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RESEARCH ARTICLE

THE STUDY OF ECOLOGICAL FACTORS, INFLUENCE ON GERMINATION AND ROOT GROWTH IN THREE CORN CULTIVARS

[1]Shabnam Bayat, [2,*]Babak Delkhosh, [3]Alireza Etminan and [4]Majid Gholibaygian

[1,2]Department of Agronomy, Science and Research Branch, Islamic Azad University, Tehran, Iran
[3]Department of Plant Breeding, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran
[4]Department of Agronomy, Science and Research Branch, Islamic Azad University, Tehran, Iran KSA

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ABSTRACT

In order to determination the effects of pH and salinity on germination and root elongation in three corn (*Zea maize*.L) cultivars, an experiment was conducted in factorial on the base of randomized complete design with four replication in agronomy lab. of Islamic Azad University Science and Research Branch of Tehran-Iran 2014. The ecological factors included three levels of pH (6.5, 7.5 as control and 8.2) as well as three levels of salinity (Distilled water as control, 6 and 10 g/l of sodium chloride) effect on three corn cultivars (KSC703, 704 and 705) had observed. Each unit test was considers a petri dish with 9 cm diameter and 10 seed of specie slightly and had employed ecological treatment. The results indicated that increasing of pH and salinity had negative effects on seed germination and root elongation also the anova analyzing showed KSC703 as the most resistant cultivars.

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INTRODUCTION

Corn production based on FAO documents accounts for 2.8% of total cereals production in Iran, with 1.6 million tones grain production from 0.25 million hectares cultivated land, in spite of the fact that the production of hybrid seed is very low (FAO 2005). Germination is a physiological process that started with seedling growth and is complete with penetrate plantlets into the tissues of the seed coat so the germination time is between the median entry of water into the seed until exit of germinated at the seed coat. (Bradford, 2002) Seed germination is a complex physiological process that is influenced by genetic factors and environmental factors (Foley, and Fennimore, 1988; Meyer, and Pendleton, 2000). The study of ecological researchis important relation to different treatments in the germination and seedling growth of crop plants. Soil salinity is one of the most important limiting factors controlling germination in arid and in semiarid regions (Noor *et al.,* 2001). Several studies have shown that the percentage of seed germination rate decreased with increasing salinity, but the reaction of various species are different (Irannejad *et al.*, 2009). pH effects on seed germination potential of the species is different, so that some species will benefit from acidic conditions, some prefer neutral or alkaline conditions for germination and some species do not react to changes in pH (Pierce, *et al*., 1999). Belnap *et al*. (2008) also was observed that the increase of soil pH, increases the rate of germination and emergence in Bromus. Reduction of nitrogen in alkaline condition that causes the activity of nitrogen-fixing microorganisms is more important in the alkaline pH. (Amooaghaie *et al*., 2002). The purpose of this experiment was to investigate the germination and seedlings growth of corn lines under different levels of osmotic potential and different pH conditions created by Solution NaCl and NaOH-HCL (respectively, as salinity and pH stress).

***Corresponding author: Babak Delkhosh,**
Department of Agronomy, Science and Research Branch, Islamic Azad University, Tehran, Iran.

MATERIALS AND METHODS

This experiment was done as factorial experiment in a randomized complete design with 4 replications, in Agronomy lab. Science and Research Branch, Islamic Azad University of Tehran, Iran. The 9 cm petri dish with 10 seeds used as unit test. Three levels of salinity was distilled water as control, 6 and 10 grams NaCl per liter and three levels of pH 6.5, 7.5 (as control) and 8.2 as an ecological factors, were evaluated with three corn cultivars (KSC703, 704 and 705). Seeds germination was counted daily and after 10 days, root length, stem length, germination percentage, seedling wet and dry weight were measured and calculated. For experiment analysis of variance used MSTAT-C software and comparison with Duncan's multiple range tests were performed at the 5% level. For draw graphs and tables from Excel and Word software was used.

RESULTS AND DISCUSSION

Analysis of variance showed that the effects of stress (pH and E.C) on all components of the study were significant (Table 1).

