



## SHORT COMMUNICATION

# EFFECTS OF PRE-TREATMENT AND FOLIAR APPLICATION OF ZINC ON GROWTH AND YIELD COMPONENTS OF MUNGBEAN (*VIGNA RADIATA* L.) UNDER INDUCED SALINITY

SUNIL KUMAR PANDEY<sup>1\*</sup>, R.N. BAHUGUNA<sup>2</sup>, MADAN PAL<sup>2</sup>, A.K. TRIVEDI<sup>1</sup>, A. HEMANTARANJAN<sup>1</sup>  
AND J.P. SRIVASTAVA<sup>1</sup>

<sup>1</sup>Department of Plant Physiology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-211 005

<sup>2</sup>Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi-110 012

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**Mungbean (*Vigna radiata* L.) is an excellent source of high quality proteins. In sprouted mungbean, high level of ascorbic acid (Vitamin C), 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 growth parameters and yield attributes of mungbean under induced salinity condition. Results from the present study revealed that under salinity condition growth and yield attributes were adversely affected while application of zinc as zinc sulphate minimized the adverse effect under salinity.**

**Key words:** Mungbean, salinity, yield, zinc

Mungbean (*Vigna radiata* L.) is an excellent source of high quality proteins. It is easily digestible and hence a preferred food for patients. Various types of abiotic stresses are presently affecting the production of pulses. Among different abiotic stresses, salt and drought stress are most limiting factors to plant productivity (Bohnert *et al.* 1995). The effect of NaCl stress is manifested as initial growth reduction, membrane disorganization, metabolic toxicity, inhibition of photosynthesis, altered nutrient acquisition and generation of reactive oxygen species (Hilal *et al.* 1998). High concentration of salts results in lower water potential in the apoplast, which subsequently injured the sub-cellular and cellular organelles and disrupts various processes like photosynthesis, respiration, and affects synthesis of nucleic acids protein and hormones (Ashraf and Harsis 2004). Previous studies have indicated the significance of B, Fe, and Zn on metabolism and growth of various

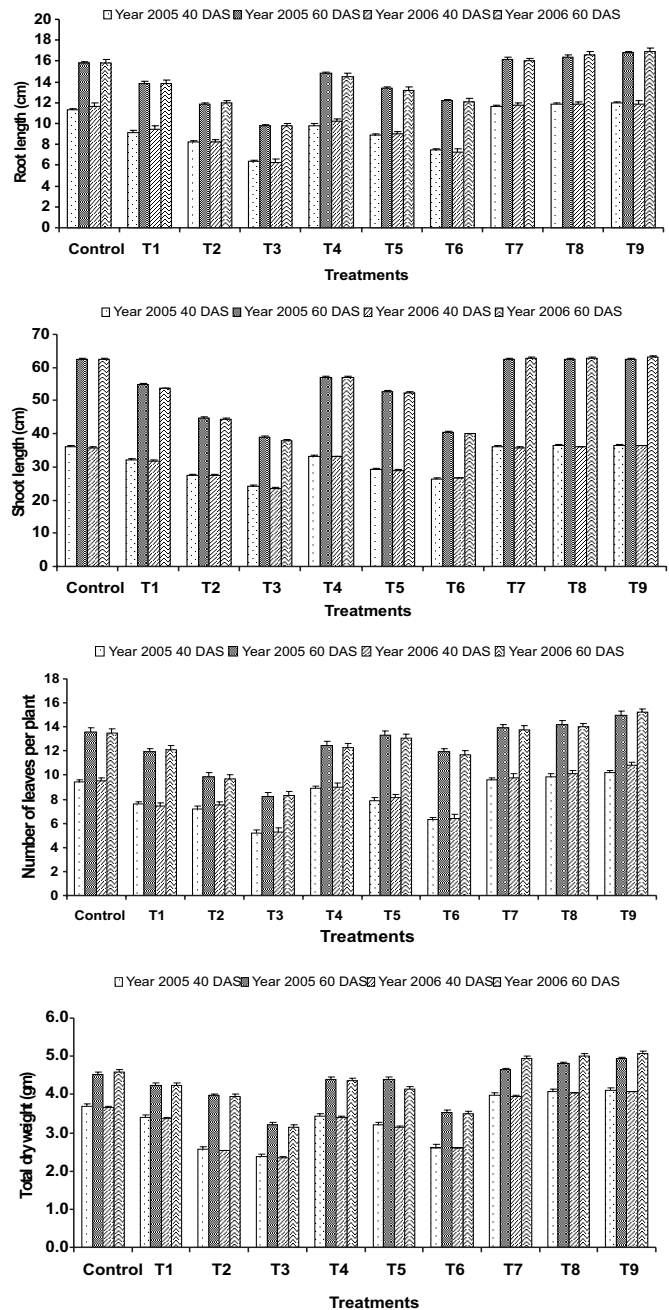
pulse crops viz. French bean, soyabean, pigeonpea as well as mungbean under stressful environment and slight deficiencies of these micronutrients led drastic decline in the growth parameter and yield attributes (Hemantaranjan and Trivedi 1997, Dar *et al.* 2007). Zinc is one of the most important micronutrient for plant. It is required either as a structural component or reaction site in numerous proteins. Zinc has an integral role in the synthesis of indole acetic acid and activation of enzymes related to carbohydrate metabolism, protein synthesis and as a key constituent in enzymes like, alcohol dehydrogenase, carbonic anhydrase and superoxide dismutase (Welch *et al.* 1982). Various studies regarding the micronutrient application for neutralizing the adverse effect of NaCl came in to focus and being used as an efficient tool for improving crop yield under saline conditions (Hemantaranjan *et al.* 2003, Gama *et al.* 2007).

