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Effect of salinity stress on antioxidant enzymes in the leaves of Trianthema portulacastrum L.

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Abstract *Salinity is one of major abiotic stresses that adversely affect crop productivity and quality. In the present investigation effect of NaCl salinity on antioxidant enzymes of the leaves of sodium loving plant Trianthema portulacastrum L. was studied. The antioxidant enzymes such as catalase (CAT), peroxidase (POX) increased up to 200 mM NaCl concentration and beyond these levels the contents decreased marginally. The activity of superoxide dismutase increased with increasing NaCl salinity levels in both the culture media. This increased activity of SOD might be helping in reducing the toxic effects of ROS in these plants under stress conditions.*
Keywords: *Antioxidant enzymes, Salinity, Trianthema, catalase, peroxidase, superoxide dismutase*

I. Introduction:

Soil salinity problem has been widely discussed all over the world. Some of productive soils are converted into the saline soils due to over irrigation, improper water management, poor drainage and excess use of fertilizers. Application of heavy doses of fertilizers and over irrigation lead to accumulation of salts like chlorides, sulphates, carbonates etc. in the soil and it becomes saline/ alkaline. The solution to make use of such soils for crop production is soil reclamation which is very costly and hence cannot be practiced in our country. Another approach to solve this problem is a selection of or breeding for salt tolerant plants. Some crops have been screened for their salt tolerance and the crops like barley, cotton and sugar beet are found to be salt tolerant (Mass and Hoffman 1977).

Various abiotic stresses act as a catalyst in producing free radicals where reactive oxygen species (ROS) e.g. superoxide (O_2^-), hydroxyl (OH^-) and hydrogen peroxide (H_2O_2) are produced (Caverzan *et. al*., 2012). Production of ROS is localized in the chloroplast, mitochondria and Peroxisome in plants which grow in stressed conditions. These reactive oxygen species cause membrane lipid peroxidation, destroy chlorophylls, reduce photosynthesis and inhibit enzymes e.g. NADH-oxidase and glutamine synthetase.

For survival, plants under stress condition develop antioxidants. These are of two types, enzymatic components e.g. superoxide dismutase, catalase and ascorbate peroxidase, while non enzymatic antioxidants are ascorbic acid, carotenoids and osmolyte proline (Larson, 1988; Gratao *et.al*., 2005; Scandalios, 2005). Antioxidants keep reactive oxygen species at low concentrations, avoiding oxidative damage in plant cells (Matamoros *et al*., 2010).The present study was made to investigate the effect of NaCl on antioxidant enzymes in the leaves of *Trianthema portulacastrum* L. grown in sand and soil culture.

II. Material and Methods:

The plants were raised from seeds in acid free silica with Hoagland medium as well as in soil culture. After stabilizing the plants under natural conditions for one month, salt treatments were commenced. The plants were treated with control (0.00) 100 mM, 200 mM, 300 mM NaCl twice a week alternating with watering the plants with equal amount of water to avoid salt accumulation and to check the loss of water due to evaporation. Two months after the growth in saline media the plants were analyzed for different parameters.

A) Catalase (E.C.1.11.1.6) & Peroxidase (E.C.1.11.1.7): The activity of enzyme catalase and peroxidase was determined by the method described by Maehly (1954).

B) Superoxide dismutase (E.C.1.15.1.1): Superoxide dismutase was determined by the method described by Giannopolitis and Ries (1977).

III. Result and Discussion:

A) Effect of salinity on catalase activity:

The effect of NaCl salinity on the activity of enzyme catalase, both on fresh tissue and protein basis, in the leaves of *Trianthema portulacastrum* L. grown in sand and soil culture is shown in Fig.1a and 1b. It is clear that in both the culture media the activity of enzyme catalase, both on fresh tissue and protein basis is increased only at low conc. (100 mM) of salinity, but later on at higher salinity level its activity decreased.

Enhanced activity of catalase was reported to be essential for the survival of the halophytes; *Halimions portulacoides* in natural saline habitats (Kalir and Poljak 1981).The catalase activity was decreased with increasing salinity level in sunflower (Saha and Gupta, 1997). Saraf (2013) has reported in increase in catalase activity of *vigna radiata* in presence of the salt stress. Catalase activity in leaves of *Phaseolus vulgaris* was decreased due to salinity (Tejera *et.al*; 2007).