Table 1. Analysis of variance, effects of light, pH and EC on percent germination, root length, root wet weight and root dry weight

S.O.V	df	Percent germination	Root length	Root wet weight	Root dry weight
variety	2	85.500**	38.955**	0.038**	0.001**
pH	2	3.792*	11.125**	0.019**	0.000**
variety×pH	4	1.146**	33.179**	0.164**	0.001**
E.C	2	91.500**	2388.414**	5.515**	0.045**
variety×E.C	4	6.083**	30.266**	0.101**	0.001**
pH×E.C	4	0.708**	21.814**	0.064**	0.001**
variety×pH×E.C	8	0.281**	15.425**	0.031**	0.001**
Error	81	1.363	0.538	0.003	0.001
Coefficient of Variation (%)		13.71	14.31	11.86	1.48

**Statistically significant at the 1 percent level,*Statistically significant at the 5 percent level, n.s Non-significan

The effect of variety on germination percentage, root length, root wet weight and root dry weight were significant at the 5% level (Table 1). The best varieties of germination percentage, root length, root fresh weight and root dry weight in terms of stress was KSC703 variety (Figure 1, 2, 3 and 4).

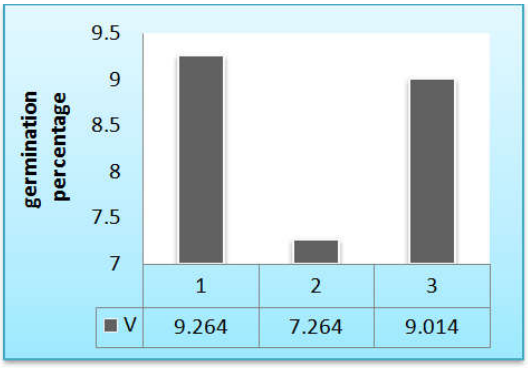

Figure 1. Effect of variety on germination

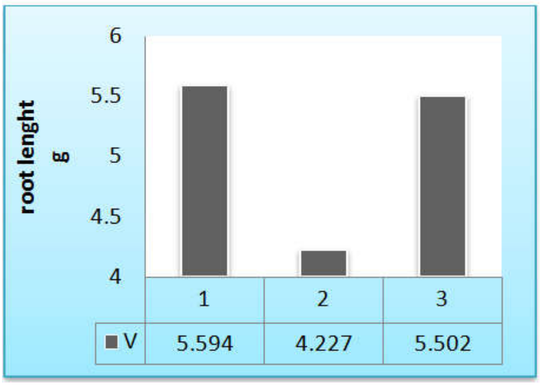

Figure 2. Effect of variety on root length

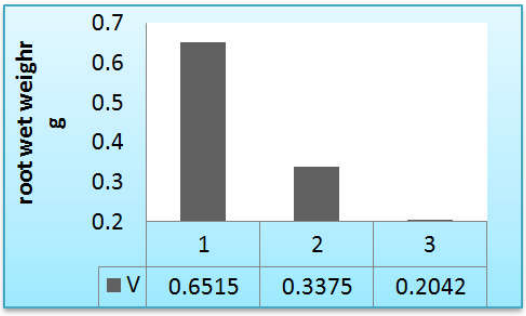

Figure 3. Effect of variety on root wet weight

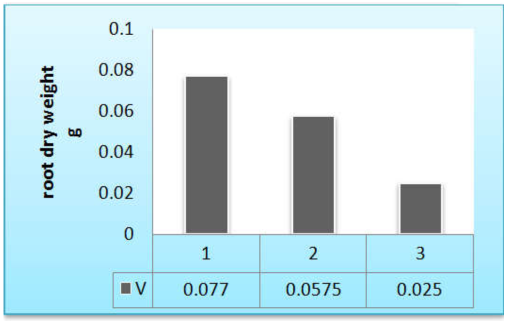

Figure 4. Effect of variety on root dry weight

The effect of pH on germination percentage was significant at the 1% level, and root length, root wet weight and root dry weight were significant at the 5% level (Table 1). The best pH of seed germination in terms of stress was pH=6.5 and inappropriate pH in terms of stress has pH=8.2 (Figure 5). Also the best pH of root length, root wet weight and root dry weight in terms of stress was pH=7.5 and inappropriate pH, pH=6.5 (Figure 6, 7 and 8).