\*Corresponding author, E-mail: sunilbhu123@gmail.com

EFFECTS OF PRE-TREATMENT AND FOLIAR APPLICATION OF ZINC ON MUNGBEAN

Seeds of mungbean (*Vigna radiata* L. var. HUM-1) were obtained from the Department of Genetic and Plant Breeding, Banaras Hindu University, Varanasi (India). Seeds were surface sterilized with  $HgCl_2$  (0.01%) for 3 minute and then washed with sterile distilled water and soaked in zinc sulphate solutions viz., ( $2 \times 10^{-5}$  M,  $3 \times 10^{-5}$  M and  $4 \times 10^{-5}$  M) for 6 hours and sown in pots (20x20 cm) filled with 3 kg soil. Experiment was conducted in three replications for each treatment with each replicate having five pots (20x20 cm). Plants were subsequently grown in a glass house with a 16/8 h photoperiod at 25 °C/21°C temperature and 55/75% relative humidity (day/night). Salt stresses at 40, 80 and 120 mM were imposed in one osmotic shock to 5 days old seedling (Dar *et al.* 2007). Spraying zinc sulphate in same stage distinct concentration of ( $2 \times 10^{-5}$  M,  $3 \times 10^{-5}$  M and  $4 \times 10^{-5}$  M, Zn) 25 ml for 15 days interval experiment. All observations were recorded at 40 and 60 days after sowing (DAS). Root length (cm), shoot length (cm) and total leaves per plant were counted at 40 and 60 DAS stage of growth. Plant samples were collected by destructive harvesting at 40 and 60 DAS. Plants were dried at 110°C for one h and 70°C till constant weight was obtained. Observation recorded on different yield attributes viz. seed weight per pod (g), test weight (g) of 1000 seeds, yield per plant (g) were made after harvest. Statistical analysis was done in completely randomized design with three replications for each treatment. Difference between the mean values was calculated at 5 per cent level of significance.

Mung bean (*Vigna radiata* L.) is an important pulse crop and found to be affected by salinity stress (Ahmed 2009, Mohamed and El Kramany 2005). In the present investigation, effect of salinity was observed on various growth parameters and yield of mung bean in two successive years, 2005 and 2006 under glass house condition. All growth parameters e.g. root length, shoot length, number of leaves and total dry matter were found to reduce under salinity stress. However, most prominent effect was observed at 120 mM NaCl level, where all the growth parameters were found to reduce by 30 to 45 per cent in both the years 2005 and 2006. Severity of salinity was more at 40 days after sowing while it was further reduced at 60 days after sowing. Per cent decrease in different growth parameters in year 2005



\* Treatments: T<sub>1</sub>. 40 mM NaCl, T<sub>2</sub>. 80 mM NaCl, T<sub>3</sub>. 120 mM NaCl, T<sub>4</sub>. 40 mM NaCl +  $2 \times 10^{-5}$  M Zinc, T<sub>5</sub>. 80 mM NaCl +  $3 \times 10^{-5}$  M Zinc, T<sub>6</sub>. 120 mM NaCl +  $4 \times 10^{-5}$  M Zinc, T<sub>7</sub>.  $2 \times 10^{-5}$  M Zinc, T<sub>8</sub>.  $3 \times 10^{-5}$  M Zinc, T<sub>9</sub>.  $4 \times 10^{-5}$  M Zinc.

