) of radicle at different intervals of time.

	Control			0.1% NaCl			0.5% NaCl			1% NaCl		
	FW	DW	MC	FW	DW	MC	FW	DW	MC	FW	DW	MC
PBG 1	0.38+0 .05	0.06+0 .02	84.2 %	0.28+ 0.01	0.05+ 0.01	82.1 %	0.26+ 0.05	0.04+0 .02	84. 6%	0.25+ 0.02	0.03+0 .01	88 %
	0.39+0 .1	0.10+0 .01	74.3 5%	0.30+ 0.02	0.08+ 0.02	73.3 %	0.27+ 0.01	0.06+0 .01	77. 7%	0.26+ 0.01	0.05+0 .02	80. 7%
	0.40+0 .18	0.11+0 .08	72.5 %	0.38+ 0.03	0.10+ 0.05	68.7 5%	0.39+ 0.05	0.08+0 .02	73. 3%	0.29+ 0.01	0.07+0 .01	75. 8%
	0.46+0 .08	0.12+0 .02	73.9 %	0.38+ 0.01	0.11+ 0.01	71.0 %	0.34+ 0.01	0.09+0 .01	73. 5%	0.32+ 0.05	0.08+0 .05	75 %
	0.48+0 .02	0.12+0 .01	75%	0.39+ 0.02	0.11+ 0.02	71.7 %	0.36+ 0.02	0.09+0 .02	75 %	0.34+ 0.06	0.08+0 .05	76. 4%
	0.73+0 .15	0.15+0 .02	79.4 %	0.52+ 0.01	0.12+ 0.05	76.9 %	0.40+ 0.01	0.10+0 .01	75 %	0.38+ 0.01	0.09+0 .01	76. 3%
	1.06+0 .05	0.22+0 .05	79.2 %	0.63+ 0.02	0.18+ 0.01	71.4 %	0.49+ 0.06	0.16+0 .02	67. 3%	0.42+ 0.06	0.12+0 .010	71. 4%
PBG 5	0.20+0 .02	0.03+0 .01	85%	0.17+ 0.01	0.03+ 0.01	82.3 %	0.15+ 0.01	0.02+0 .01	86. 6%	0.13+ 0.01	0.02+0 .01	84. 6%
	0.22+0 .03	0.05+0 .02	77.2 %	0.17+ 0.02	0.03+ 0.01	82.3 %	0.15+ 0.01	0.02+0 .01	86. 6%	0.13+ 0.02	0.02+0 .01	84. 6%
	0.26+0 .01	0.07+0 .01	73.0 %	0.23+ 0.05	0.06+ 0.01	73.9 %	0.17+ 0.05	0.05+0 .01	70. 6%	0.16+ 0.06	0.04+0 .02	75 %
	0.27+0 .05	0.07+0 .01	74.1 %	0.26+ 0.0	0.07+ 0.02	73.1 %	0.22+ 0.01	0.06+0 .02	72. 3%	0.18+ 0.02	0.05+0 .01	72. 2%
	0.35+0 .02	0.15+0 .02	57.1 %	0.28+ 0.02	0.08+ 0.01	71.4 %	0.25+ 0.02	0.07+0 .03	72. 0%	0.21+ 0.01	0.06+0 .01	71. 4%
	0.40+ 0.03	0.15+0 .02	62.5 %	0.39+ 0.01	0.10+ 0.02	74.3 %	0.30+ 0.01	0.08+0 .02	73. 3%	0.25+ 0.02	0.07+0 .01	72 %
