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Morphological Variations in Maize (*Zea mays* L.) Under Different Levels of Nacl at Germinating Stage

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Abstract: Perti dishes experiments were conducted at Botany lab of University of Gujrat-Pakistan during 2010 for the study of NaCl effect on maize (*Zea mays* L.) at germinating stage. There were three levels of NaCl (0, 40 and 80 mol mG^{3}) applied on growth medium of germinating seeds. Two varieties of maize were used in this experiment i.e. EV-1098 and Agaiti. All the growth attributes such as germination %, root and coleoptile lengths and plant fresh weight reduced with increase in salinity levels. It was concluded that salinity had adverse effect on growth of maize. NaCl concentrations at germinating stage could have much adverse effects on maize than later stages of growth.

Key words: NaCl % Maize % Germination % Growth

INTRODUCTION

Many species of higher plants including most crops are subjected to growth inhibition under high NaCl conditions. The salt stress induced inhibition of plant growth is caused not only by osmotic effects on water uptake but also by variable effects on plant cell metabolism under salt stress [1]. Reduction in growth of plants is mainly due to the severe effects of salinity on various biochemical and physiological processes [2]. It might be due to the salt induced osmotic and toxic effects which minimize the uptake of other mineral nutrients such as N, K^{+} and Ca^{+2} [3]. The ion concentrations in roots, shoots and leaves are maintained by regulating ion transport to acclimatize salt stress [4].

Maize (*Zea mays* L.) is one of the important crops in Pakistan, which serves as food and corn oil for human consumption, feed for livestock and poultry and raw material for agro-based industries. Maize is a relatively sensitive to saline irrigation water showing 50 % reduction in yield at EC 3.9 dS mG^{1} [5]. Salinity has a two-fold effect on plants: the salt in the soil solution decreases the availability of water to the roots (osmotic stress) and the salt taken up by the plant can accumulate to toxic levels in certain tissues (ionic stress) [6]. Reduction in growth under saline conditions is a consequence of several physiological responses, including modification of ionic balance, water status, mineral nutrition, stomatal behavior, photosynthetic efficiency and carbon allocation and utilization [7].

According to many reports maize is sensitive at early stages but could withstand under NaCl stress at later growth stages to saline irrigation water [8]. Several repots appearing in the literature revealed that salinity causes many adverse effects on the morphology, anatomy and physiology of pearl millet [9]. For instance, percent germination, height, grain and straw yield of pearl millet decreased with increasing concentration of salinity [10]. Salinity stress disturbs the uptake and accumulation of essential nutrients [11, 12].

In review of the above literature the objective of present study was to asses the salt stress effect in maize morphology at germinating stage.

MATERIALS AND METHODS

Seeds of maize (*Zea mays* L.) were obtained from University of Agriculture, Faisalabad Pakistan. There were two varieties used in this experiment i.e. EV-1098 and Agaiti. Seeds were surface sterilized by dipping in 10% sodium hypochlorite solution for 10 min, then rinsed with sterilized distilled water and air-dried at an ambient temperature of 32°C in the laboratory. Ten seeds were put in each petri dish with six replicates. Following treatments of NaCl salinity were applied.

T_0 = Control (Distilled water)
T_1 = NaCl 40-mol mG^{3}
T_2 = NaCl 80-mol mG^{3}

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Plants were harvested after 10-days of treatment and following studies were made. Germination % was calculated by dividing of germinated seeds with total seeds. Root and coleoptiles lengths (cm) were measured with the help of scale meter. Plant fresh weight (g) was noted by electric balance.

RESULT AND DISCUSSION

Salinity had highly significant effect on growth attributes of maize in Petri dishes under different levels of NaCl stress. The results are given below.

Germination (%): NaCl severely affected the germination (%) in both varieties of maize (Fig. 1). Maximum germination % was noted in V_2 (Agaiti) in control that was 100%, while minimum was calculated in T_2 (80 mM NaCl) of variety EV-1098 (Fig. 1) Germination is one of the most salt-sensitive stages of plant growth and severely inhibited with increasing salinity both in glycophytes and halophytes [13].

Root Length (cm): Data regarding of root length of maize is given in Fig. 2. NaCl stress has highly significant effect on root length of both varieties under studied. Root lengths decreased with increasing NaCl concentrations. Maximum reduction in root length was noted in V_1 (EV-1098) at 80 mM NaCl. Similarly, Hussain *et al*. [14] found the reduction of root length in black seeds under salt stress. This may due to water potential changes caused by salt concentrations in growth medium.

Coleoptile Length (cm): Coleoptile lengths significantly decreased with increasing NaCl levels in both varieties of maize (Fig. 3). Maximum reduction was observed in T_2 (80 mM NaCl) that was 4.90 and 4.47 in Ev-1098 and Agaiti respectively (Fig. 3). It is generally accepted that plant growth at all stages of development and sensitivity to salinity varies from one growth stage to another [15, 16]. According to many reports maize is sensitive at early stages but could withstand at later growth stages to saline conditions [8].