Fig. 1. Effect of different treatments\* on (a) root length, (b) shoot length, (c) number of leaves plant<sup>-1</sup> and (d) total dry weight of mung bean (*Vigna radiata* L.). Observations were taken at 40 and 60 days after sowing in two successive experiments in 2005 & 2006. Data represents the mean value of both experiments having three replications for each treatment in each experiment

and 2006, indicate the significant affect of salinity on growth and yield reduction (Figure 1a to 1d and Table 1). It is well established fact that salinity stress cause changes in various physiological processes and particularly increase in Na<sup>+</sup> and Cl<sup>-</sup> ions in seedlings under salinity leads to decrease in root shoot length, biomass, dry matter and other growth parameters (Ashraf and Rasul 2005, Agarwal and Pandey 2004).

Zinc is an important micronutrient and there are some reports regarding the application of micronutrients (including zinc) for relieving various stresses and promoting growth under stress (Garg *et al.* 1986, Hemantranjan *et al.* 2003, Bartels and Sunkar 2005). It was observed that among the three concentrations of ZnSO<sub>4</sub> used, treatment with 4x10<sup>-5</sup>M zinc was most effective when applied as pre treatment of seeds and foliar spray on the seedlings both. Under stress condition different growth parameters were improved in comparison to plants having only NaCl treatment. Beside the significant decrease under salinity stress, plants having zinc treatment showed comparatively better root length (18.48%), shoot length (9.50%), total dry matter

(51.68%), number of leaves per plant (21.15%), weight of seeds per pod (35.29%), test weight (10.7%) and final yield per plant (58.54%) respectively (Figure 1a to 1d and Table 1). Reduction in stress severity with Zn application can be described as the ability of Zn to reduce cellular Na<sup>+</sup> concentration and simultaneously increase K<sup>+</sup> level resulting in high Na<sup>+</sup>perK<sup>+</sup> ratio. This ultimately maintains the osmotic balance of the cell and hence the various growth and metabolic processes (Weimberg and Shannon 1988, Gama *et al.* 2007). The importance of Zinc in growth promotion also results by the fact that Zn promotes the availability of other growth regulators such as gibberellins, kinetin, indole-3-acetic acid etc. and enhances the ability of plant to cope up with adverse environment (Chakrabarti and Mukharje 2002, Data *et al.* 2004).

Application of Zn (both foliar and pre treatment) on unstressed plants showed considerable increase in growth dynamics and different yield attributes in comparison to control plants having no NaCl and no Zn application. It was observed that in both years 2005 and 2006 Zn application (4x10<sup>-5</sup>M) enhanced root length

**Table 1.** Effect of salinity on weight of seed per pod, test weight and yield per plant in mung bean (*Vigna radiata* L.) with pre-treated and foliar application of zinc. Data represents the mean value of two successive experiments in 2005 & 2006 having three replications for each treatment in each experiment.

Treatment	Weight of seed pod <sup>-1</sup> (g)		Test weight (g)		Yield plant <sup>-1</sup> (g)	
	First year (2005)	Second year (2006)	First year (2005)	Second year (2006)	First year (2005)	Second year (2006)
Control	0.39	0.42	34.3	33.9	9.51	10.37
40 mM NaCl	0.32	0.34	30.1	30.4	7.77	7.87
80 mM NaCl	0.21	0.25	28.4	27.5	3.84	3.82
120 mM NaCl	0.17	0.19	24.3	23.4	2.87	3.06
40 mM NaCl+2x10 <sup>-5</sup> M Zn	0.36	0.40	32.6	32.8	10.14	9.90
80 mM NaCl+3x10 <sup>-5</sup> M Zn	0.29	0.33	30.6	30.4	9.65	9.46
120 mM NaCl+4x10 <sup>-5</sup> M Zn	0.23	0.29	26.9	27.0	4.55	4.20
2x10 <sup>-5</sup> M Zn	0.45	0.47	34.5	34.4	10.41	11.00
3x10 <sup>-5</sup> M Zn	0.48	0.50	34.8	34.8	11.08	12.05
4x10 <sup>-5</sup> M Zn	0.51	0.53	35.1	35.2	12.17	12.80
LSD (5%)	0.021	0.024	2.076	2.462	1.267	1.820
SEm±	0.007	0.008	0.693	0.822	0.423	0.608

LSD = Least Significance difference

(5.3%), shoot length (0.94%), total dry matter (11.11%), number of leaves per plant (8.51%), weight of seeds per pod (30.77%), test weight (2.33%) and final yield per plant (27.97%) respectively (Figure 1a to 1d and Table 1). Growth increase was found comparatively more at 40 DAS stage than to 60 DAS. Overall it can be concluded from the present study that Zn application under both normal and salinity stress, provides better chance to survive and enhance almost all the major growth processes that leads to better growth and yield. Zn application appears as an efficient measure to minimize the negative effect of salinity and improvement of growth and seed yield even under stress condition that gives a better hope for this sensitive pulse crops under saline conditions.

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