	0.44+0 .03	0.19+0 .010	56.8 %	0.39+ 0.01	0.13+ 0.01	66.6 %	0.32+ 0.02	0.10+0 .01	68. 7%	0.30+ 0.01	0.09+0 .01	70 %
BG1 053	-	-	-	-	-	-	-	-	-	-	-	-
	0.18+0 .01	0.02+0 .01	88.8 %	0.15+ 0.01	0.02+ 0.01	86.6 %	0.14+ 0.02	0.02+0 .01	85. 7%	0.13+ 0.02	0.02+0 .01	84. 6%
	0.20+0 .02	0.04+0 .01	80%	0.15+ 0.03	0.03+ 0.01	80%	0.15+ 0.01	0.02+0 .01	86. 6%	0.13+ 0.01	0.02+0 .01	84. 6%
	0.22+0 .03	0.06+0 .02	72.7 %	0.20+ 0.01	0.05+ 0.02	75%	0.16+ 0.02	0.03+0 .02	81. 2%	0.14+ 0.1	0.03+0 .01	78. 5%
	0.24+0 .01	0.06+0 .02	75%	0.24+ 0.02	0.05+ 0.01	79.2 %	0.20+ 0.01	0.04+0 .01	80 %	0.16+ 0.01	0.04+0 .01	75 %
	0.26+0 .01	0.12+0 .01	53.8 %	0.26+ 0.01	0.09+ 0.01	65.3 %	0.21+ 0.02	0.05+0 .01	76. 2%	0.20+ 0.01	0.05+0 .01	75 %
	0.28+0 .07	0.15+0 .01	46.4 %	0.32+ 0.01	0.11+ 0.02	65.6 %	0.28+ 0.02	0.09+0 .01	67. 8%	0.25+ 0.01	0.06+0 .01	76 %
GPF 2	0.19+0 .01	0.03+0 .00	84.2 %	0.16+ 0.02	0.03+ 0.01	81.2 5%	0.13+ 0.01	0.02+0 .01	84. 6%	0.13+ 0.01	0.02+0 .01	84. 6%
	0.21+0 .01	0.04+0 .01	80.9 %	0.16+ 0.01	0.03+ 0.01	81.2 5%	0.14+ 0.01	0.02+0 .01	85. 7%	0.13+ 0.02	0.02+0 .01	84. 6%
	0.24+0 .02	0.06+0 .01	75%	0.21+ 0.05	0.05+ 0.01	76.1 %	0.16+ 0.01	0.04+0 .001	75 %	0.15+ 0.01	0.03+0 .01	80 %
	0.26+0 .01	0.06+0 .01	76.9 %	0.22+ 0.01	0.05+ 0.01	77.2 %	0.21+ 0.01	0.05+0 .01	76. 2%	0.17+ 0.01	0.05+0 .01	70. 5%
	0.28+0 .02	0.14+0 .01	50%	0.25+ 0.02	0.09+ 0.02	64%	0.24+ 0.02	0.06+0 .01	75 %	0.22+ 0.02	0.06+0 .01	72. 7%
	0.32+0 .06	0.10+0 .01	56.3 %	0.28+ 0.01	0.09+ 0.01	67.6 %	0.28+ 0.01	0.07+0 .01	75 %	0.24+ 0.03	0.08+0 .01	75 %
	0.34+0	0.17+0	50%	0.34+	0.12+	64.7	0.30+	0.10+0	66.	0.28+	0.08+0	71.

