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Effect of increasing salinity levels on different growth parameters in American cotton genotypes

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ABSTRACT : Maximum germination was observed in control (untreated) of H 1226 (52.84%), whereas, it was minimum (38.88%) in H 1250. Similarly, maximum germination (4.66) was also recorded in H 1226, followed by H 1117 (4.07) and minimum (1.17) in H 1250 in control. Enhancement in germination was observed under 50mM NaCl in the experimental genotypes, whereas, at 125mM NaCl, there was 58.10, 49.50 and 49.60 per cent reduction in the germination in H 1250, H 1226 and H 1117, respectively. Maximum root and shoot lengths and dry weight of seedlings were recorded at minimum level of salinity in all the 3 genotypes. As the levels of the salinity increased there was a gradual and significant decline in all the parameters. The decline was, however, dose and genotype dependent.

Key words: Cotton, germination, NaCl, root length, salinity, shoot length

Cotton is the most important fibre crop of India and its seed is a rich source of high quality protein and oil. Salt stress is one of the most important environmental stress influencing the productivity of agricultural system, particularly in the developing countries. It has been estimated that approximately 25 per cent of the world's total irrigated land is affected by salinity and in India it is about 36 per cent (Singh and Sharma, 2003). When soil and water salinity exceeds the tolerance limit it causes various morphological disorders in plant body and results upto 50 per cent reduction in cotton yield. The most common physiological and biological disorders in the plants subjected to salt stress are reduced water potential, ion imbalance, toxicity and reduction of CO_2 assimilation. Crop plants suffer a decline in growth and yield when exposed to saline conditions and the deleterious effects of salinity are considered to be a result of water stress due to a combination of various factors. Salinity inhibits seedling germination by lowering water uptake and inhibition of activities of hydrolytic enzymes such as á–amylase, proteases and ribonucleases in the endosperm. Salt sensitivity of crop varies with the stage of growth and flowering stage is considered the most sensitive to sodium chloride for seed and boll yield, whereas, dry matter production is affected more adversely by salinity at the seedling stage. Keeping this in view, the present study was undertaken to assess the effects of increasing levels of salinity (NaCl) on different growth parameters like germination, its speed, root and shoot lengths and seedlings dry weight in three genotypes of American cotton (*Gossypium hirsutum* L.).

The experimental material comprised of 3 genotypes of American cotton (*Gossypium hirsutum* L.) *viz.,* H 1226, H 1236 and H 1117, seedlings of which were raised in 12 in earthern pots in triplicate lined with polythene bags and filled with 6 kg sandy loam soil in screen house of Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The sandy loam soil was saturated with water (control) and 5 different levels of NaCl (treatments) *i.e.* 50 mM, 75 mM, 100 mM, 125 mM and 150 mM which were used for assessing the effect of salinity on different growth parameters in these genotypes. Observations were recorded after 8 DAS on 5 random seedlings from each treatment on germination (%), speed of germination, root length (cm), shoot length (cm) and dry weight of seedlings (mg).

The effects of different levels of salinity (NaCl) on different parameters *viz.,* germination, speed of germination, root length, shoot length and

Table 1 : Effect of different salinity (NaCl) levels on germination (%), speed of germination, root and shoot length (cm) and seedlings dry weight (mg) in 3 genotypes of American cotton

