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Effects of Plant Growth Regulators on Nutrient Content of Young Wheat and Barley Plants under Saline Conditions

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Abstract: The objective of this study was to evaluate, the effect of pre-sowing the plant growth regulators (kinetin and gibberellic acid) treatments on micro nutrients composition of young wheat and barley plants under saline conditions. Barley and wheat seeds were used as seed material. Before sowing, the seeds were soaked in distilled water (Control, C) and in aqueous solutions containing growth regulators in predetermined concentrations (0.5 mM Kinetin (KIN) and 2.0 mM Gibberellic Acid (GA_3)). The soaked seeds were sown in the soil containing four different levels of NaCl (0 (no NaCl), 94, 164 and 240 mM NaCl). In wheat, iron and manganes content decreased as salinity levels increases. Zinc content increased as NaCl concentration up to 164 mM and the highest Zn value obtained from GA_3 treatment in 94 mM NaCl concentration in barley. Generally, GA_3 and Kinetin applications increased Fe, Mn and Zn contents in barley compared to the control. However, the highest values of Fe and Mn and Zn in wheat were obtained from 0 NaCl and treatment that had no hormone.

Key words: Mineral content, plant growth regulators, salinity stress, wheat and barley young plants

INTRODUCTION

Wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) are the most important cereals grown for human food and animal feed. They are mainly grown for their grains, but can also be used as forage source by cutting or grazing at early stages of plant development (Nowar *et al*., 1985). Forage and animal scientists are aware of the importance of the concentrations of mineral nutrient in diets for ruminants (Kidambi *et al*., 1989). Therefore, it is important to know the variability of mineral content of young cereal plants grown at different ecological conditions.

Salinity has been recognized as a major ecological agricultural problem in arid and semi-arid regions. Salinity affects plant physiology through changes of water and ionic status in cells (Hasegawa *et al*., 2000). Under salinity stress conditions, the uptake of nutrient elements by crop plants is generally affected. Salinity stress may curtail or promote nutrient uptake by plant species by affecting the mobility of a nutrient within the plant or by increasing the nutrient requirement by plants in the cells (Pessarakli, 2001). Alam (1994) informed that the uptake of Fe, Mn, Zn and Cu generally increased in crop plants under salinity stress. The detrimental effects of NaCl stress on the nutrition of bean plants are reflected in higher concentrations of Mn in roots and Fe and Mn in leaves and Fe in fruits (Carbonell-Barrachina *et al*., 1998). Erdal *et al*. (2000) determined that high salinity increased Mn, Cu and Fe contents of cucumber seedlings. Bhivare and Nimbalkar (1984) applied Sodium Chloride and Sodium Sulphate as salt applications on bean plant and determined an increase in Fe content, but a reduction in Cu and Zn contents.

The mechanism of salt tolerance of cultivated crop species that differ considerably in tolerance to salinity generally range from restricted ion uptake and translocation into the shoot to structural metabolic changes that decrease salt injury (Pessarakli, 2001). Plant Growth Regulators (PGRs) have been found to play a central role in the integration of the responses expressed by plants under stress conditions (Amzallag *et al*., 1990). Especially, addition of cytokinins into the growth medium can improve the salt tolerance of the plants (Braun and Khan, 1976; Kabar and Baltepe, 1987).

The objective of this study were to evaluate the effects of pre-sowing plant growth regulators (kinetin and gibberellic acid) treatments on some nutrient contents of two cereal species differing in salt tolerance (wheat and barley) under saline conditions.