Plant Fresh Weight (g): Reduction in plant fresh weight was also noted in both varieties of maize (Fig. 4). Maximum reduction was present in V_2 (Agaiti) at 80 mM NaCl. These results are similar with the earlier findings in maize [1, 17].

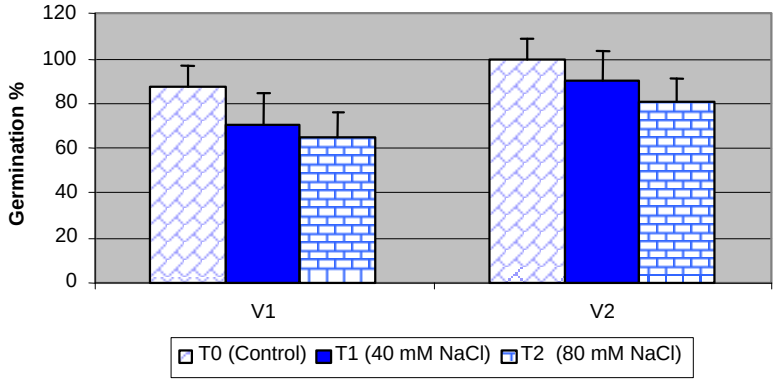

Fig. 1: Germination (%) of Maize in response to different concentrations of NaCl

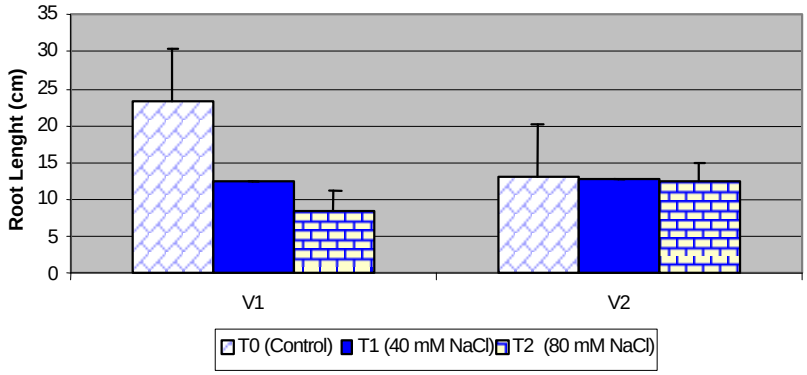

Fig. 2: Effect of different concentrations of NaCl on Root length (cm) of Maize

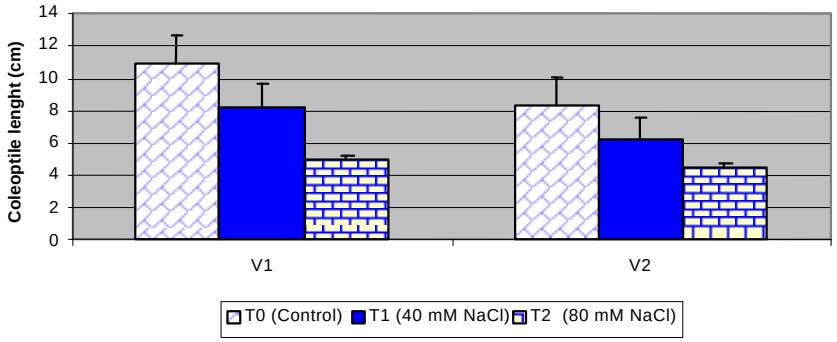

Fig. 3: Effect of different concentrations of NaCl on coleoptile lenght(cm) of Maize

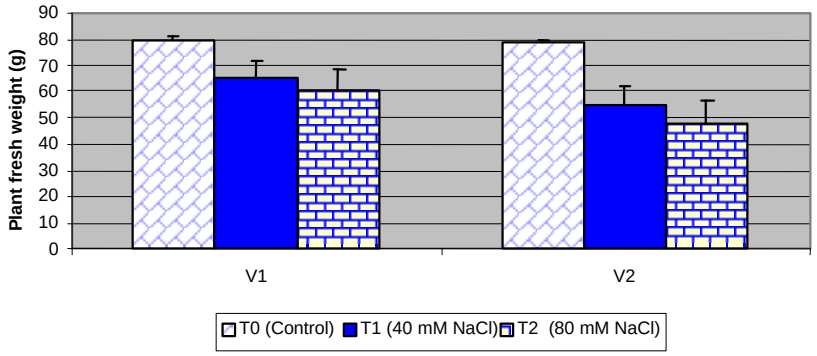

Fig. 4: Effect of different concentrations of NaCl on plant fresh weight (g) of Maize

Addition of NaCl had an adverse effect on the growth of maize. Salinity caused a significant effect on all growth attributes. The reason for growth reduction in black seeds could be due to water shortage and ionic toxicity caused by salinity [1]. The increase 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 [18]. Assessment of pattern of accumulation of toxic ions in a species is vital importance to understand, whether the species uses partial exclusion or inclusion mechanism for tolerating toxic ions present in its growth medium [19].

CONCLUSION

It was concluded that salinity had adverse effect on growth of maize. NaCl concentrations at germinating stage could have much adverse effects on maize than other stages of growth.

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