Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 06, pp.52438-52440, June, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECT OF ELECTROLYTE LEAKAGE ACTIVITY ON MUNGBEAN LEAF UNDER INDUCED SALINITY AND ZINC LEVELS

[1,*]Pandey, S. K., [2]Sujata Upadhyay, [1]Zaffar Mehdi Dar, [1]Hemantaranjan, A. and [1]Srivastava, J.P.

[1]Department of Plant Physiology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005 (U.P), India
[2]Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005 (U.P.), India

ARTICLE INFO

Article History:
Received 24th March, 2017
Received in revised form
03rd April, 2017
Accepted 17th May, 2017
Published online 30th June, 2017

Key words:

Mungbean, Salinity, NaCl, Zn, Electrolyte leakage.

ABSTRACT

Mungbean (*Vigna radiata* L.) is an excellent source of high quality proteins. In sprouted mungbean, high level of ascorbic acid, riboflavin and thiamine is found. But the production of mungbean is threatened by salinity. In the present study, observations were made for two consecutive years regarding the electrolyte leakage activity level in mungbean leaves under induced salinity conditions. Ten different treatments comprising of various levels of NaCl and Zn separately and in combinations i.e. 40mM NaCl, 80mM NaCl, 120mM NaCl, 40mM NaCl+2×10^{-5}M Zn, 80mM NaCl+3×10^{-5}M, 120mM NaCl+ 4×10^{-5}M, 2×10^{-5}M Zn, 3×10^{-5}M Zn and 4×10^{-5}M Zn were applied to salt stressed mungbean along with control. The treatments were replicated thrice and the statistical analysis was done using CRD. Under study of effects of various salinity levels electrolyte leakage activity (%) was increased under salt stressed mung bean *(Vigna radiata* L.) pre-treated foliar application of Zn reduced the ion accumulation. The treatment 120mM NaCl+ 4×10^{-5}M Zn gave the best results with minimum electrolyte leakage as compared to control.

Citation: Pandey, S. K., Sujata Upadhyay, Zaffar Mehdi Dar, Hemantaranjan, A. and Srivastava, J. P. 2017. "Effect of electrolyte leakage activity on Mungbean leaf under induced salinity and zinc levels", *International Journal of Current Research*, 9, (06), 52438-52440.

INTRODUCTION

Enhanced salinity levels have deleterious effects on plant productivity. A total of 800 mha of land throughout the world is salt affected, either by salinity (397 mha) or the associated condition of sodicity (434 mha) (FAO, 2005). Pulse crops are essentially required in human food for supplementing with good quality protein. Since time immemorial, mungbean *(Vigna radiata* L.) have been cultivated under rainfed conditions especially in marginal lands i.e. poor soil fertility and moisture stress condition. Mungbean tolerant variety exhibited less reduction in plant height, total chlorophyll and carotenoid contents, leaf area, rate of photosynthesis, number of pods per plant and grain yield at high salinity level (Sehrawat *et al*., 2015). Zinc (Zn) is an important micro-element for the terrestrial life since it is required either as a structural component or reaction site in numerous protein metabolism and protein synthesis and as a key constituent in enzymes like alcohol dehydrogenase, carbonic anhydrase, and superoxide dismutase. Zn as a micronutrient has a tremendous influence on growth and development of the plant (Jyung *et al*., 1975). Zn increases the permeability of the plasma membrane of the root cells to phosphorus and also to chloride (Welch *et al.,* 1982). The zinc molecule in zinc-containing enzymes was found to act as an antioxidant and protect specific regions of the enzyme from free radical attack, thus preserving its stability and activity. The ROS including super oxide (O_2^-), H_2O_2, hydroxyl radicals (OH^-) and singlet oxygen ($^1O_2$), are inevitable by products of the cell metabolism. Therefore it is interesting to explore whether, micronutrient Zn may be involved in the initiation of protective mechanism with a view to enhance tolerance to salinity.

Corresponding author:* **Pandey, S. K.
Department of Plant Physiology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005 (U.P), India.

MATERIALS AND METHODS

Mungbean (*Vigna radiata* L. var. HUM-1) was selected as the plant material to be used in the experiment. The variety was developed at the Dept. of Genetics and Plant Breeding, B.H.U., Varanasi (India). Certified seeds were procured and only the bold and healthy seeds were selected to be sown in the pots. Seeds of uniform size were selected and surface sterilized before using for the experiment. They were first washed with tap water for 7 minutes and then sterilized with $HgCl_2$ (0.1%) for 5 minutes and then washed with sterile distilled water. The experiment was laid down in a Completely Randomised Design