	.01	.01		0.02	0.01	%	0.01	.01	6%	0.01	.01	4%
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Significant at 5% level, values represent mean \pm S.E.

Although all the above parameters increased with time but decreased with increasing salt concentrations suggesting that higher concentration affect the osmotic adjustments and the effect was more pronounced in BG1053 as compared to PBG 1, PBG 5 and GPF 10 varieties of *Cicer arietinum*.

Table 2: Effect of presoaking of seeds of different varieties of *Cicer arietinum* in different salt concentrations on fresh weight (g), dry weight (g) and moisture content (%) of plumule at different intervals of time.

	Control			0.1% NaCl			0.5% NaCl			1% NaCl		
	FW	DW	MC	FW	DW	MC	F W	D W	MC	F W	D W	MC
PBG 1	-	-	-	-	-	-	-	-	-	-	-	-
	0.33+0.01	0.01+0.10	66.6%	0.02+0.01	0.01+0.01	50%	-	-	-	-	-	-
	0.04+0.01	0.03+0.01	25%	0.03+0.01	0.02	33.3%	0.02	0.01	50%	-	-	-
	0.05+0.12	0.04+0.01	20%	0.04+0.01	0.03	25%	0.03	0.02	33.3%	-	-	-
	0.08+0.03	0.07+0.01	12.5%	0.06+0.01	0.05	16.6%	0.05	0.03	40%	0.04	0.02	50%
	0.12+0.10	0.10+0.01	16.6%	0.11+0.02	0.09	18.1%	0.10	0.06	40%	0.06	0.05	16.6%
	0.19+0.16	0.18+0.01	5.3%	0.17+0.01	0.12	29.4%	0.13	0.10	23%	0.08	0.06	25.5%
PBG 5	0.02+0.10	0.01+0.01	50%	-	-	29.4%	-	-	-	-	-	-
	0.03+0.10	0.02+0.01	33.3%	0.02+0.01	0.01	50%	-	-	-	-	-	-
	0.02+0.10	0.01+0.01	50%	-	-	-	-	-	-	-	-	-
	0.03+0.10	0.02+0.01	33.3%	0.02+0.01	0.01	50%	-	-	-	-	-	-
	0.04+0.01	0.03+0.01	25%	0.03+0.01	0.02	33.3%	0.01	0.01	-	-	-	-
	0.06+0.02	0.05+0.01	16.6%	0.04+0.02	0.03	25%	0.02	0.02	-	0.02	0.01	50%
	0.10+0.05	0.08+0.02	20%	0.06+0.01	0.05	16.6%	0.04	0.03	25%	0.03	0.02	33.3%
BG1053	0.13+0.02	0.10+0.01	23%	0.08+0.01	0.07	12.5%	0.06	0.05	16.6%	0.05	0.04	20%
	0.14+0.03	0.12+0.10	14.3%	0.10+0.01	0.08	20%	0.08	0.07	12.5%	0.07	0.06	14.3%
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	0.02+0.01	0.01+0.01	50%	-	-	-	-	-	-	-	-	-
	0.03+0.01	0.02+0.01	33.3%	0.02+0.01	0.01+0.01	50%	-	-	-	-	-	-
	0.04+0.02	0.03+0.01	25%	0.03+0.01	0.02+0.01	33.3%	0.02	0.01	50%	0.02	0.01	50%
GPF2	0.05+0.01	0.04+0.01	20%	0.04+0.01	0.03+0.01	25%	0.03	0.02	33.3%	0.02	0.01	50%
	0.09+0.02	0.07+0.02	22.2%	0.07+0.01	0.05+0.01	28.5%	0.06	0.05	16.6%	0.04	0.02	50%
	0.01+0.01	-	-	-	-	-	-	-	-	-	-	-
	0.02+0.01	-	-	-	-	-	-	-	-	-	-	-

	0.03+0.0 1	0.02+0. 01	33.3 %	0.02+0. 01	0.01	50%	-	-	-	-	-	-
	0.05+0.0 2	0.03+0. 01	40%	0.04+0. 01	0.03	25%	-	-	-	0.0 2	0.0 1	50%
	0.06+0.1 2	0.05+0. 02	16.6 %	0.05+0. 02	0.04	20%	0.0 3	0.0 2	33.3 %	0.0 2	0.0 1	50%
	0.08+0.0 1	0.06+0. 02	25%	0.06+0. 01	0.05	16.6 %	0.0 5	0.0 4	20%	0.0 4	0.0 3	25%
	0.12+0.0 2	0.10+0. 01	16.6 %	0.09+0. 02	0.08	11.1 %	0.0 7	0.0 6	14.3 %	0.0 6	0.0 5	16.6 %

Significant at 5% level, values represent mean \pm S.E.

Similar trend has been observed in vigour index of seedlings. These findings are similar to that reported by Singh *et al.* (1980) in *Cicer arietinum*.

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