MATERIALS AND METHODS

The present study was carried out in a greenhouse in spring of 2006. B-22 bread wheat line (*Triticum aestivum* L. subsp. *vulgare* (Vill.) Thell.) and TARM-92 two-row barley commercial variety (*Hordeum vulgare* convar. *distichon* (L.) Alef.) were used as plant materials. The seeds were surfaced sterilized with 1.0% sodium hypochlorite. Before sowing, they were soaked in distilled water (Control, C) and in aqueous solutions of growth regulators in predetermined concentrations, 0.5 mM Kinetin (KIN), 2.0 mM Gibberellic Acid (GA_3) for 3 h at room temperature. Thereafter, the solutions were decanted off and the seeds were vacuum dried for 1 h (Braun and Khan, 1976). The pot soil was collected from the soil surface (0-15 cm), air-dried, ground, passed through a 5 mm mesh screen and thoroughly mixed. The soil consisted of 23.1 clay, 33.9 silt, 43 sand and 1.34% (organic matter). The pH of the soil was 8.1 and its electrical conductivity ranged from 0.2-0.4 mmhos cm^{-1}. The soil were spread separately over thick plastic sheets and moistened with treatment solutions of 0 (no NaCl), 94, 164 and 240 mM concentration of NaCL in deionized water to achieve a 13% moisture content. One kilo gram soil portions of each lot were filled in pots (13.7 cm dia.) and 10 seeds were sown in each pot at a depth of about 10 mm. For each seed treatment (control, KIN and GA_3), there were four replicates at each salinity levels of wheat and barley. Plants were harvested 30 days after sowing. The seedlings were counted, cleaned and dried. In order to characterise the plant nutrient status, whole plant samples were used. Fe, Mn, Cu and Zn were analysed with an atomic absorption spectrometer in Suleyman Demirel University Central Research laboratory.

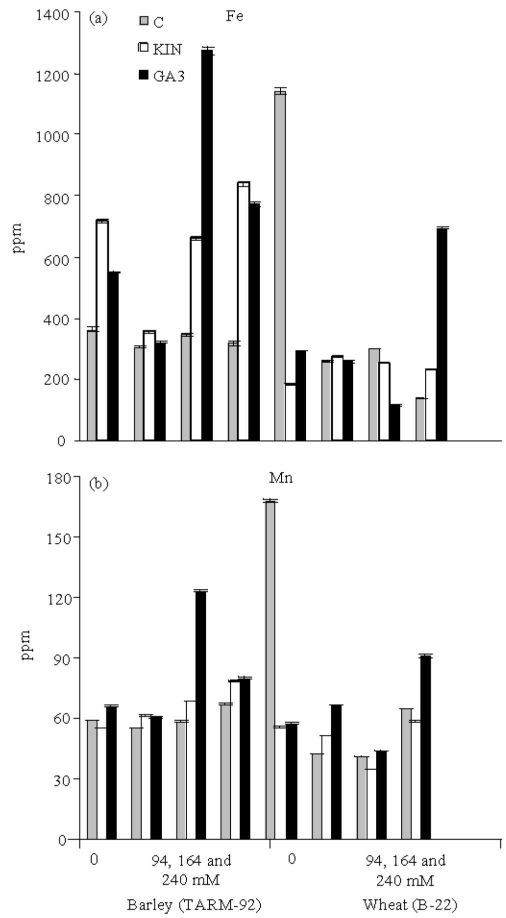

Fig. 1: Effects of plant growth regulators pre-sowing treatments on Mn and Fe concentration of wheat and barley under saline conditions

RESULTS AND DISCUSSION

The influence of salinity levels and hormone pre-treatments on concentrations of Fe and Mn in wheat and barley is shown in Fig. 1. Results in Fig. 1 shows progressive and consistent decreases of Fe and Mn contents by increasing salinity levels in wheat except GA_3 treatment in 240 mM NaCl concentration. These decreases may be due to the depressive effect of salinity on root growth and distribution in soil in this plant (Hala and Mona, 2008). However, Mn tends to increase by increasing NaCl concentration up to 240 and the highest value obtained with GA_3 treatment in 164 mM salinity level in barley. Erdal *et al.* (2000) reported that increasing salinity levels increased Mn content in cucumber plant. It was not determined that any regular effect by increasing salinity on Fe concentration of barley genotype. Data presented in Fig. 2 shows that Zn concentration tends to increase by increasing NaCl concentration up to 164 mM the highest value obtained with GA_3 treatment in 94 mM salinity level in barley. On the contrary, zinc content decreased in wheat plant stressed by salinity as compared to the control treatment (0 NaCl solution) (Fig. 2). Akman and Kara (2003) reported that there were significant variations among genotypes for nutrient contents.

