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Changes in Morphological Attributes of Maize (*Zea mays* L.) Under NaCl Salinity

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Abstract: Lab experiments were conducted for the study of morphological changes in maize induced by NaCl at Botany Lab, University of Gujrat, Pakistan during the year 2010. The variety used in this experiment was Haricon-11. There were three levels of NaCl including control (0, 50, and 100 m Mol). Germination % and root length had non-significant effect of NaCl at 50 m Mol but 100 m Mol drastically reduced the germination % and root length of maize. Coleoptile length, root and coleoptile fresh weights decreased with the increase of NaCl levels. Maximum reduction in growth attributes was observed at 100 m Mol of NaCl. It was concluded that 100 m Mol of NaCl salinity had adverse effect on morphological attributes in maize as compared to control and 50 m Mol of NaCl applied in growth medium of germinating seed.

Key words: NaCl · Morphology · Growth · Germination

INTRODUCTION

Salinity is a common abiotic stress factor seriously affecting crop production in different regions, particularly in arid and semi-arid regions [1]. This reduction in growth observed in many plants subjected to salinity stress is often correlated with salt-induced osmotic effect, nutrient deficiency or specific ion toxicity [2]. Most of crop species *i.e.* bean, eggplant, onion, pepper, corn, sugarcane, potato and cabbage are sensitive to salinity (ECe 1.0-1.8 dS m^{-1}), which reduce crop productivity about 6-19%. In general, biochemical, physiological, morphological and anatomical characteristics of crop species directly affected by soil salinity are well established [3].

A plant's ability to acclimate to salt stress includes alterations at the leaf level, associated with morphological, physiological and biochemical characteristics whereby many plants adjust to high salinity and the consequent low soil water availability [2, 3]. High salinity causes both hyper osmotic and ionic stress, which results in alteration in plant metabolism including reduced water potentials, ionic imbalances and specific ion toxicity [4, 5]. High concentration of complex inorganic salts present in the growing medium, retard the growth in most of the crop plants depending on the nature of salt present, the growth Stages and the salt tolerance or avoidable mechanism of the plant tissue [6].

Maize (*Zea mays* L.) is one of the significant crops, which serves as food and oil for human consumption and as feed for livestock [7]. It is world wide recommended that the germination and seedling stage of plant life cycle is more sensitive to salinity than the adult stage [8]. Effect of salinity at different growth stages in wheat, sorghum and cowpea was investigated and it was found that the early seedling period was the most sensitive one in all the crops and reduction in growth was observed which decreased with increase in salinity [9].

The main objective of the present study was to study the morphological attributes of maize variety for slat tolerance under NaCl salinity applied in growth media of germinating seeds.

MATERIALS AND METHODS

For Petri dishes experiments, seeds of maize (*Zea mays* L.) were obtained from University of Agriculture, Faisalabad Pakistan. One variety of maize was used in this experiment, i.e. Haricon-11. Seeds were surface sterilized by dipping in 10% sodium hypochlorite solution for 8-10 minutes, then rinsed with sterilized distilled water and air-dried at an ambient temperature of 32°C in Botany lab, University of Gujrat. Ten seeds were put in each petri dish with six replicates. Following treatments of NaCl salinity were applied in growth medium.

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T_0 = Control (Distilled water)
T_1 = NaCl 50 mMol
T_2 = NaCl 100 mMol

Plants were harvested after 15-days of treatments and following studies were made. Germination % was calculated by dividing of germinated seeds with total seeds on per petri dish basis. Root and coleoptiles lengths (cm) were measured with the help of scale meter. Coleoptile fresh weight (g) was noted by electric balance.

RESULTS AND DISCUSSION

NaCl salinity adversely affected the morphological attributes of maize variety Haricon-11 when applied in growth medium of germinating seeds. Detailed results have been described below:

Germination (%): Germination % was significantly affected by NaCl (Fig. 1). Maximum reduction in germination % was noted at T_2 (100 m Mol NaCl). At lower concentrations of NaCl (50 m Mol) the germination % was almost equal with control. From germination % it was concluded that maize variety Haricon-11 can germinate upto 50 mMol NaCl.

Root Length (cm): Data regarding root length is described in Fig. 2. In T_1 (50 m Mol NaCl) there was non-significant effect of NaCl for root length in maize but at T_2 (100 m Mol NaCl), there was a highly significant effect. In control plants root length was 12.8 cm while at 100 m Mol NaCl it decreased to 8.7 cm (Fig. 2).

Coleoptile Length (cm): Effect of NaCl was highly significant on coleoptile length in maize (Fig. 3). Coleoptile length decreased with the increase in concentrations of NaCl. Maximum reduction (2.6 cm) was noted in T_2(100 m Mol NaCl) as compared to control (10.8 cm). It was concluded from these results that Coleoptile length highly affected by NaCl.

