© 2017 IJSRSET | Volume 3 | Issue 6 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Effect of Sodium Nitroprusside (Snp) on Physiological and Biochemical Responses of *Sorgum Vulgare* Pres Under Salt Stress

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ABSTRACT

Salt stress is one of the major abiotic stress in Agriculture which induces morphological, physiological, and biochemical changes in plants, worldwide. This study was carried out to investigate the protective role of exogenous Sodium Nitroprusside (SNP) on alleviation of salt stress in *Sorgum vulgare* Our results showed that salt stress induced plants significantly decrease in growth characters, total soluble sugars, amino acids while increase in proline content and peroxidase activity. However salt stress induced plant SNP treated samples showed positive effect on growth characters and biochemical constituents. Therefore suitable concentration of SNP could be used as a simple, practical and inexpensive method for modulating the effects of salt stress induced plant.
Keywords: Sodium Nitroprusside, Salt, *Sorgum vulgare***,** Physiological and Biochemical.

I. INTRODUCTION

Plants growing in natural environments experience various abiotic stresses. Environmental stresses strongly influence plant growth and development. Plants often experience abiotic stress like salinity, drought, toxic metals, extreme temperatures, flooding, UV – radiations, ozone *ect*. Abiotic stress is responsible for the huge crop loss and reduced yield more than 50% of some major crops (Ahamad and Prasad, 2012; Hasanuzzaman *et al.*, 2012).

Soil salinity is one of the major environmental abiotic stresses especially in arid and semi-arid regions and can severely limit plant growth and yield.

Today, 20% of the world's cultivated land and nearly half of all irrigated lands are affected by salinity. So salt stress has become one of the most damaging environmental hazards to crop productivity all over the world. High salt stress disrupts the homeostatic balance of water potential and ion distribution within a plant. Under high salinity, sodium toxicity may cause a range of disorders affecting germination, development, photosynthesis, protein synthesis, lipid metabolism, leaf chlorosis, and senescence (Koca *et al.*, 2007).

Sodium nitroprusside (SNP) releases nitric oxide (NO), a highly reactive gas and ubiquitous bioactive molecule that plays a central role in signal transduction in plant stress response. Nitricoxide (NO) is as mall and lipophilic gas and a bioactive molecule that play an important role in different physiological processes. There is increasing evidence showing that NO acts like a signal molecule in processes such as growth and development, respiratory metabolism, cell death, and ion leakage. On the other hand, NO can also mediate plant growth regulators and ROS metabolism and increasingly evident have shown, which is involved in signal transduction and responses to biotic and abiotic stress such as drought, low and high temperatures, UV and ozone exposure, heavy metal, herbicides, cold, and salt stress(Nasibi and Kalantari, 2009; Corpas*et al*., 2011).

The main objective of the study is to investigate whether SNP could act as a regulator effect on growth and biochemical changes of *Sorgum vulgare*.

II. MATERIALS AND METHODS

Cultivation of Plants:

Healthy and uniform seeds of *Sorgum vulgare*. were sown in pots containing mixture of red soil, black soil, and sand in the ratio of 2:2:1 Seeds were sown in the pots and they were kept in dark for overnight. Soon after seedling emergence, the pots were shifted to daylight conditions.

Foliar Applicaion:

20 days old *Sorghum vulgare L.* seedlings were treated with different concentration of NaCl +SNP (0.5mM, 2mM, 3mM, 5mM) under different concentration of salinity stress sprayed using as sprayer for a period of 2 days. Care was taken to wet both surfaces completely to ensure maximum application. The control plants were treated only with water at a temperature of 27^0C natural photoperiod and 75% of average humidity. The following parameters were analysed after 2 days treatment The biochemical and enzymatic characters were analyzed by the following methods: chlorophyll and carotenoids (Wellburn and Lichtenthalar, 1984), Anthocyanin and Flavonoid Mirecki and Teramura (1984), Total soluble sugar (Jayaraman, 1981), Protein content (Lowry *et al*., 1951), *in vivo* nitrate reductase activity (Jaworski, 1971), Catalase activity (Kar and Mishra, 1976), Peroxidase activity (Addy and Goodman, 1972) and Malondialdehyde content .

