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Salt Tolerance of Cotton Cultivars in Relation to Relative Growth Rate in Saline Environments

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ABSTRACT

Relative growth rate (RGR) was used as a criterion to measure the salt tolerance of four cotton cultivars in salinized nutrient culture upto 75, 150 and 250 mol m^{-3} NaCl. The RGR of shoot and root were reduced to 24, 47 and 70% at salt concentrations of 75, 150 and 250 mol m^{-3}, respectively as compared to control. NIAB 78 gave higher RGR of shoot and root compared to MNH 93, D9 and Ravi in all salinity levels. By this growth parameter (RGR), NIAB 78 placed in the group of tolerant while D9 and Ravi to salt sensitive ones.

Key Words: Salinity; Relative Growth Rate; Cotton

INTRODUCTION

Salt tolerance is the ability of a plant to grow and complete its life on saline environment that contain high concentrations of salt, mostly NaCl but sometimes also other salts including calcium salts and sulphates. Salt. tolerance of plants not only varies considerably among species but also between varieties (Mass & Hoffman, 1977) Varietal differences in salt tolerance are closely related to the growth of a plant. This paper presents data to relate the relative growth rate of cotton cultivars to salt tolerance.

MATERIALS AND METHODS

Seeds of four cotton cultivars were germinated in silica sand culture in iron trays. Cotton seedling at two leaves were transferred to aerated half strength Hoaglands solution in plastic coated lined iron tanks (120 x 90 x 30 cm) covered with foam sheets having holes for holding plants supported on iron stands 90 cm above ground. The solution was aerated using an air compressor. The medium was changed to full strength Hoagland solution after establishment of the seedling. Nutrient solutions were salinized in increments of 25 mol m^{-3} per day upto the desired salinity levels (0, 75, 150 and 250 mol m^{-3} NaCI) which were maintained for the rest of the growth period. Two harvests were done (one on day 3 and the other on day 17 after salinization) to record dry matter yields of shoot, leaves, stem and roots. The relative growth rate was determined according to the following formula used by Salim and Pitman (1983).

$$RGR\ (\log_e w_2 - \log_e W_1) / \Delta T$$

Where W_2 = Dry weight of plant tissue (g) at harvest 2
W_1 = dry weight of plant tissue (g) at harvest 1
Δ = Difference in time (days)
RGR = Relative growth rate g (g plant tissue dry weight)$^{-1}$ day^{-1}

Table I. Relative Growth Rate g (g plant tissue D.W.)$^{-1}$ day $^{-1}$ of Different Cotton Cultivars Under Saline Conditions (H_1 to H_2)

	mol m^{-3} NaCI				
Variety	**0(Control)**	**75**	**150**	**250**	**Mean**
			SHOOT		
NIAB 78	0.1641	0.1481(90)	0.0884(54)	0.0795(48)	0.1200(73)
MNH 93	0.1741	0.1338(77)	0.0742(43)	0.0534(31)	0.1089(63)
D 9	0.1032	0.0758(74)	0.0673(65)	0.0205(20)	0.0667(65)
Ravi	0.1221	0.0703(58)	0.0674(55)	0.0157(13)	0.0689(53)
Mean	0.1409	0.1070(76)	0.0743(53)	0.0423(30)	
			ROOT		
NIAB 78	0.0873	0.0876(100)	0.0588(67)	0.0551(63)	0.0722(83)
MNH 93	0.0910	0.0787(87)	0.0506(56)	0.0357(39)	0.0640(70)
D 9	0.0699	0.0602(86)	0.0507(73)	0.0186(27)	0.0499(71)
Ravi	0.0785	0.0637(81)	0.0495(63)	0.0209(27)	0.0532(68)
Mean	0.0817	0.0725(89)	0.0524(64)	0.0326(40)	

Harvesting time : H_1 (3 days), H_2 (17 days), after salt stress.
Values in parenthesis ( ) represent percentages of respective controls.

Table II. Relative growth rate g (g plant tissue D.W.)$^{-1}$ day $^{-1}$ of Different Cotton Cultivars Under Saline Conditions (H_1 to H_2)

Variety	0(Control)	75	150	250	Mean
			mol m^{-3} NaCI		
			LEAF		
NIAB 78	0.1450	0.1298(90)	0.0795(55)	0.0762(53)	0.1076(74)
MNH 93	0.1510	0.1148(76)	0.0693(46)	0.0460(30)	0.0953(63)
D 9	0.1050	0.0646(62)	0.0575(55)	0.0159(15)	0.0608(58)
Ravi	0.1039	0.0608(58)	0.0536(52)	0.0117(11)	0.0575(55)
Mean	0.1262	0.0922(73)	0.0650(51)	0.0374(30)	
			STEM		
NIAB 78	0.1985	0.1842(93)	0.1058(53)	0.0865(44)	0.1438(72)
MNH 93	0.2039	0.1696(83)	0.0835(41)	0.0661(32)	0.1308(64)
D 9	0.1457	0.0997(68)	0.0914(63)	0.0364(25)	0.0933(64)
Ravi	0.1669	0.1183(71)	0.0995(60)	0.0279(17)	0.1032(62)
Mean	0.1787	0.1430(80)	0.0951(53)	0.0542(30)	

Harvesting time : H_1 (3 days), H_2 (17 days), after salt stress.
Values in parenthesis ( ) represent percentages of respective controls.

RESULTS AND DISCUSSION

Data show that RGR (root and shoot) decreased with increase in external salt concentration (Table I.). The RGR of shoot was 24, 47, and 70% lower at 75, 150 and 250 mol m^{-3} NaCI in the external solution, respectively as compared to the control. The RGR (shoot) was higher for NIAB 78 than all other cultivars at all the salinity levels while MNH 93 had slightly greater RGR than other in the case of control (Table I). The RGR differences among the cultivars were pronounced at the highest salinity level. Generally, the trends in RGR of leaf, stem (Table II) and root (Table I) at various salt concentration were similar. However, in the case of root, RGR was less affected at different salinity levels as compared to leaf and stem it was reduced by 11, 36 and 60% at 75, 150 and 250 mol m^{-3} NaCI levels, respectively compared with the control.

The growth rate was reduced with increase in salinity as was also observed in the case of other crops (Kingsbury *et al*., 1984; Pitman, 1984). The effect on RGR varied with salinity, tolerance level of the cultivar and the tissues involved; shoot was affected to a greater extent then root.

Tolerant cultivar (NIAB 78) had higher RGR than the sensitive cultivars and the differences were more striking at the highest salinity level (250 mol m^{-3} NaCI). Similar differences between cultivars of wheat (Kingsbury *et al.*, 1984; Rashid, 1986) and barley (Greenway, 1962a) have been reported earlier.

REFERENCES

Kingsbury, R.W., E. Epstein, and R.W. Pearcy, 1984. Physiological responses to salinity in selected lines of wheat. *Plant Physiol.,* 74: 417–23

Maas, E.V. and G.J. Hoffman, 1977 salt tolerance current assessment. *J. Irrig. Drainage Div. Am. Soc. Civil Engg*., 103: 115–34

Pitman, M.G., 1984. Transport across the root and shoot/root interactions. *In:* Staples, R.C. and G.H. Toenniessen (eds). *Salinity Tolerance in Plants, Strategies for Crop Improvement* pp: 93–123. John Wiley and sons

Rashid, A., 1986 Mechanisms of salt tolerance in wheat *Ph.D Thesis*, University Agriculture, Faisalabad–Pakistan

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