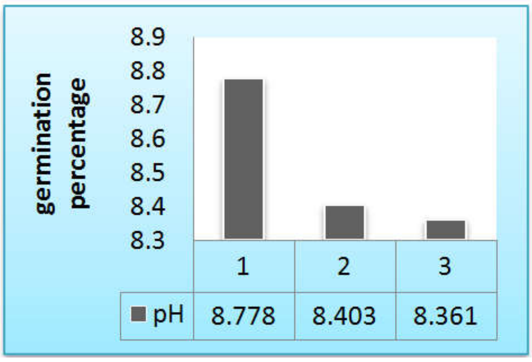

Figure 5. Effect of pH on germination

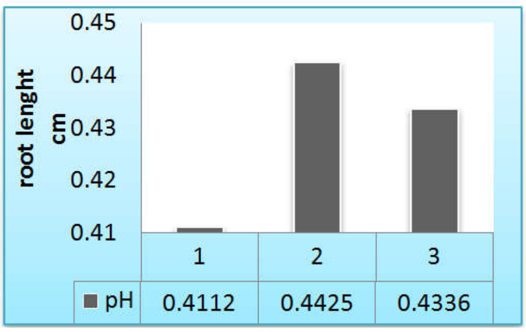

Figure 6. Effect of pH on root length

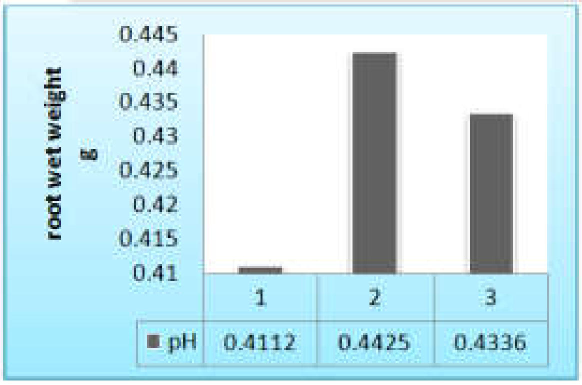

Figure 7. Effect of pH on root wet weight

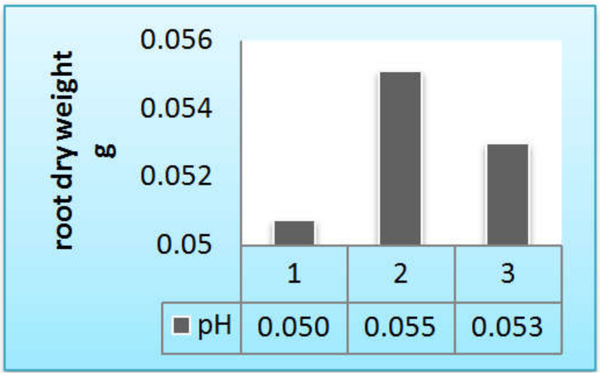

Figure 8. Effect of pH on root dry weight

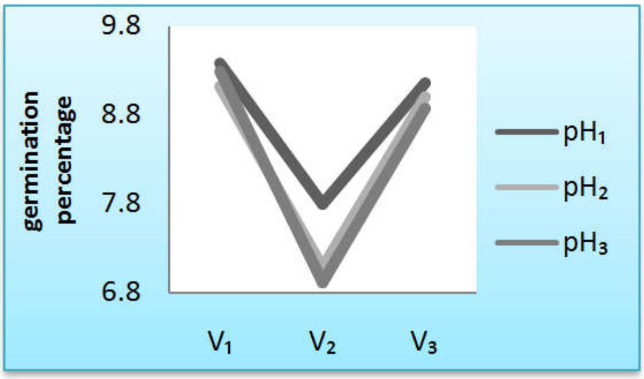

Figure 9. Effect of interaction variety & pH on germination

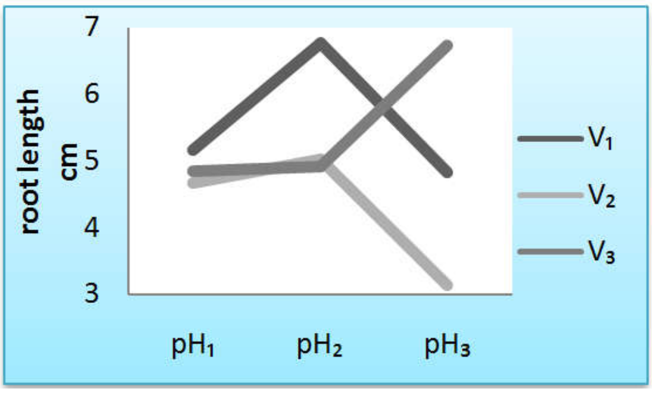

Figure 10. Effect of interaction variety & pH on root length

The pH of soil is another important factor that influences the process of plant growth. The low pH of seedling environment may also cause root elongation (Edwards and Scot, 1974; Evans, 1976). Kiong Ling and *et al*. studied had shown pH=6.5 as optimum growth pH (Kiong Ling *et al*., 2009). Interaction between variety and pH on germination percentage, root length, root wet and dry weight were significant at 5% level (Table 1). The best seed germination percentage was observed in interaction between cultivar KSC703 and pH=6.5 (Figure 9). The best interaction between variety and pH on root length was KSC703 in pH=7.5 (Figure 10). The best interaction between variety and pH on root wet weight was observed in KSC705at pH=8.2 (Figure 11). The best interaction between variety and pH on root dry weight in terms of stress was KSC703 and pH=7.5 (Figure 12).