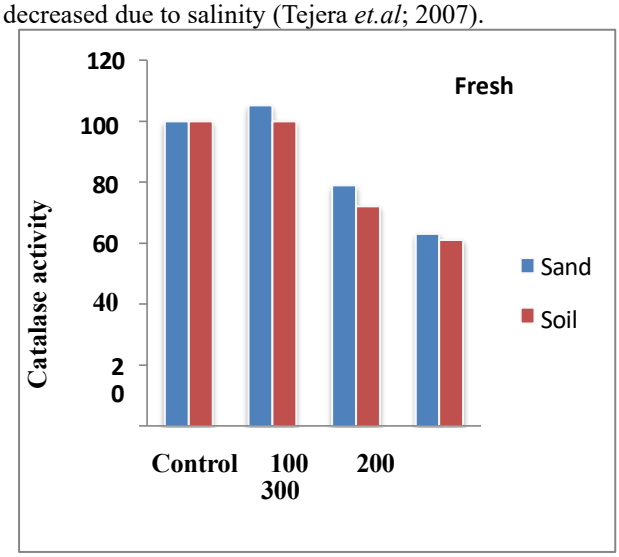

Fig. 1a.Effect of NaCl salinity on the activity of enzyme catalase (Δ.O.D.min-1.g-1.fresh tissue) in the leaves of *Trianthema portulacastrum* L. grown in sand and soil cultures.

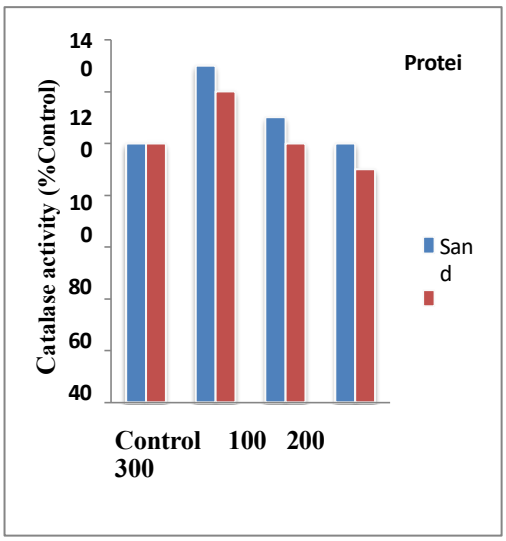

Fig. 1b Effect of NaCl salinity on the activity of enzyme catalase (Δ.O.D.min^{-1}.mg^{-1}.protien) in the leaves of *Trianthema portulacastrum* L. grown in sand and soil

B) Effect of salinity on peroxidase activity:

The effect of NaCl salinity on the activity of enzyme peroxidase, both on fresh tissue and protein basis, in the leaves of *Trianthema Portulacastrum* L. grown in sand and soil culture is shown in fig.2. The activity of this enzyme, both on fresh tissue and protein basis is increased upto 200mM NaCl conc. but later on at higher salinity level its activity decreases.

Peroxidase is involved in many physiological processes in plants, involving responses to biotic and abiotic stresses. An increased peroxidase activity helps the plants to protect against salt conditions (Passardi *et al*., 2005). Kate (2008) reported that peroxidase activity was increased in the leaves of *Tribulus* and *Pedalium* with increasing salinity up to 200 mM NaCl and then decreased under higher concentrations.

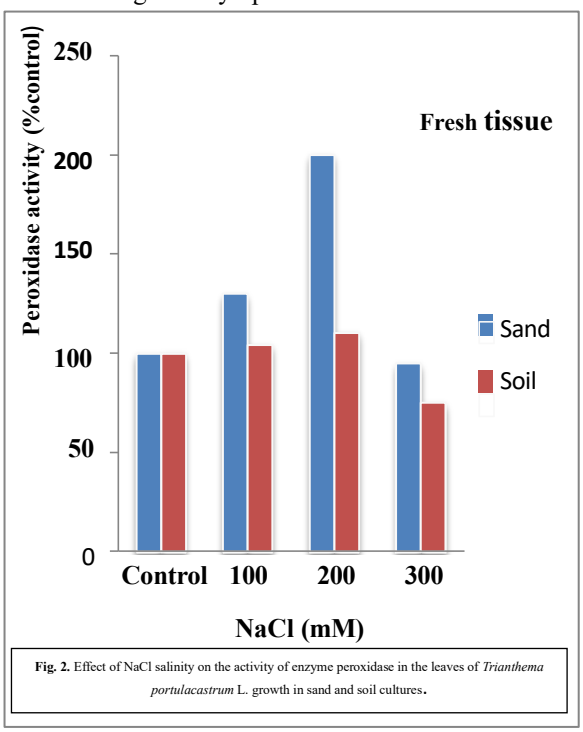

Fig. 2. Effect of NaCl salinity on the activity of enzyme peroxidase in the leaves of *Trianthema portulacastrum* L. growth in sand and soil cultures.

