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SHORT COMMUNICATION

EFFECT OF SALINITY ON ANTIOXIDANT ENZYMES IN WHEAT

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The effect of salinity on antioxidant metabolites and antioxidant enzymes activity was studied in two wheat (*Triticum aestivum* L.) genotypes GW-322 (salt susceptible) and Raj-3077 (salt tolerant) grown for 10 days under the influence of 100 mM salinity. Seeds were primed with 50 ppm ascorbic acid, 50 ppm gibberellic acid and 100 ppm salicylic acid for 4 h followed by germination in 100 mM of sodium chloride. Contents of proline, ascorbic acid and activities of catalase and superoxide dismutase were examined in the seedlings at the end of experiment. Salinity increased the proline content, catalase and superoxide dismutase activity and decreased the ascorbic acid content. Deleterious effect of salinity was counteracted by ascorbic acid, gibberellic acid and salicylic acid.

Key words : **Antioxidants, antioxidant enzymes, salinity, wheat**

Salinity is one of the major problems in irrigated agriculture, particularly in wheat and rice grown areas. The increasing pressure of population and the dwindling land resources had made it necessary to get better production from saline lands. However, most crop plants are glycophytes and their growth is severely retarded by salt stress. Environmental stresses are thought to result in the production of reactive oxygen species (ROS) in plants, causing oxidative stress (Smirnoff 1993, Gossett *et al*. 1994 and Hernandez *et al*. 2000). The ability of higher plants to scavenge the toxic ROS seems to be a very important determinant of their tolerance to environmental stresses. The various components of this antioxidant system include carotenoids, flavonoids, phenolic compounds as well as antioxidant enzymes such as catalase and peroxidase (Ali and Abbas 2003). Presoaking seeds with optimal concentration of phytohormones has been shown to be beneficial to growth and yield of some crop species under saline condition by increasing nutrient reserves through increased physiological activities and root proliferation (Singh and Dara 1971). The present study evaluates the effect of pretreatment seed soaking with ascorbic acid, gibberellic acid and salicylic acid on antioxidant defense system as affected by salinity.

The seeds were sterilized with 0.1% mercuric chloride for a minute and thoroughly washed with distilled water. Seeds were soaked in distilled water, 50 ppm ascorbic acid, 50 ppm gibberellic acid and 100 ppm salicylic acid solutions for 4 h before they were soaked in Hoagland solution with salinity (100 mM). Seeds were then transferred to sterile petridishes containing two sheets of blotting paper moistend with 10 ml of Hoagland solution. Each petridish contained 10 seeds. Each treatment was replicated three times. The seeds were allowed to germinate at 25 ºC with 12 h light/dark photoperiod and relative humidity of 50±2 % in seed germinator. Seedlings were allowed to grow for 10 days and 10 ml of Hoagland solution was added on the 5th day. The seedlings were harvested on 10th day and the following parameters were analyzed by standard methods. Proline was estimated by the method of Bates *et al.* (1973), ascorbic acid was estimated by the method

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Table 1. Proline, ascorbic acid, catalase and superoxide dismutase content in two wheat varieties under different treatments

Treatments	Proline (mg g^{-1})		Ascorbic acid (mg g^{-1})		Catalase (units mg^{-1})		Superoxide dismutase (units mg^{-1})	
	GW -322	Raj -3077	GW- 322	Raj -3077	GW- 322	Raj -3077	GW –322	Raj- 3077
T_1	3.663	2.959	3.469	3.566	116.667	250.833	136.470	158.667
T_2	6.480	5.664	2.936	3.192	343.333	344.167	167.000	205.833
T_3	5.218	4.141	3.703	3.816	185.000	211.667	77.468	73.536
T_4	5.252	4.206	3.579	3.661	127.500	200.833	40.750	39.590
T_5	5.304	4.281	3.606	3.691	152.500	215.000	48.611	45.804
SEm ±	0.051		0.027		5.108		2.007	
CD at 5 %	0.150		0.081		15.069		5.921	
CD at 1 %	0.205		0.111		20.554		8.077	

Where, T_1 : Control, T_2 : 100 mM salinity, T_3 : 50 ppm Ascorbic acid + 100 mM salinity, T_4 : 50 ppm Gibberellic acid + 100 mM salinity, T_5 :100 ppm Salicylic acid + 100 mM salinity

of Freed (1966), CAT was assayed by measuring the residual H_2O_2 (Masia 1998) and SOD was assayed by its ability to inhibit the photochemical reduction of NBT (Asada *et al.* 1974).