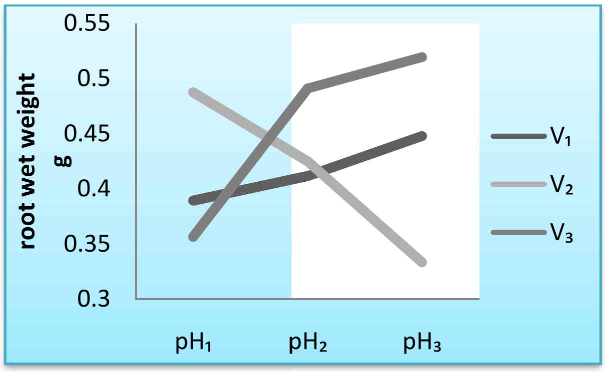

Figure 11. Effect of interaction variety & pH on root wet weight

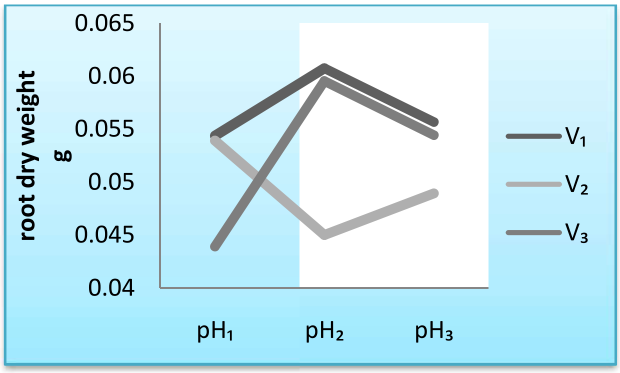

Figure 12. Effect of interaction variety & pH on root dry weight

Effect of E.C on germination percentage, root length, root wet weight and root dry weight were significant at 5% level (Table 1). The best effect of E.C on germination percentage, root length, root wet weight and root dry has E.C=0 g/L (as control) and E.C inappropriate has E.C=10 g/L. (Figure 13, 14, 15 and 16).

Interaction between variety and E.C on germination percentage, root length, root wet weight and root dry weight were significant at 5% level (Table 1). The best interaction between variety and E.C on germination percentage and root length in terms of stress was KSC703 and E.C=0 (as control) and inappropriate interaction was KSC704 and E.C=10 g/L (Figure 17 and 18). The best interaction between variety and E.C on root wet weight in terms of stress was KSC705 and E.C=0 (as control) and inappropriate interaction was KSC705 and E.C=10 g/L (Figure 19). The best interaction between variety and E.C on root dry weight in terms of stress was KSC703 and E.C=0 (as control) and inappropriate interaction was KSC705 and E.C=10 g/L (Figure 20).