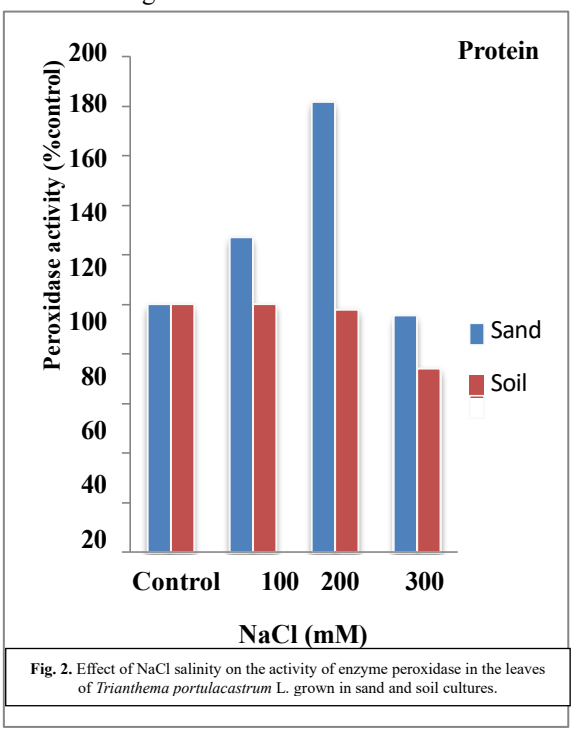

Fig. 2. Effect of NaCl salinity on the activity of enzyme peroxidase in the leaves of *Trianthema portulacastrum* L. grown in sand and soil cultures.

C) **Effect of salinity on superoxide dismutase (E.C.1.15.1.1):**

SOD serves a key antioxidant role; it plays a major role in the defense mechanism against the toxic effects of increased level of ROS, which are generated as byproducts of many biological oxidations. Activity of this enzyme in the leaves is increased with increasing NaCl concentrations over the control in both culture media. It shows perfect correlation with salinity stress by increasing about 2 to 28% in sand culture and 6 to 22% in soil culture over the control. Koca *et al.* (2006) found that superoxide dismutase activity was increased in the leaves of *Lycopersicon esculentum* and *Lycopersicon pennellii* due to salinity. Goa *et al*. (2008) reported that SOD activity was increased in the seedlings of *Jatropha curcas* L. Carrasco and Pinto (2014) observed a decrease in the activity of SOD in two corn cultivars due to salinity. This increased activity of SOD might be helping in reducing the toxic effects of ROS in these plants under stress conditions.

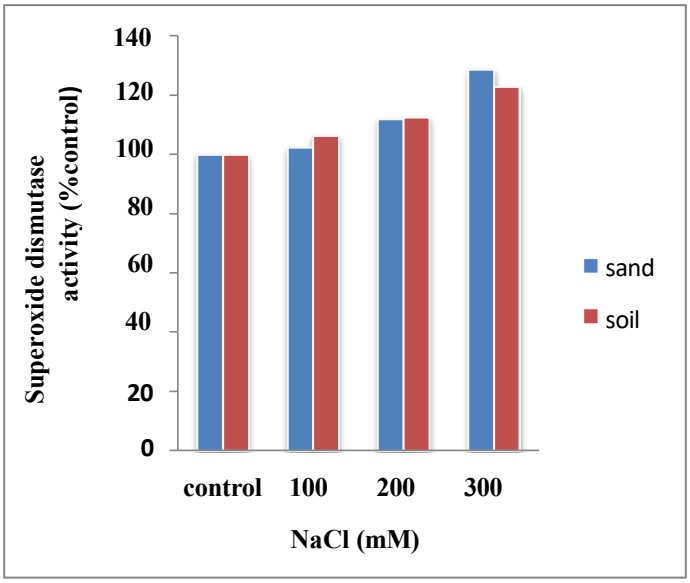

Fig.3. Effect of NaCl salinity on the activity of enzyme superoxide dismutase in the leaves of *T. portulacastrum* L. growth in sand and soil cultures.

IV. Conclusion:

Activity of both enzymes i.e. catalase and peroxidase decreased only at higher level of salinity; while activity of superoxide dismutase increased with increasing salinity levels. It appears that salinity act as catalyst in producing free radical reactions resulting in oxidative stress where reactive oxygen species are produced. These ROS are dismuted by SOD whose activity was increased with the increasing salinity level. This increased activity of SOD helps in reducing the toxic effects of ROS in this plant under adverse conditions.

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