The effects of pretreatment on proline, ascorbic acid, catalase and superoxide dismutase are illustrated in Table 1. In this study it was observed that 100 mM salinity increased proline content while ascorbic acid decreased significantly in both the varieties (GW-322 and Raj-3077). Presoaking of seeds with ascorbic acid, gibberelic acid and salicylic acid reduced the adverse effect of salinity by decreasing the proline content as compared to saline treatment alone. The ascorbic acid was increased when compared with the control. Proline is a marker of stress, change in proline level in several crops and cell cultures have been correlated with their ability to tolerate or adopt to salinity (Choudhary *et al.* 1993). Ascorbic acid is an antioxidant which can scavenge O_2 and H_2O_2 nonenzymatically and also takes part in APX (ascorbate peroxidase) mediated scavenging of H_2O_2 (Asada 1992). The plant hormones decreased the deleterious effect of salinity and increased the ascorbic acid content (Sairam and Srivastva 2002 and Mittova *et al.* 2004).

It was found that salinity caused the increase in catalase and SOD activity in both the varieties as compare to control. The effect was more significant in salt susceptible variety GW-322. High level of anti-oxidative enzymes are a part of biochemical and physiological make up involved in salt tolerance and ameliorate the oxidative damage arising from salt stress (Sairam and Srivastva 2002). Hormonal priming reduced the salinity effect and lowered the enzyme activity (Sharma and Sharma 2005). From the present study it appears that priming of seeds with growth regulators might help the plants in adaptation to salinity by supplementing the endogenous content of hormones and reducing the oxidative breakdown by controlling the activity of enzymes and there by improving the growth and yield under salinity (Zaidy and Singh 1995).

REFERENCES

Ali, R.M. and Abbas, H.M. (2003). Response of salt stressed barley seedlings to phenylurea. *Plant Soil Environ.* **49:** 158-162.

Asada, K. (1992). Ascorbate pesoxidase a hydrogen peroxide scavenging enzyme in plants. *Physiol. Plant.* **55:** 235-241.

Asada, K., Takahashi, M. and Nagate, M. (1974). Assay and inhibitors of spinach superoxide dismutase. *Agril. Biol. Chem.* **38:** 471-473.

Bates, L.S., Waldren, R.P. and Teere, I.D. (1973). Rapid determination of free proline for water stress studies. *Plant Soil.* **39:** 205-207.

Choudhury, J.B., Jain, S. and Jain, R.K. (1993). Biotechnological approaches for developing salt-tolerant crops. *J. Plant Biochem. Biotech.* **2:** 1-7.

Freed, D.W. (1966). Methods of vitamin assay. *Intl. Sci.* London. 306-312.

Gossett, D.R., Millhollon, E.P. and Changes, M.C. (1994). Lucas in antioxidant levels in response to NaCl treatment in salt tolerant and sensitive cultivars of cotton, *Gossypium hirsutum* L. *Crop Sci.* **34:** 706-714.

Hernandez, J.A., Jimenez, A., Mullineaux, P. and Sevilia, F. (2000). Tolerance of pea (*Pisum sativum L.*) to long-term salt stress is associated with induction of antioxidant defences. *Plant Cell Environ.* **23:** 853-862.

Masia, A. (1998). Superoxide dismutase and catalase activities in apple fruit during ripening and post-harvest and with special reference to ethylene. *Plant Physiol.* **104:** 668-672.

Mittova, V., Guy, M., Tal, M. and Volokita, M. (2004). Salinity upregulates the antioxidative system in root mitochondria and peroxisomes of the wild salt tolerant tomato species *Lycopersicon pennellii. J. Exp. Bot.* **55:** 1105-1113.

Sairam, R.K. and Srivastava, G.C. (2002). Changes in antioxidant activity in sub-cellular fractions of tolerant and susceptible wheat genotypes in response to long term salt stress. *Plant Sci.* **162:** 897-904.

Sharma, M.K. and Sharma, V. (2005). Effect of growth regulators on salinity induced physiological and biochemical parameters of tolerant and susceptible wheat genotypes at seedling stage. *J. Cell Tissue Res.* **5:** 44.

Singh, H. and Dara, B.L. (1971). Influence of presoaking of seeds with gibberellin and auxins on growth and yield attributes of wheat (*Triticum aestivum* L.) under high salinity, sodium adsorption ratio and boron levels. *Indian J. Agri. Sci.* **41:** 998-1003.

Smirnoff, N. (1993). The role of active oxygen in the response of plants to water deficit and desiccation. *New Phytol.* **125:** 27-58.

Zaidy, P.H. and Singh, B.B. (1995). Effect of growth regulators on IAA oxidase and peroxidase activity in soyabean under salinity. *Indian J. Plant Physiol.* **38:** 337-339.