(CRD) with three replications. Control (T_0), 40mM NaCl (T_1), 80mM NaCl (T_2), 120mM NaCl (T_3), 40mM NaCl+2×10^{-5}M Zn (T_4), 80mM NaCl+3×10^{-5}M(T_5), 120mM NaCl+ 4×10^{-5}M(T_6), 2×10^{-5}M Zn(T_7), 3×10^{-5}M Zn(T_8) and 4×10^{-5}M Zn (T_9) each treatment in the experiment was replicated thrice.The seeds were preconditioned by soaking wetted sand with seeds in different concentrations of $ZnSO_4$ i.e. 2x10^{-5} M, 3x10^{-5} M and 4x10^{-5}M respectively for 6 hours. They were then dried under shade after sowing. Hardened and non hardened seeds were sown directly in pots (size: 20 x 20 cm) filled with soil (3 kg). After germination, only five seedlings were maintained in each pot. Electrical conductivity under induced salinity conditions was measured and maintained by the soil supplemented with 0, 40, 80 and 120 mM NaCl, which represent 0.2, 4, 8 and 12 dSm^{-1} respectively. Plants were grown in a lysimeter with a 16/8h photoperiod at $25^0C/21^0C$ and 55/75 % RH (day/ night). Salt stress was applied after sowing when the seedlings were five days old. Leaves were washed thoroughly and 0.9 mm leaf disc were cut. Ten discs were placed in vials containing 10 millilitre 40 per cent polyethylene glycol 6000 (PEG). The osmotic potential of this concentration of PEG was -1.4 mPa. Samples were incubated at 10 ± 1 ^{O}C for 24 hours and the incubation media was drained out from the vials and the leaf samples of the treatments were washed again. Samples were again incubated in 10 mL distilled water for 24 hours at 10 ± 1^{o}C. The conductivity (C_1) of this bathing media was measured with dried reading conductivity meter (Systronic model 304), by Blum and Ebercon (1981). The vial was then autoclaved for 15 minutes at 15 PSI and final conductivity (C_2) was measured. The per cent electrolytes leaked were calculated as:

The percent electrolytes leaked were calculated as

$$\text{Electrolytes leaked (\%)} = \frac{\text{Conductivity of incubation medium before autoclaving}}{\text{Conductivity of incubation medium after autoclaving}} \times 100$$

and the results were similar for both the years. Electrolyte leakage activity was significantly higher in the plants treated with 120 mM NaCl as compared to control. At 120 mM NaCl electrolyte leakage activity level was increased by 28.69, 28.10 and 28.64 per cent as compared to unstressed plants in the first year and in the second year it was increased by 27.86, 26.57 and 28.69 per cent. Electrolyte leakage activity was not significantly affected in the Zn pre-treated plants and the values were almost nearly equal to the control plants. However, in the salt stressed plants electrolyte leakage activity was decreased by Zn priming. In the plants primed with Zn and stressed with NaCl electrolyte leakage activity decreased as compared to the plants treated with different concentrations of NaCl. At 120 mM NaCl electrolyte leakage activity was increased only by 22.30, 23.91 and 25.94 and 23.41, 22.35 and 27.03 per cent as compared to control in the two consecutive years. In the unstressed plants treated with different concentrations of Zn electrolyte leakage activity was found to be decreased as compared to control (Fig-1). In the year 2005, priming with Zn (4x10^{-5} M) decreased the electrolyte leakage activity by 1.41, 2.35 and 1.05 per cent as compared to the control and in the year 2006 electrolyte leakage activity was decreased by 1.60, 1.55 and 0.91 per cent after the respective growth intervals as compared to control. It has been observed that with increase in salinity level electrolyte leakage activity is also increased and Zn decreases the rate of lipid peroxidation and electrolyte leakage in the salt stressed plants (Pandey and Hemantaranjan, 2006). Mungbean plant to NaCl stress more electrolyte leakage (30.3%), than the plants exposed to Zn stress (19.8%) as compared to the control plants. However, the value for electrolyte leakage in the plants treated with NaCl and Zn in combination was 21.3% higher over the control. Similar results were reported by Mir *et al.* (2015). Zn can partially fulfill this need because Zn has saturated d orbitals and a small molecular size, which favours tetrahedral complexes. Zn does not help in