III. RESULTS AND DISCUSSION

Salinity has been shown to reduce water uptake by roots because of lowered osmotic potentials of the substrate, and to cause changes in metabolic activities leading to reduction in plant growth (Jaleel *et al.,* 2007). Decrease in growth parameters are found in salt stressed plants. The over all reduction in the growth of the salt treated samples might be ascribed to the ill effect of salt stress on the various physiological processes such as photosynthesis, accumulation of compatible solutes and activities of antioxidant enzymes.

Sorghum vulgare act as an absorber of Na and may be incapable of coping with it, leading to the leaves eventually suffering from the toxic effect and resulting in reduced leaf growth as reported in *Withania somnifera* (Jallel *et al* .,2008). Due to abiotic stress from salt the plant tries to cope with its situation by decreasing its leaf area, hence, conserving energy.

A decrease in photosynthetic pigment chl *a* of the experimental samples under salt stress was observed in both seedlings compared to the control. There was a decrease of 24% and 37% of chl *a* in response to 5mM NaCl treatment. The results obtained in this study are in agreement with those of Azooz *et al.,* 2004. The reduction of chlorophyll content under NaCl stress has been attributed to the destruction of chlorophyll pigment and the instability of the pigment complex. (Levit, 1918). It is also attributed that interference of salt ions with the de novo synthesis of proteins, the structural component of chlorophyll, rather than the breakdown of chlorophyll. It was reported that an appropriate concentration of NO could improve photosynthesis and chlorophyll content. In this findings, 5mM NaCl+SNP could restrain chlorophyll synthesis, promote photosynthetic efficiency and transpiration rate. In addition, NaCl increased stomatal resistance. Low photosynthetic pigment or high Na^+ content could inhibit Mg^{2+}absorbing and restrain chlorophyll synthesis (Li *et al*., 2011), it is possibly due to too much of Na^+ inhibited photosynthesis, weakened the links of chlorophyll and chloroplastin and led to chlorophyll decomposing. (Corps *et al*., 2006) suggested that adding appropriate SNP could really alleviate salt toxicity through improving the plant photosynthesis.

In NaCl+SNP subjected samples reported with 31%, 13% and 40% of anthocyanin at 5mM concentration respectively. Total protein content decrease significantly in leaves expose to salinity. Total protein content decreases to 23% in 5mM compared to 0.5mM NaCl concentration in *Sorghum vulgare*. This was in accordance with results of previous experiments by Feller *et al.,* (2008) and Zhang *et al.,* (2011).

The reduction in level of glucose up on NaCl irradiation accounts for the substantial changes in membrane architecture and low rate of carbon assimilation. Soluble sugar can be involved in or related to ROS producing metabolic pathways. In salt+SNP administred leaves glucose accumulation is enhanced with increase dosage

of SNP. It might either directly detoxify ROS in chloroplast and vacuoles or indirectly stimulate the classic antioxidative defense systems (Khodary *et al*., 2009). A key step in nitrate assimilation is the reduction of this anion to nitrite in the reaction catalyzed by NR, an enzyme that is highly regulated at the transcriptional and post- transcriptional levels. NR has been studied extensively as a key enzyme of nitrogen metabolism. NR activity was significantly enhanced by the addition of SNP. NR activity was significantly stimulated by SNP at 0.5mM itself in our experimental conditions. The reason behind this that NO stimulate the post translational regulatory pathway of All this results indicate foliar application of SNP is important for enhancing NR activity (Rosales *et al.,* 2012). The content of MDA is an indicator of lipid peroxidation and oxidative damage to the membrane. Salt stress, can lead to oxidative stress through the increase in ROS, which can potentiate the accumulation of MDA, an indicator of salt- induced oxidative damage to the membranes. Therefore, we deduced that the protective role of SNP might be related to its effects on the elimination of MDA. In *Sorghum vulgare* 5 mM concentration of SNP increased MDA content. Where as salt treated and salt+SNP, treated plants were promoted the accumulation of MDA. This investigation suggested that SNP could partially alleviate the toxic effect of NaCl on O_2 generation rate. However high concentration of SNP could make catalase activity decrease, and MDA content increase.

IV. CONCLUSION

A study was conducted to assess whether foliar applied nitro oxide (NO) could alleviate the adverse effects of NaCl stress on *Sorghum vulgare* L. The subjected plants (leaves) were carried out for biochemical analysis. Based on the findings it is concluded that both the experiment plants can be cultivated under salt affected areas which could increase the production of secondary metabolite at the plant level especially at 5mM NaCl and SNP treated plants. The concentrations ranging from 3mM to 5mM favoured the growth parameters.

