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Research Article

Assessment of salinity tolerance in tomato cultivars grown in Maharashtra, India.

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Abstract: The present study was undertaken to assess the genotypic variation for salinity tolerance in five commercial cultivars of tomato (*Solanum lycopersicum* L.) grown in Maharashtra. Growth parameters such as shoot length, root length, fresh weight and dry weight were assessed at control, 50 mM and 100 mM NaCl with Hoagland's solution. The shoot/root length and fresh/dry weight declined at 100 mM stress. Proline accumulated as a consequence of salt stress. On the basis of growth parameters and proline accumulation cultivars Abhinav and Rohini were tolerant, TO1389 and N2535 moderately tolerant and Naina sensitive towards salinity stress.

Keywords: Genotypic Variation, Tomato Cultivars, Salinity, *Solanum lycopersicum* L., Proline

Introduction

Soil salinity is a major abiotic stress occurring in arid and semi-arid regions of the world limiting crop productivity and quality (Foolad, 2004). Increment in saline areas is due to low rainfall, high evaporation, native rocks, saline irrigation water, poor water management and disproportionate use of chemical fertilizers (Dasgan *et. al.*, 2002; Mahajan and Tuteja, 2005; Li *et. al.,* 2011). Salinity retards the ability of plant to absorb water due to reduced water potential in the root zone. It leads to increased accumulation of Na^+ and Cl^- ions and nutritional imbalance thus limiting overall plant growth and development (Arzani, 2008). Plants subjected to salt stress accumulate compatible solutes such as proline for osmotic adjustment. Proline helps the plant in activating multiple responses required for its adaptation towards salt stress (Szabados and Savoure, 2010).

Currently in India, more than 9 million hectares of land is salt affected which is rapidly increasing (Vijayan *et al.,* 2004). Implementing corrective measures for salinity in field and greenhouse is usually expensive and temporary. Screening and selection for salt tolerance is a more promising approach for reducing the detrimental effects of salinity (Singh *et al.,* 2012). Genetic diversity amongst plant species and cultivars within crop species provide a valuable tool for screening and breeding for improved salt tolerance (Arzani, 2008). Most of the commercial cultivars of tomato (*Solanum lycopersicum* L.), a popular vegetable valued for its important nutrients such as lycopene, β-carotene, flavonoids and vitamin C (Gerszberg *et al.,* 2015) are moderately sensitive to salinity at all stages of plant development hampering their productivity (Foolad, 2004). Therefore, the present study was undertaken to assess the genotypic variation for salinity tolerance in five commercial cultivars of tomato grown in Maharashtra for their better adaptability under salinity stress.

Materials and Methods

Seeds of five tomato cultivars (Abhinav, TO1389 from Syngenta Seeds; Naina from Monsanto Seeds; N2535 from Namdhari Seeds and Rohini from Indo-American hybrid seeds) were sown in plastic pots (8.5 x 7.5 cm) filled with washed, sterilized sand (received as a kind gift from Dr. A.K. Mathur, Ex-Chief Scientist and Presently Consultant, CIMAP, Lucknow, India) and kept in dark for germination. On emergence of first two true leaves the seedlings were transferred to shade net and irrigated with 50 ml half-strength Hoagland solution. Fifteen-day old seedlings were divided into three groups (each containing five pots) for salt treatment. The first group served as control, the second as 50mM NaCl and the third as 100mM NaCl. Control received half-strength Hoagland solution while rest of the two received Hoagland solution supplemented with NaCl (50 and 100 mM) twice at 12 days interval till the final concentration was achieved. The plants were harvested after five weeks and growth parameters such as shoot length, root length and fresh weight were recorded. For determining dry weight the plants were oven dried at 60ºC for 48 hrs and weighed.

Proline was estimated according to Bates *et al.,* 1973 with slight modification (Mishra and Saxena, 2009). Oven dried plant material (shoot) was crushed and weighed (50 mg) into 1.5 ml centrifuge tubes. Sulphosalicylic acid (3%, 1.2 ml) was added to precipitate protein. Samples were mixed, centrifuged at 18,000 x g for 10 min. and filtrate transferred to a

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fresh 1.5 ml centrifuge tube. Filtrate (0.5 ml) was made to 1 ml with distilled water, glacial acetic acid (1 ml) and ninhydrin reagent (1 ml) added and tubes kept for 1 h at 90º C. The tubes were cooled in ice and toluene (2 ml) was added and vortexed. The toluene layer was aspirated and the absorbance read at 520 nm. Proline concentration was expressed as μmol gfwt^{-1} using proline standard (0 to 50 μg/ml).

