Case Report

Effect of Rhizobium on Growth of Different Mungbean Varieties under Salt Stress Conditions

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Excessive and imbalanced use of chemical fertilizers may pose devastating effect on soil fertility and sustainable productivity. Bio-organic amendments improve soil fertility and sustainable crop productivity. Seeds of mungbean varieties i.e. NCM-2013, Chakwal-Mung 06, NM2011 and AZRI Mung 2006 were inoculated with rhizobium (biozote) in saline soil. These inoculated mungbean varieties were sown under artificially developed saline soil (ECe= 5.0 dSm⁻¹) using completely randomized design with three replicates for enhancement of growth. The experiment was conducted during July to September, 2015 in the Head House of Land Resources Research Institute, National Agricultural research Centre, Islamabad, Pakistan. Data were collected on germination, plant height, root length, fresh / dry weight and chlorophyll contents during the course of experiment. Ionic concentrations of mungbean P, Cu, Fe, Mg and Zn in plant shoot were determined to compare the difference of edible quality in saline soil under the inoculation of seeds with rhizobium. Effect of biozote on germination, root length, fresh weight and dry weight was significant in all mung bean varieties. The maximum root length (10.1 cm) was possessed by NM-2011. Fresh weight / plant was maximum (5.1 g) by AZRI-Mung 2006. The maximum dry weight/plant (1.5 g) was recorded in AZRI-Mung 2006. Maximum P% (0.14), Cu (4.83 ppm), Fe (179.3 ppm), Mg (2.07 ppm) and Zn (168.8 ppm) of Chakwal Mung-2006 with the use of rhizobium under salt stress by NM-2011. Similar trend was also recorded in ionic concentration of P, Cu, Fe and Mg by NM-2011 without rhizobium under salt stress conditions. The saline soil affected the quality of mungbean showing the reduction caused by salt stress without rhizobium inoculation in ionic concentration, fAZRI-06.

Keywords: Mungbean varieties, Saline soil, Rhizobium growth, Edible quality, Ionic concentration.

INTRODUCTION

Biofertilizers are known to play an important role in increasing biological fixation of atmospheric nitrogen and enhance phosphorus availability to crop (Bhat et al., 2013). Similarly, humus derived from vermicompost is most commonly used for sustainable production (Premsekhkar and Rajashree, 2009) due to its beneficial effects on nutrient uptake and retention, pest control and productivity (Barrios et al., 2011).

Mungbean is a very important pulse crop which provides an inexpensive source of vegetable dietary protein. In Pakistan, mungbean is cultivated on an area of 127.7 thousand hectares with total grain production of 98.7 thousand tons, (Economic survey of Pakistan, 2019). It is popular for its nutritive value and digestibility, containing high, protein contents (30%), fat (1.2%), carbohydrates (65%) and essential macronutrients like Phosphorus 340 mg 100 g⁻¹ and Calcium 118 mg 100 g⁻¹ (Anwar et al., 2007). It can be cultivated during spring and summer seasons, it takes less time to mature and fits well in existing cropping pattern of the country. Among various abiotic stresses, appearing today, soil salinity is known to cause considerable crop losses (Ashraf et al., 2008). Although, soil salinity occurs predominantly in arid and semiarid regions, it has been found in all the climatic zones (Munns, 2008). Moreover,
the problem in salt affected land is increasing due to low quality water usage for irrigation, improper drainage in canal-irrigated wetland agro-ecosystems, entry of seawater in coastal areas during cyclones, and higher accumulation of salts in the root zone due to considerable evaporation of water and insufficient leaching of ions due to low rainfall in arid and semi-arid regions (Munns, 2008). According to an estimate, 33% of irrigated land has been affected by salinity on worldwide basis (Ashraf et al., 2008). Pakistan is worst hit by soil salinity as about 14% of total irrigated land in Pakistan is salt affected (Economic Survey of Pakistan, 2008). Salt affected soils are generally categorized as saline, sodic, or saline-sodic. In other words, a soil is considered to be saline when electrical conductivity of saturate soil pastes is equal or greater than 4 dS m\(^{-1}\) at 25°C (equivalent to 40 mM NaCl) and the sodium adsorption ratio (SAR) is 13-15 (Munns, 2008).

Inside the plant, soluble salts at higher concentrations cause hyper-osmolarity, ion toxicity and dis-equilibrium of nutrients that adversely affect plant growth and development (Munns, 2008). High levels of both Na\(^+\) and Cl\(^-\) in cytosol are inhibitory to a number of metabolic and cellular processes (Ashraf, 2009).

Soil salinity causes prominent losses of yield in most crops, therefore causing reduction in crop production (Ashraf, 2009; Cha-um et al., 2011). Reduction in yield due to salinity is due to a number of physiological and biochemical abnormalities in plant growth which have been mentioned in a number of comprehensive reviews on salinity effects and tolerance in plants (Ashraf et al., 2008; Munns, 2008; Jamil et al., 2011; Krasensky and Jonak, 2012). Researchers have been struggling for the last decades to solve this issue by conducting a variety of experiments. The conduct of such experiments has resulted in a substantial increase in both growth and yield of many crops grown under saline conditions (Ashraf, 2009; Cha-um et al., 2011). Exogenous application of inorganic essential nutrients as foliar spray or through the root growing medium has also been reported to be an economical and efficient means of mitigating the adverse effects of salt stress on different crops (Ashraf, 2009; Kaya et al., 2010). Of different major essential nutrients, such as potassium (K) and phosphorus (P) which play vital roles in plant growth and