Root Fresh Weight (g): Data obtained for root fresh weight under NaCl salinity is given is Fig. 4. It is apparent that NaCl salinity had significant effect in T_2(100 m Mol). In contrast at T_1, there was a non significant effect of NaCl for root fresh weight in maize.

Coleoptile Fresh Weight (g): Coleoptile fresh weight reduced with the increase in NaCl concentrations in maize. Maximum reduction was observed at 100 mMol of NaCl that was 0.10, while in control it was 0.16g (Fig. 5).

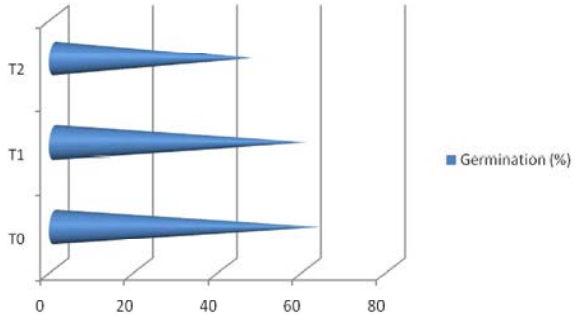

Fig. 1: Effect on NaCl on germination (%) of maize

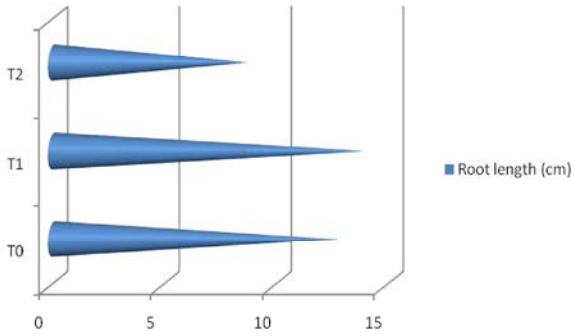

Fig. 2: Effect on NaCl on root length (cm) of maize

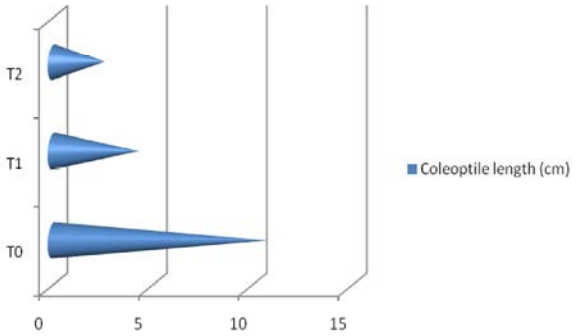

Fig. 3: Effect on NaCl on coleoptile length (cm) of maize

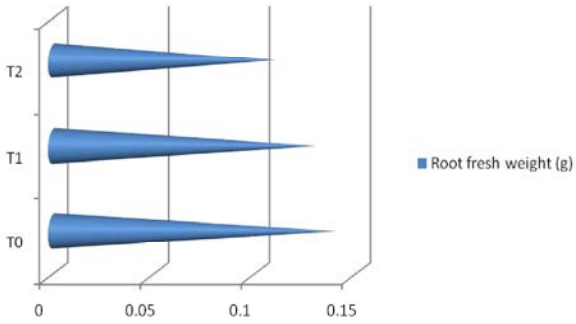

Fig. 4: Effect on NaCl on root fresh wight (g) of maize

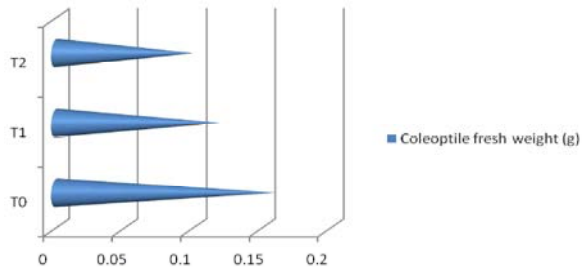

Fig. 5: Effect on NaCl on coleoptile fresh wight (g) of maize

Results had shown that NaCl salinity has deprived effects on morphological attributes of maize. Reduced growth of plants is mainly due to the severe effects of salinity on various biochemical and physiological processes and this was mainly due to the salt induced osmotic and toxic effects which minimize the uptake of other mineral nutrients such as N, K^+ and Ca^{+2}, from the rooting medium [3, 10]. The decrease in plant growth may be due to turgor potential which is decreased by water deficit produced by high concentrations of the salts in the soil [7]. These results are in accordance with earlier findings in chaksu by Hussain *et al*. [11] and black seeds [12].

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