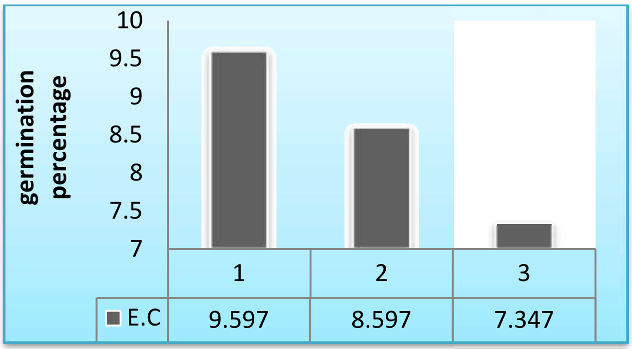

Figure 13. Effect of E.C on germination

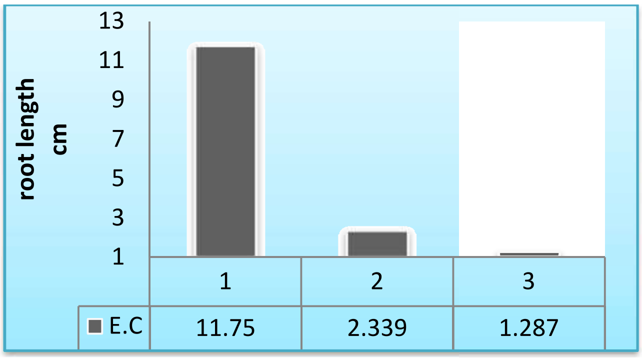

Figure 14. Effect of E.C on root length

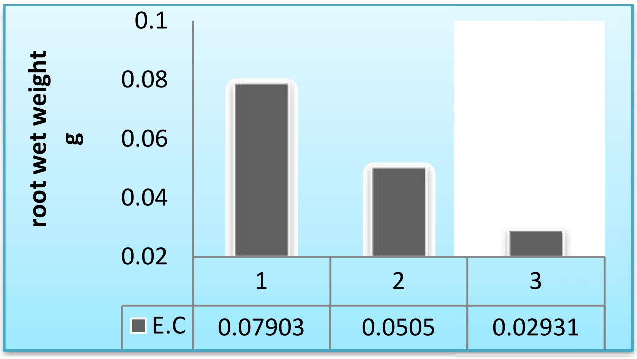

Figure 15. Effect of E.C on root wet weight

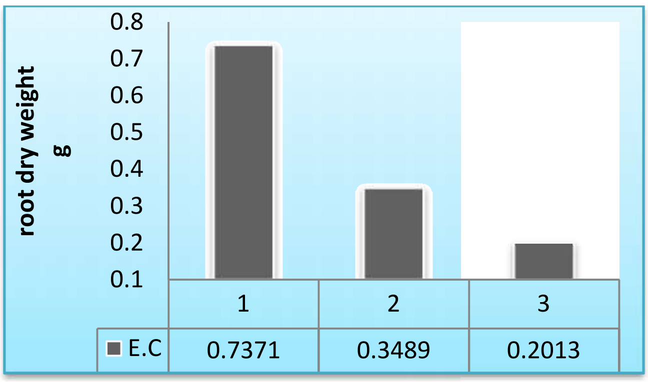

Figure 16. Effect of E.C on root dry weight

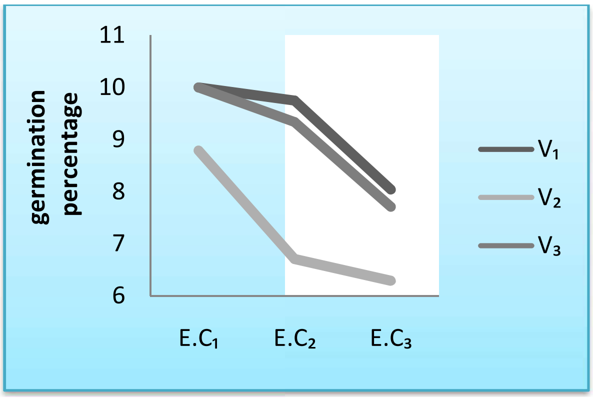

Figure 17. Effect of interaction variety & E.C on germination

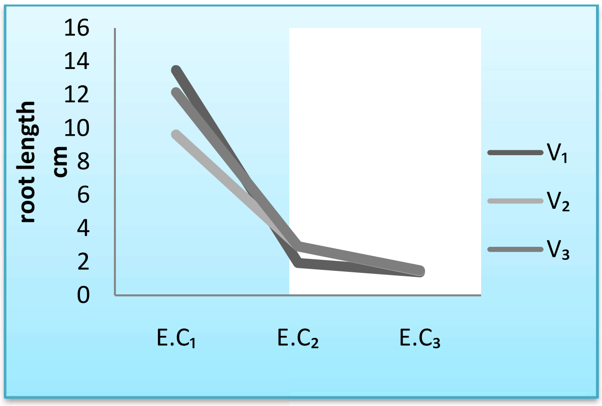