Results and Discussion

Salinity inhibited overall growth amongst all the tomato cultivars. Reduction in shoot length, root length, fresh weight and dry weight became evident at 100 mM stress. The average shoot length on control was 11.9 ± 1.11 cm while it was 8.55 ± 1.01 cm on 100 mM stress showing 28.65% reduction (Table 1). The decrease in shoot length at 100 mM stress over control was: Abhinav 27.04%, Rohini 22.68%, TO1389 29.72%, N2535 31.1% and Naina 36.01%. The average root length was 6.00 ± 0.45 cm on control which reduced to 4.99 ± 0.50 cm at 100 mM stress showing reduction of 16.85% (Table 1). Inhibition in root length at 100 mM stress as compared to control was: Abhinav 12.41%, Rohini 11.85%, TO1389 14.55%, N2535 15.37% and Naina 31.74%. Salinity adversely affects root growth because of water deficit in the root zone, intervention of saline ions with nutrient uptake or excessive accumulation of ions leading to toxicity and cell death (Cuartero and Munoz 1999). Although there was negative impact of salt stress on root, the root growth was less affected compared to shoot growth amongst all the tomato cultivars as the root to shoot growth ratio increased in presence of salinity stress. The average root to shoot growth ratio on control was 0.51 ± 0.02 which increased to 0.59 ± 0.02 at 100 mM stress showing an increment of 13.55% (Table 1). The rise in root to shoot growth ratio under salt stress might be due to greater distribution of plant assimilates towards root as shoot growth is relatively reduced in presence of salinity induced water deficit (Parida and Das, 2005, Singh *et al.,* 2011). The average fresh weight was 2.096 ± 0.287 g on control which decreased to 1.265 ± 0.220 g in presence of 100 mM salt stress showing a reduction of 39. 62 %(Table 2). Decline in fresh weight at 100 mM stress over control was in the following order: Abhinav 34.12%, Rohini 39.38%, TO1389 40.80%, N2535 43.01% and Naina 45.85%. The dry weight showed a declining trend with increase in salt stress. On control the average dry weight was 0.195 ± 0.023g that lowered to 0.111 ± 0.017g at 100 mM showing a reduction of 42.97% (Table 2). The decrease in dry weight at 100 mM stress as compared to control was: Abhinav 38.25%, Rohini 41.45%, TO1389 44.77%, N2535 46.06% and Naina 47.50%. The genotypic variation for salinity tolerance in tomato cultivars observed in the present study corroborates with earlier studies (Perez-alfocea *et al.,* 1993, Alian *et al.,* 2000; Dasgan *et al.,* 2002; Juan *et al.,* 2005, Singh *et al.,* 2012).

Table 1. Growth parameters in five tomato cultivars exposed to salinity.

	NaCl (mM)								
Cultivars	0			50			100		
	SL	RL	R:S	SL	RL	R:S	SL	RL	R:S
Abhinav	15.35	7.25	0.47	17.9	9.44	0.53	11.20	6.35	0.57
Naina	9.65	5.75	0.60	9.32	5.8	0.62	6.18	3.93	0.64
N2535	10.00	4.75	0.48	12.06	6.55	0.54	6.89	4.02	0.58
Rohini	13.80	6.75	0.49	15.75	8.55	0.54	10.67	5.95	0.56
TO1389	11.13	5.50	0.49	13.10	7.25	0.55	7.83	4.70	0.60
Mean	11.99	6.00	0.51	13.63	7.52	0.56	8.55	4.99	0.59
SE	1.11	0.45	0.02	1.48	0.59	0.02	1.01	0.50	0.01

SL - Shoot Length (cm); RL - Root Length (cm); R: S - Root: Shoot Growth Ratio

Table 2. Effect of salinity on fresh and dry weight of five tomato cultivars.

	NaCl (mM)					
Cultivars	0		50		100	
	FW	DW	FW	DW	FW	DW
Abhinav	3.195	0.285	2.748	0.242	2.105	0.176
Naina	1.625	0.160	1.125	0.110	0.880	0.084
N2535	1.725	0.165	1.265	0.116	0.983	0.089
Rohini	2.118	0.193	1.783	0.155	1.284	0.113
TO1389	1.816	0.172	1.428	0.134	1.075	0.095
Mean	2.096	0.195	1.670	0.151	1.265	0.111
SE	0.287	0.023	0.291	0.024	0.220	0.017

FW- Fresh Weight (g); DW-Dry Weight (g)

Accumulation of proline was evident amongst all the cultivars under the influence of salinity stress. At 100 mM salt stress Abhinav accumulated 2.4 folds, Rohini 2.8 folds, TO1389 2.0 folds, N2535 1.7 folds and Naina 1.4 folds more proline as compared to their respective control (Fig. 1). Accumulation of proline was marginally higher in Abhinav and Rohini, followed by TO1389 and N2335 and least in Naina. Increment in proline in response to salt stress is genotype dependent. Its accumulation is generally higher in salt tolerant cultivar which serves as an indicator of tolerance potential amongst the cultivars (Mishra and Gupta, 2005, Niknam*et al.,* 2006).