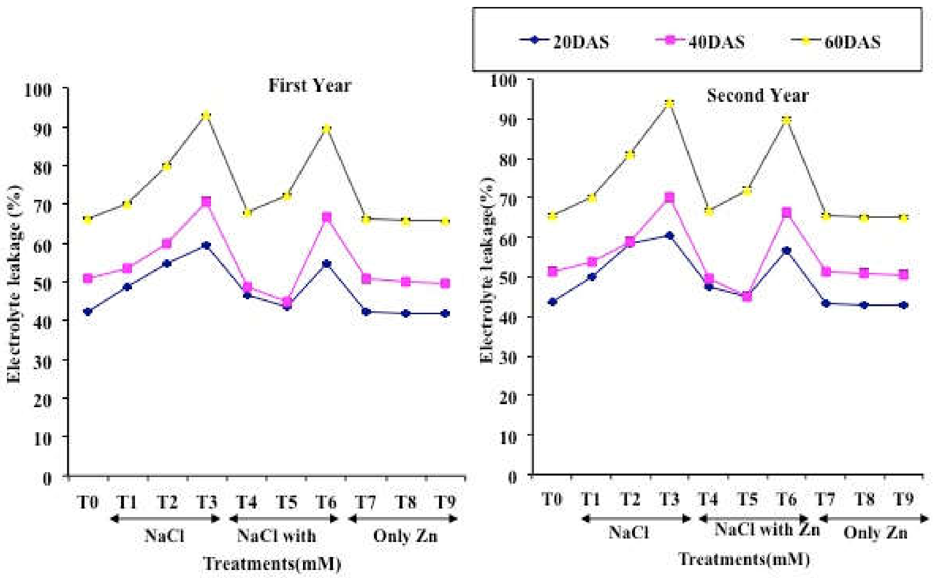

Fig-1. Effect of Zn on electrolyte leakage of Salt Stressed Mung bean (*Vigna radiata* L.) at Twenty Days Interval in the First Years(2005) and Second Year (2006). Bars represent the standard error of mean.

RESULTS AND DISCUSSION

Salinity increased the electrolyte leakage activity accumulation of ions beyond the control values (Fig-1). The electrolyte leakage activity at 40 and 80 mM NaCl after 40 days of growth was followed by a significant increase by 60 days of growth, though highly significant increase was reported after 20 days

only regulating the metabolic processes of plant rather this precisely alleviates the injurious effects of reactive oxygen species. NADP oxidase activity increases in stress conditions and produces superoxide radical (O_2^-) and these radicals damage cell membrane. Similar results were shown by Zafar *et.al* (2014). The findings support the results obtained in the present study.

Conclusion

Zinc could not alleviate the harmful effects of salinity on mungbean upto the optimum. However, it diluted the effects of salinity to a great extent, probably by increasing the root length that might have favoured the proper water absorption. But treatment with Zn decreased Na^+ levels in saline conditions and ameliorated salinity, probably due to increase in the level of anti-oxidative enzymes and reduction in the electrolyte leakage activity. The presence of zinc reduces the production of NADP oxidase activity and enhances the formation of SOD activity, therefore it develops tolerance in plants facing abiotic stresses like salinity.

Acknowledgements

I acknowledge the guidance provided by Chairman and members of my Advisory Committee and the research facilities provided by Department of Plant Physiology, Banaras Hindu University, Varanasi for successful completion of research work.

REFERENCES

Blum, A. and Ebercon, A. 1981. Cell membrane stability as a measure of drought and heat tolerance in wheat. *Crop Science*, 21: 43–47.

FAO 2005. Global network on integrated soil management for sustainable use of salt –affected soils. Rome Italy: FAO Land and Plant Nutrition Management Service.http:www. fao.org/ag/agl/agll/spush.

Jyung WH, Ehmann A, Schlender KK. and Scala, J. 1975. Zinc nutrition and starch metabolism in *Phaseolus vulgaris* L. *Plant Physiology,* 55: 414-420.

Mir, B. A., Khan T. A, Fariduddin Q. 2015. 24-epibrassinolide and spermidine modulate photosynthesis and antioxidant systems in *Vigna radiata* under salt and zinc stress. *International Journal of Advance Research,* 5: 592-608.

Pandey, S.K. and Hemantaranjan, A. 2006. Physiological and biochemical changes in mung bean (*Vigna radiata* L.) as influenced by various level of zinc under salinity. Abstract: 8th Indian Agricultural Scientists and Farmers Congress. *Bioved Research and Communication Centre*, Allahabad and B.H.U, Feb. 21-22, Varanasi, 105.

Sehrawat N , Yadav M, Bhat K.V., Sairam R. K. and Jaiwal P. K. 2015. Effect of salinity stress on mungbean [vigna radiata (l.) Wilczek] during consecutive summer and spring seasons. *Journal of Agriculture Sciences,* 60 (1): 23-32. DOI:10.2298/JAS1501023S.

Welch, R.M., Webb, M.J. and Loneragan, J.F. 1982. Zinc in membrane function and its role in phosphorus toxicity. *In:* "Proceedings of the Ninth International Colloguium, Warwick, England". (Ed.) A. Scaife. Commonwealth Agric. Bur., Farnham Royal, Bucks. pp. 710-715.

Zafar S, Nasri M, Reza H, Moghadam T, Zahedi H. 2014. Effect of zinc and sulfur foliar applications on physiological characteristics of sunflower (*Helianthus annuus* L.) under water deficit stress. *International Journal of Biosciences*, 12 : 87-96.

****