

ANTI-OXIDANT ENZYME ACTIVITY OF SUGARCANE (*Saccharum officinarum* L.) GENOTYPES FOR MOISTURE STRESS

ABSTRACT

The bio-chemical activity in eight Sugarcane genotypes was studied in a poly bag experiment at Agricultural Research Station, Basanthpur, Medak, India. The anti-oxidant enzyme activity in terms of superoxide dismutase and peroxidase activity in sugarcane genotypes increased upon exposure to moisture stress for 20 days at formative stage and the maximum was found in the varieties Co 95020 and Co 87025 ranging from 109 to 122 and 20 to 21 eu/100ml/gram fresh weight, respectively. The biochemical activity thus was invariably associated with better crop performance under moisture stress conditions.

Key words: Superoxide dismutase, Peroxidase, Moisture stress.

INTRODUCTION

~~In the present scenario of climate change, plants are exposed to adverse environmental conditions and drought has become a major abiotic factor that can damage their growth and development. As for any crop, water is essentially required during vegetative growth to harness maximum yield and drought events in this stage can significantly affect productivity of the crop. Sugarcane (*Saccharum officinarum* L.) is a C₄ crop which produce higher amount of biomass per unit cultivated area and its water requirement varies with the development stages, thus the highest water requirement being observed at maximum tillering and culm development stages than during the maturation stage, when this need would be diminished. This indicates that formative stage is the most important one for growth and yield.~~

When plants are subjected to various abiotic stresses, some reactive oxygen species (ROS) such as the superoxide radical, hydrogen peroxide and hydroxyl radical can cause lipid peroxidation and consequently membrane injury which leads to leakage of cellular content, protein degradation, enzyme inactivation, pigment bleaching and disruption of DNA strands and thus cell death. They initiate destructive oxidative processes. However, antioxidant enzymes like superoxide dismutase (SOD), catalase and peroxidase play a key role in scavenging those activated species (Swamy *et. al.*, 2011). The relation between drought stress and enzymatic antioxidant systems has been studied in some plant species (Sairam *et. al.*,

2002; Suman *et. al.*, 2013) and was noted that enhanced production of oxygen free radicals is responsible for peroxidation of membrane lipids and the degree of peroxides damage of cell was controlled by the potency of peroxidase enzyme system. Also, plants have developed a series of both enzymatic and non-enzymatic detoxification systems to counteract antioxidant system, thereby protecting cells from oxidative damage (Sairam and Tyagi, 2004). Thus, the modulation of the activity of these enzymes was found to be an important factor in the tolerance of various plants to environmental stress.

40

41 MATERIALS AND METHODS

42 The poly bag experiment was carried out during *rabi*, 2013-14 at Agricultural
43 Research Station, Basanthpur, Medak district of Telangana state situated at 17° 47' East
44 longitude and 77° 32' North latitude. It comes under peninsular India situated at an altitude of
45 645 m above mean sea level. The experiment was laid out in randomized block design with
46 eight Sugarcane genotypes (Co 86032, Co 87025, Co 8014, 2003 V 46, 97 R 129, Co 94012,
47 97 R 401 and Co 95020) in three replications. Bud chip seedlings of the above varieties were
48 planted in poly bags and were grown under normal conditions. The plants in the polybags
49 were exposed to stress by with-holding irrigation for 20 days at formative stage i.e., at 120
50 DAP. After relieving of stress, the plants were removed from the bags and observed for
51 antioxidant enzyme activity in terms of superoxide dismutase (SOD) and peroxidase activity
52 (POX) as affected by stress at formative stage. The activity of SOD and POX in the plants
53 was measured as per the standard procedures given by Misra and Fridovich (1972) and
54 Chance and Meahley (1955), respectively and was expressed in eu/100ml/ gram fresh weight.

55

56 RESULTS AND DISCUSSION

57 Stress imposed during formative stage in sugarcane genotypes showed significant
58 difference in SOD activity throughout the stress period (Table 1 and Fig 1). The Superoxide
59 dismutase activity of different Sugarcane varieties up-on exposure to moisture stress for 20
60 days ranged from 50.04 to 122.04 eu/100ml/ gram fresh weight. Significantly highest SOD
61 activity was observed in the varieties Co 95020 and Co 87025 which being on par recorded
62 SOD values of 122.04 and 109.12 eu/100ml/ gram fresh weight, respectively. Conversely the
63 varieties, Co 8014, 97 R 401 and 2003 V 46 registered lowest SOD values of 50.04, 57.90
64 and 68.60 eu/100ml/ gram fresh weight, respectively. The increase in SOD activity in the
65 varieties Co 95020 and Co 87025 by combating oxidative stress and by decreasing the

deleterious effect of H_2O_2 under drought stress (Alscher *et al.*, 2002) might had made them capable to tolerate drought as compared to other varieties. The results are in agreement with Halliwell and Gutteridge (1990).