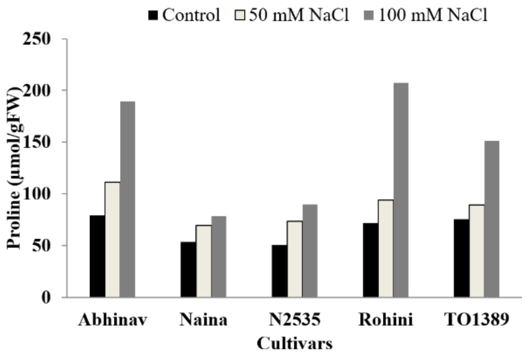

Fig. 1. Proline accumulation in five tomato cultivars exposed to salinity.

Conclusion

Based on growth parameters and proline accumulation the five tomato cultivars were categorized as tolerant (Abhinav and Rohini), moderately tolerant (TO1389 and N2535) and sensitive (Naina) towards salinity stress. The significance of this study is in screening commercial tomato cultivars and suggesting appropriate cultivars to farmers for cultivation in saline areas.

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References

1. Alian A, Altman A, Heuer B, Genotypic difference in salinity and water stress tolerance of fresh market tomato cultivars. *Plant Sci.* 152 (2000): 59-65. Print
2. Arzani A, Improving salinity tolerance in crop plants: a biotechnological view. *In Vitro Cell. Dev. Biol.-Plant.* 44 (2008): 373-383.Online
3. Bates LS, Waldren RP, Teare ID, Rapid determination of free proline for water stress studies. *Plant Soil.* 39 (1973): 205-207. Print
4. Cuartero J, Fernandez-Munoz R, Tomato and salinity. *Scientia Hort.* 78 (1999): 83-125. Print
5. Dasgan HY, Aktas H, Abak K, Cakmar I, Determination of screening techniques to salinity tolerance in tomatoes and investigation of genotypes response. *Plant Sci.* 163.4 (2002): 695-703. Print
6. Foolad MR, Recent advances in genetics of salt tolerance in tomato. *Plant Cell Tiss. Org. Cult.* 76 (2004): 101-119.Online
7. Gerszberg A, Hnatuszko-Konka K, Kowalcyzk T, Kononowicz AK, Tomato (*Solanum lycopersicum* L.) in the service of biotechnology. *Plant Cell Tiss. Organ Cult.* 120 (2015):881-902. Print
8. Juan M, Rivero RM, Romero L, Ruiz JM, Evaluation of some nutritional and biochemical indicators in selecting salt-resistant tomato cultivars. *Environ. Expt. Bot.* 54 (2005): 193-201.Print
9. Li J, Liu L, Bai Y, Zhang P, Finkers R, Du Y, Visser R G F, van Heusden AW, Seedling salt tolerance in tomato. *Euphytica* 178 (2011): 403-414.Online
10. Mahajan S, Tuteja N, Cold, salinity and drought stresses. An overview. *Arch. Biochem. Biophys.* 444 (2005):139-158.Print
11. Misra N, Gupta AK, Effect of salt stress on proline metabolism in two high yielding genotypes of green gram. *Plant Sci.* 169 (2005): 331-339.Print
12. Mishra N, Saxena P, Effect of salicylic acid on proline metabolism in lentil grown under salinity stress. *Plant Sci.* 177 (2009): 181-189.Print
13. Niknam V, Razavi N, Ebrahimzadeh H, Sharifizadeh B, Effect of NaCl on biomass, protein and proline contents, and antioxidant enzymes in seedlings and calli of two *Trigonella* species. *Biologia Plantarum* 50. 4 (2006): 591-596.Online
14. Parida A K, Das A B, Salt tolerance and salinity effects on plants: a review. *Ecotoxicology and Environmental Safety* 60 (2005): 324-349.Online
15. Perez-alfocea F, Estan MT, Caro M, Bolarin MC, Response of tomato cultivars to salinity. *Plant Soil* 150 (1993): 203-211.Print
16. Singh J, Divakar Sastry E V, Singh V, Effect of salinity on tomato (*Lycopersicon esculentum* Mill.) during seed germination stage. *Physiol Mol.Biol. Plant* 18 (2012): 45-50. Online
17. Szabados L, Savoure A, Proline: a multifunctional amino acid. *Trends in Plant Science* 15 (2009): 89-97. Online
18. Vijayan K, Chakraborti SP, Ghosh P D, Screening of mulberry (*Morus* spp.) for salinity tolerance through in vitro seed germination. *Indian J Biotecnol.* 3 (2004): 47-51. Online

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