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Growth Reticence of Maize (*Zea mays* L.) Under Different Levels on NaCl Stress

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Abstract: Petri dishes experiments for the evaluation of growth of two maize varieties were conducted at Botany Lab, University of Gujrat, Pakistan during 2010. Two varieties were used in this experiment i.e. V_1 (Haricon-11) and V_2 (EV-1098). There were five NaCl treatments (0, 20, 40, 60 and 80 m Mol). Germination %, root and coleoptile lengths and root and coleoptile fresh weights decreased with the increase of NaCl levels. Maximum reduction was observed at 80 m Mol of NaCl. It was concluded that salinity applied at germinating stage have drastic effects on maize germination and growth.

Key words: Maize · NaCl · Growth · Germination

INTRODUCTION

Salinization is the accumulation of water soluble salts in the soil that has a drastic impact on agricultural production, environmental health and economic welfare of the country [1]. Most of the crops tolerate salinity to a threshold level and yield decreases as the salinity increases [2]. Salinity not only affects the morphology, but also modifies the metabolisms of plants. Extent of modification depends upon cultivars, duration and intensity of stress [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 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 [7]. Maize has become highly polymorphic and is perhaps the cultivated species that contains the greatest amount of genetic variability. Being cross pollinated, salinity tolerance may exist in maize [8]. Salinity causes not only differences between the mean yield and the potential yield, but also causes yield reduction. It affects the plant growth directly through its interaction with metabolic rates and pathways within the plants [9].

It is generally accepted that the germination and seedling stage of plant life cycle is more sensitive to salinity than the adult stage [10]. 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 [11]. In maize, Na+ and Cl- accumulation in root and shoot increased following 50 to 200mM NaCl treatment while K+ content in root and shoot decreased with the increase in salinity levels at all the three ages Beck *et al.* [12] found increased accumulation of Na+ and strong inhibition of K^+ and Ca^{+2} accumulations in the root, stem and leaves with NaCl-induced salinity.

In the view of above literature the main objective of present study was to evaluate the growth pattern in two varieties of maize under different levels of NaCl.

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. V_1 (Haricon-11) and V_2 (EV-1098). 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. Eight seeds were put in each petri dish with eight replicates. Following treatments of NaCl salinity were applied.

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Table 1: Effect of different levels of NaCl on two varieties of maize

	Germination %		Root length (cm)		Coleoptile length (cm)		Root fresh weight (g)		Coleoptile fresh weight (g)	
Treatments	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
T0 (control)	100a	100a	24.7a	17.3a	10.2a	9.9a	0.34a	0.44a	0.63a	0.34a
T1 (20 m Mol)	75b	100a	20.3b	14.0b	9.1b	8.3b	0.31b	0.40b	0.59b	0.31b
T2 (40 m Mol)	60c	100a	14.8c	13.6b	7.3c	6.9c	0.25c	0.33c	0.55c	0.25c
T3 (60 m Mol)	50d	75b	11.6d	11.8c	6.1d	5.9d	0.16d	0.21d	0.44d	0.16d
T4 (80 m Mol)	25e	50c	8.7e	9.2d	4.6e	4.2e	0.11e	0.16e	0.33e	0.11e
LSD (5 %)	10	15	2.1	1.9	1.2	1.3	0.03	0.04	0.03	0.02

Note: V1 (Haricon-11) and V2 (EV-1098)

T_0 = Control (Distilled water)
T_1 = NaCl 20-mol m^{-3}
T_2 = NaCl 40-mol m^{-3}
T_3 = NaCl 60-mol m^{-3}
T_4 = NaCl 80-mol m^{-3}

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. Coleoptile fresh weight (g) was noted by electric balance.

RESULT AND DISCUSSION

Effect of salinity was highly significant on maize when NaCl was applied on germinating seeds. Detailed results have been described below:

Germination %: Effect of NaCl was significant on germination % of maize. Both the varieties showed minimum germination % with increase in the salinity level (Table 1). Maximum reduction in germination % was noted in variety (Haricon-11) that has only 25% germination at 80 m Mol of NaCl. Incase of variety EV-1098 germination % deceased upto 50% (Table 1). Germination % of variety EV-1098 was unaffected upto 40 m Mol but it reduced at 60 and 80 mMol of NaCl.

Root Length (cm): Data regarding root length is presented in Table 1. In both maize varieties there was a reduction in root length. With increase in NaCl level there was a remarkable decrease in root length. Maximum reduction in root length was measured at 80 mMol of NaCl (Table 1).

Coleoptile Length (cm): Due to NaCl stress, length of coleoptile in both varieties decreased with increase in salinity levels (Table 1). Maximum reduction in coleoptile length was observed at 80 mMol with equal pattern in both varieties of maize as compared to other treatments.

Root Fresh Weight (g): As all growth parameters of both the varieties decreased with increase of NaCl levels. NaCl stress also reduced the root fresh weight in both maize varieties (Table 1). Maximum reduction in root fresh weight was noted at 80 mMol of NaCl as compared to other treatments. Maximum reduction was in variety (Haricon-11).

Coleoptile Fresh Weight (g): Coleoptile fresh weight reduced with the increase in NaCl concentrations in both varieties of maize (Table 1). Maximum reduction was observed at 80 mMol of NaCl that was 0.33 and 0.11 g in V_1 (Haricon-11) and V_2 (EV-1098) respectively.

NaCl has deprived effects on germination and growth of maize. The reason for growth reduction in maize could be due to water shortage and ionic toxicity caused by salinity [13]. 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.* [14]. Similarly Hussain *et al.* [15] concluded that salinity caused a significant reduction in shoot and root lengths, shoot fresh and dry weights in black seeds.

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