Similar to SOD values, the peroxidase activity in Sugarcane varieties also showed significant variations when exposed to moisture stress for 20 days during the formative stage. The peroxidase activity was significantly highest in Co 95020 (21.24 eu/100ml/ gram fresh weight) and Co 87025 (20.60 eu/100ml/ gram fresh weight) compared to other genotypes. The remaining varieties viz., Co 86032, 97 R 129, Co 94012, 2003 V 46, 97 R 401 and Co 8014 being on par registered low POX values ranging from 13.21 to 15.60 eu/100ml/ gram fresh weight.

Moisture stress leads to oxidative stress through an increase in ROS such as superoxide ($O_2^{\cdot -}$), hydrogen peroxide (H_2O_2) and hydroxyl radicals ($OH^{\cdot}$) which attack the most sensitive biological macromolecules like lipids, proteins and nucleic acids, cause lipid peroxidation mainly at membranes to impair their function. Plants have an enzymatic and non-enzymatic system that protects them against the damage of ROS. The anti oxidative enzymes include superoxide dismutase, peroxidase, glutathione reductase and catalase. Peroxidase and catalase detoxify the hydrogen peroxide, which accumulates in the plants under water stress. As the increase in peroxidase activity in the varieties Co 95020 and Co 87025 might be due to formation of large amount of H_2O_2 during water stress.

CONCLUSION

Increase in anti-oxidant enzyme activity viz., superoxide dismutase and peroxidase in the varieties Co 95020 and Co 87025 is an indication that these varieties can perform well under moisture stress by tolerating oxidative stress and detoxifying H_2O_2 which form in large quantities during moisture stress as compared to the other varieties.

REFERENCES:

- Alscher R G, Erturk N, Heath L S. Role of superoxide dismutases (SODs) in controlling oxidative stress in plants. *J. Exp. Bot.*2002; 53: 1331-1341.
- Chance B and Meahley A C. Methods in enzymes assay of Catalase and Peroxidase. Methods in enzymology – II. Academic press Inc. Publication, New York.1955; 773-775.

- 97 Halliwell B and Gutteridge J. Free radicals and catalytic metal ions. *Methods Enzymes*. 1990;
98 186: 1-16.
- 99 Misra H P and Fridovich I. The generation of superoxide radical during auto oxidation. *J.*
100 *Biol. Chem.* 1972; 247: 6960-6966.
- 101 Sairam R K and Tyagi A Physiological and molecular biology of salinity stress tolerance in
102 plants. *Curr. Sci.* 2004; 86: 407- 421.
- 103 Sairam R K, Rao K V and Srivastava G C. Differential response of wheat genotypes to long-
104 term salinity stress in relation to oxidative stress, antioxidant activity and osmolyte
105 concentration. *Plant Sci.* 2002;163: 1037-1046.
- 106 Suman K, Kondamudi R, Venkateswara Rao Y, Vishnu Kiran T, Swamy KN, Raghuv
107 Rao P, Subramanyam D and Voleti SR. "Effect of triacontanol on rice seed germination,
108 seedling growth and some antioxidant enzyme status under PEG induced drought stress".
109 *The Andhra Agricultural Journal*, Bapatla. 2013; 60 132-137.
- 110 Swamy KN, Anuradha S, Ramakrishna B, Siddulu N, and Rao SSR. Cadmium toxicity
111 diminished by 24-epibrassinolide in seedlings of *Trigonella foenum-graecum* L. *Genetics*
112 *and Plant Physiology*, 2011;1: 163-175.

**Table.1. Anti-oxidant enzyme activity during moisture stress at formative stage in
different sugarcane genotypes**

S.No.	Variety	Super oxide dismutase (eu/100ml/ gram fresh weight)	Peroxidase (eu/100ml/ gram fresh weight)
1	Co 86032	99.76	15.46
2	Co 87025	109.12	20.60
3	Co 8014	50.04	13.21
4	2003 V 46	68.60	14.10
5	97 R 129	75.81	15.60
6	Co 94012	73.30	14.99
7	97 R 401	57.90	13.23
8	Co 95020	122.04	21.24
Mean		82.07	16.05
SEM		9.037	2.085
CD(0.05)		19.38	4.47



Fig 1. Anti-oxidant enzyme activity as affected by moisture stress at formative stage in different sugarcane genotypes