V. ACKNOWLEDGEMENT

The authors are thankful to the Management and Principal for providing the necessary facilities to carry out the experiments.

VI. REFERENCES

[1]. Addy, S.K., Goodman, R.N. (1972). Polyphenol oxidase and peroxidase in apple leaves inoculated with a virulent or an avirulent strain for Ervinia amylovora. Ind Phytopath. 25: 575-579.

[2]. Ahamad, P. and Prasad, M.N.V. (2012). Abiotic stress Responses in plants: Metabolism ,productivity and sustainability. Springer, New York.

[3]. Corpas, F.J., Leterrier, M., Valderrama, R., Airaki, M., Chaki, M., Palma, J.M. and Barroso, J.B. (2011). Nitric oxide imbalance provokes a nitrosative response in plants under abiotic stress. J. Plant sci. 181: 604 - 611.

[4]. Corps AN, Robinson AH, Movin T, Costa ML, Ireland DC, Hazleman BL, Riley GP. Versican splice variant messenger RNA expression in normal human Achilles tendon and tendinopathies. Rheumatology (Oxford). 2004;43:969–972.

[5]. Hasanuzzaman, M., Nahar, K., Alam, M.M. and Fujita, M. (2012). Exogenous nitric oxide alleviates high temperature induced oxidative stress in wheat (Triticum aestivum L.) seedlings by modulating the antioxidant defence and glyoxalase system. Aust. J. Crop Sci. 6: 1314–1323.

[6]. Jaleel, C.A., Manivannan, P. and Sankar, B. (2007). Pseudomonas fluoresens enhances biomass yield and ajmalicine production in Catharanthus roseus under water deficit stress. Plant Physiol.60: 7-11.

[7]. Jaworski, E.G. (1971). Nitrate reductase activity assay in intact plant tissue. Biochim. Biophys. Res. Commun. 43: 1274-1279.

[8]. Jayaraman, J. 1981. Laboratory Manual in biochemistry, Wiley Eastern Limited, Madras. 180.

[9]. Jayaraman, J. 1981. Laboratory Manual in biochemistry, Wiley Eastern Limited, Madras. 180.

[10]. Kar, M. and Mishra., D. (1976). Catalase, Peroxidase and Polyphenol Oxidase Activities during Rice Leaf Senescence. Plant Physiology. 57: 315-319.

[11]. Koca, H., Bor, M. and Ozdemir, F.(2007). The effect of salt stress on lipid peroxidation,antioxidative enzymes and proline

content of sesame cultivars. Environ Exp Bot. 60: 344-351.

[12]. Li, J., L. Liu, A.A. Lacis, and B.E. Carlson, 2010: An optimal fitting approach to improve the GISS ModelE aerosol optical property parameterization using Aeronet data. J. Geophys. Res., 115.

[13]. Lowry, O.H., Rosebrough, N.J., Farr, A.L. and Randall, R.J. (1951). The original method of Protein estimation. J. Biol. Chem. 193: 265-268.

[14]. Mirecki, R.M. and Teramura, A.H. (1984). Effects of Ultraviolet-B Irradiance on Soybean : V. The Dependence of Plant Sensitivity on the Photosynthetic Photon Flux Density during and after Leaf Expansion, Plant Physiol. 74(3): 475-80.

[15]. Rosales, E.P., Jannone, M.P. and Groppa, M.D. (2012). Polyamine modulate nitate reductase activity in wheat leaves;involvement of nitric oxide .aminoacid.42:988-955.

[16]. Wellburn, A.R. and Lichtenthaler, H. (1984). Formulae and program to determine total carotenoids and chlorophyll a and b of leaf extracts in different solvents. In: Advances in Photosynthesis research (Sybesma, C.ed.) The Hague, pp. 9-12.

[17]. Zhang, Y.Y., Wang, L.L., Liu, Y.L., Zhang, Q., Wei, Q.P. and Zhang. W.H. (2006). Nitric oxide enhances salt tolerance in maize seedlings through increasing activities of protonpump and Na+/H+ antiport in the tonoplast. Planta. 224: 545-555