### Table 1. Effect of biozote on germination, root and shoot lengths, fresh and dry weights and chlorophyll contents of Mungbean varieties under saline conditions

| Mung bean Varieties | Germination (%) | Shoot height (cm) | Root length (cm) | Fresh weight plant\(^{-1}\) (g) | Dry weight plant\(^{-1}\) (g) | Chlorophyll Contents (%) |
|---------------------|-----------------|------------------|-----------------|-------------------------------|--------------------------|--------------------------|
|                     | -Biozote       | + Biozote        | -Biozote        | + Biozote                     | -Biozote                 | + Biozote                | -Biozote | + Biozote | -Biozote | + Biozote | -Biozote | + Biozote | -Biozote | + Biozote |
| NCM-2013            | 40b            | 50a              | 11.1            | 12.1                          | 6.3b                     | 8.1a                     | 3.4ab     | 4.2a      | 0.8c     | 1.2a      | 24.3     | 24.8c     |
| Chakwal-Mung 06     | 45ab           | 53a              | 10.2            | 9.9                           | 6.0b                     | 8.2a                     | 3.1ab     | 4.5a      | 0.6c     | 1.1b      | 23.1     | 22.9c     |
| NM-2011             | 36b            | 45a              | 9.5             | 11.5                          | 8.2a                     | 10.1a                    | 3.1b      | 4.0b      | 0.5c     | 1.0b      | 24.3     | 25.1bc    |
| AZRI Mung-2006      | 42ab           | 51a              | 11.7            | 10.7                          | 5.5c                     | 6.5c                     | 3.6ab     | 5.1a      | 0.9bc    | 1.5a      | 24.6     | 23.2c     |
| LSD                 | 12             | NS               | 2.4             | 1.1                           |                          |                          | 0.4       | NS        |          |           |          |           |

### Table 2. Effect of biozote on ionic concentration of Mungbean varieties under saline conditions

| Mung bean Varieties | P (%) | Cu (ppm) | Fe (ppm) | Mg (ppm) | Zn (ppm) |
|---------------------|-------|----------|----------|----------|----------|
|                     | -Biozote | + Biozote | -Biozote | + Biozote | -Biozote | + Biozote | -Biozote | + Biozote | -Biozote | + Biozote | -Biozote | + Biozote |
| NCM-2013            | 0.06   | 0.12     | 2.62     | 3.12     | 140.3    | 176.4     | 1.72     | 1.82     | 100.4    | 152.7    |
| Chakwal-Mung 06     | 0.07   | 0.11     | 3        | 3.94     | 142.4    | 162.4     | 1.25     | 1.62     | 105.6    | 142.3    |
| NM-2011             | 0.06   | 0.14     | 2.26     | 4.83     | 139.4    | 179.3     | 1.85     | 2.07     | 99.8     | 168.8    |
| AZRI Mung-2006      | 0.03   | 0.12     | 3.98     | 4.33     | 142.6    | 165.2     | 1.47     | 1.78     | 109.1    | 155.4    |
regulate various metabolic reactions (Taiz and Zeiger, 2010). Therefore, study was carried out to evaluate the performance of mungbean varieties under saline conditions for the enhancement of pulse production at marginal lands.

MATERIALS AND METHODS

Mungbean varieties i.e. NCM-2013, Chakwal-Mung 06, NM 20-11 and AZRI Mung 20-06 seeds were treated with rhizobium inoculation under saline soil. These inoculated mungbean varieties were sown at artificially developed saline soil (ECe= 5.0 dSm⁻¹). Completely randomized design with three replications was implemented. The experiment was conducted during July to September, 2015 in the Head House of Land Resources Research Institute, National Agricultural research Centre, Islamabad, Pakistan. Data were collected on germination, plant height, root length, fresh / dry weight and chlorophyll contents during the course of experiment period. Ionic concentrations of P, Cu, Fe, Mg and Zn were determined to compare the difference of edible quality in saline soil under the inoculated seeds with rhizobium. The data collected were analyzed statistically following the described procedure (Steel and Torrie, 1997) using statistix, 2000 package and means between treatments were compared using LSD test at 5% probability level.

RESULTS AND DISCUSSION

Effect of biozote on germination, root length, fresh weight and dry weight was statistically significant among all mung bean varieties: NCM-2013, Chakwal-Mung 06, NM-2011 and AZRI Mung 2006 under salt stress conditions (Table-1). Maximum germination (53%) was recorded by Chakwal-Mung-06 followed by 51% by AZRI-06. The maximum root length (10.1 cm) was possessed by NM-2011. Fresh weight/plant was maximum (5.1 g) by AZRI-Mung 20-06. The Maximum dry weight/plant (1.5 g) was recorded for AZRI Mung 20-06. These results are in conformity with the findings of (Ashraf et al., 2008; Munns, 2008; Jamil et al., 2011; Krasensky and Jonak, 2012). Maximum P% (0.14), Cu (4.83 ppm), Fe (179.3ppm), Mg (2.07ppm) and Zn (168.8ppm) of Chakwal Mung-06 with the use of rhizobium under salt stress in NM-2011. Similar trend was also determined in ionic concentration of P, Cu, Fe and Mg by NM-2011 without rhizobium under salt stress conditions. (Table-2). The saline soil affected the quality of mungbean showing the reduction under salt stress without rhizobium inoculation in ionic concentration. The results of ionic values showed that NM-2011 attained the highest position following AZRI Mung 2006. Some other researchers have reported same results regarding K and P of different crops under salt stress conditions (Ashraf et al., 2008; Akram et al., 2009 and Taiz and Zeiger 2010).

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