NaCl concentration (mM)	Germination (%)			Speed of germination			Root length (cm)			Shoot length (cm)			Seedlings dry weight (mg)		
	H 1250	H 1226	H 1117	H 1250	H 1226	H 1117	H 1250	H 1226	H 1117	H 1250	H 1226	H 1117	H 1250	H 1226	H 1117
Control	38.88±0.01	52.84±0.03	45.50±0.02	1.17±0.01	4.66±0.03	4.07±0.02	14.70±0.29	10.12±0.32	17.46±0.25	6.98±1.31	8.05±0.49	8.68±1.72	61.87±0.27	57.13±0.34	89.20±0.06
50	42.00±0.11	59.45±0.15	52.25±0.03	2.77±0.11	5.33±0.15	5.24±0.03	16.00±0.29	15.08±0.25	18.08±0.26	7.62±1.41	7.82±1.97	7.67±0.59	59.11±0.24	55.54±0.58	66.61±0.52
	(+8.02)	(+12.50)	(+14.83)	(+136)	(+14.40)	(+28.70)	(+8.80)	(+49.00)	(+3.50)	(+9.20)	(-2.80)	(-11.6)	(-4.40)	(-2.80)	(-25.30)
75	32.74±0.08	47.59±0.02	37.18±0.03	1.34±0.08	3.49±0.02	3.32±0.03	15.30±0.29	14.29±0.26	12.91±0.23	6.40±2.05	7.34±0.67	7.12±0.55	46.13±0.32	52.34±0.17	54.94±0,35
	(-15.80)	(-9.94)	(-18.28)	(+14.5)	(-25.90)	(-18.40)	(+4.08)	(+41.40)	(-26.00)	(-8.30)	-8.8	(-17.90)	(-25.40)	(-8.40)	(-38.40)
100	27.03±0.04	39.53±0.08	35.26±0.01	0.67±0.03	3.79±0.08	3.23±0.01	12.10±0.29	14.50±0.26	11.14±0.25	4.66±1.76	5.19±0.39	5.84±0.15	38.45±0.18	51.82±0.55	44.06±0.30
	(-30.50)	(-25.20)	(-22.51)	(-42.70)	(-18.60)	(-20.60)	(-17.60)	(+43.20)	(-36.20)	(-33.20)	(-35.50)	(-32.27)	(-37.80)	(-9.30)	(-50.6)
125	22.40±0.02	28.11±0.03	20.30±0.03	0.49±0.02	2.35±0.03	2.05±0.03	9.48±0.21	13.52±0.32	8.73±0.28	3.38±0.35	3.89±0.84	3.97±0.24	30.90±0.29	42.28±0.23	35.74±0.25
	(-42.40)	(-46.8)	(-55.40)	(-58.10)	(-49.50)	(-49.60)	(-35.50)	(+33.50)	(-50.00)	(-51.50)	(-51.60)	(-54.30)	(-50.00)	(-26.00)	(-59.90)
150	20.31±0.02	28.01±0.03	19.33±0.03	0.42±0.02	2.28±0.03	1.34±0.03	10.12±0.21	8.46±0.29	8.14±0.32	2.28±0.69	3.51±0.22	3.87±0.35	23.90±0.29	31.53±0.23	29.73±0.15
	(-47.78)	(-47.00)	(-57.53)	(-64.10)	(-51.00)	(-67.00)	(-31.20)	(-16.40)	(-53.40)	(-67.30)	(-56.40)	(-55.40)	(-61.40)	(-44.8)	(-66.60)
CD (p=0.05)	1.38			0.06			0.32			1.25			0.34		

seedlings dry weight in 3 genotypes of American cotton are presented in Table 1. Germination was observed maximum (52.84%) in H 1226, whereas, it was minimum (38.88%) in H 1250. In general, with the increase in levels of salinity, there was a corresponding decrease in germination but at 50 mM NaCl, there was an enhancement in germination in all the 3 genotypes. However, further increase in salinity lead to decrease in germination. At 125 mM NaCl stress, there was 46.8 and 55.4 per cent reduction in germination in H 1226 and H 1117.Similar results have been reported by Asharf (2002), however, Chachar *et al.,* (2008) has reported that seed germination in cotton was slightly affected by an increase in salinity but there were severe decline in other growth parameters.

Maximum speed of germination (4.66) was found in H 1226, followed by H 1117 (4.07) and minimum (1.17) in H 1250 in control. Under 50 mM NaCl, enhancement in speed of germination took place in all genotypes whereas, at 125 mM NaCl, there was 58.10, 49.5 and 49.6 per cent reduction in H 1250, H 1226 and H 1117, respectively.

The perusal of the data in Table 1 revealed that maximum root and shoot lengths of seedlings was recorded at minimum level of salinity in all the three genotypes. As the levels of the salinity increased there was a gradual significant decline in root and shoot length. Almost 50 per cent reduction in shoot length took place at 125 mM of NaCl stress. Salinity stress also caused reduction in dry weight of seedlings of all the three genotypes of American cotton. Fifty per cent reduction was observed in H 1250 at 125 mM NaCl, whereas, 26.0 and 59.90 per cent reduction was observed in H 1226 and H 1117, respectively. However, the effects of reduction in seedlings dry weight was genotype dependent as the effects were more pronounced in the genotypes H 1117 and H 1250 whereas, lesser decrease was recorded in H 1226. Ahmad *et al.,* (2002) also reported that salt stress adversely affects the biomass production.

Different levels of salinity stress had variable effects on all the genotypes as well as on growth parameters. Maximum germination and speed of germination were observed in case of control. Similarly maximum root and shoot lengths and dry weight of seedlings were observed at minimum salinity level in all the genotypes. With the increasing levels of salinity there was a corresponding decrease in estimates of all the growth parameters which were dose and genotype dependent.

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