Figure 2 is also shown that Cu concentration increased by increasing salinity levels except for 164 mM NaCl concentration in barley. In wheat, the further increase in salinity (240 mM NaCl) resulted in an increase in Cu content. The obtained results were confirmed by Erdal *et al.* (2000).

Data presented in Fig. 1 proved that GA_3 application increased Fe and Mn contents at 164 mM NaCl concentration in barley compared with no salt level (control). In the concern, it is shown that corn plants treated with GA_3 recorded a highest content of Zn, Mn, Fe and Cu, a result, which suggested that such materials (growth regulators) might enhance nutrient uptake by the roots (Hassan *et al.*, 1979). However, the highest values

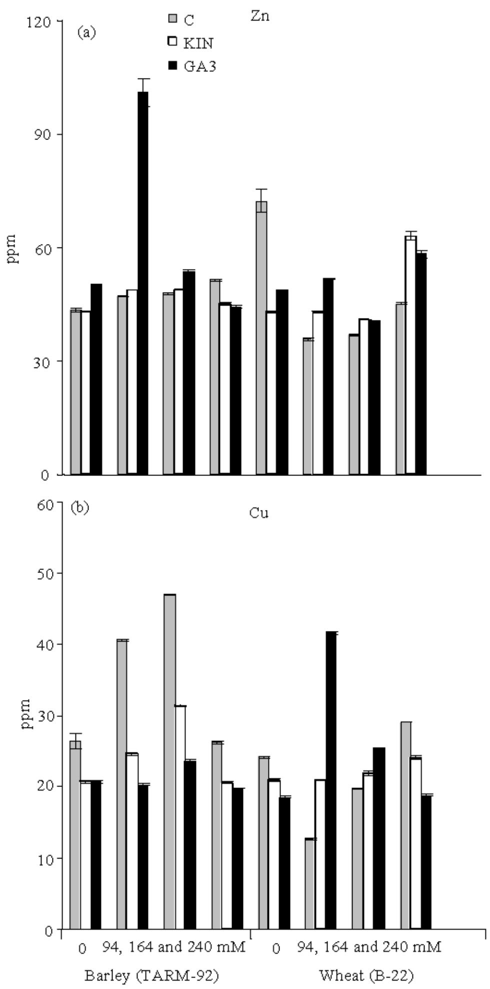

Fig. 2: Effects of plant growth regulators pre-sowing treatments on Zn and Cu concentration of wheat and barley under saline conditions

of Fe and Mn concentration of wheat plant were obtained under control (0 NaCl) and no hormone treatment. Differences between plant species for obtained results can be explain by genotypic variation. The highest values of Zn content of barley was obtained from GA_3 treatment in 94 mM salinity level. The highest Zn content of wheat plant was found under 0 NaCl concentration (control) and no hormone treatment (control). For copper concentrations, the highest values were obtained under GA_3 treatment under 164 and 94 mM NaCl concentrations in barley and wheat plant, respectively.

Jamil and Rha (2007) informed that one of the most effective ways to overcome salinity problems was to use plant growth regulators. GA_3 and Kinetin pre-sowing seed treatments increased plant capacity for studied micronutrients uptake of barley young plant in saline conditions except for Cu. This is probably caused by the fact that the barley is more saline resistant than wheat (Kun, 1988) and genotypic variation.

CONCLUSION

The obtained result clearly shown that the effect of plant growth regulators on the nutrients concentration of plant could be changing according to genotypes. Generally, between two cereal species differing in salt tolerance, pre-sowing PGRs seed treatment increased Fe and Mn, Zn concentrations of barley seedling in saline conditions.

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