Figure 18. Effect of interaction variety & E.C on root length

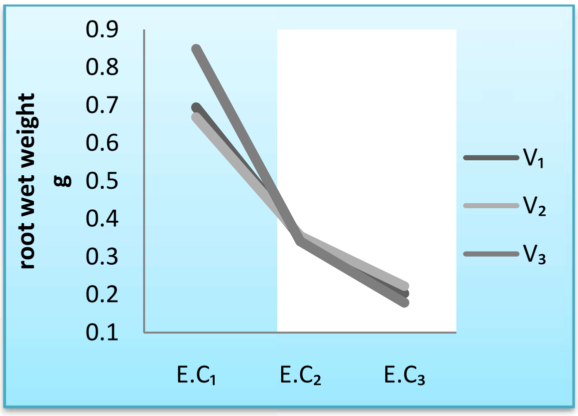

Figure 19. Effect of interaction variety & E.C on root wet weight

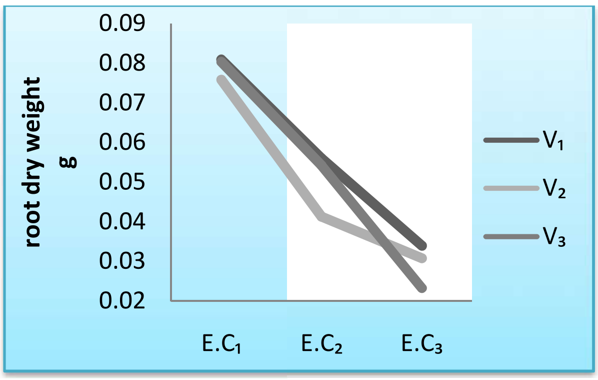

Figure 20. Effect of interaction variety & E.C on root dry weight

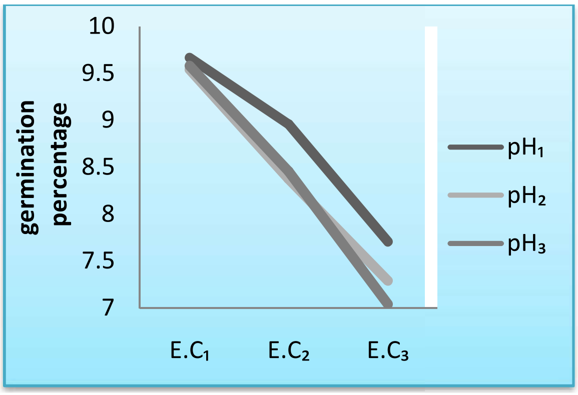

Figure 21. Effect of interaction pH & E.C on germination

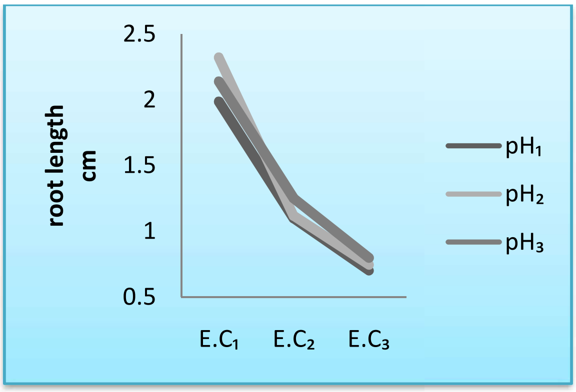

Figure 22. Effect of interaction pH & E.C on root length

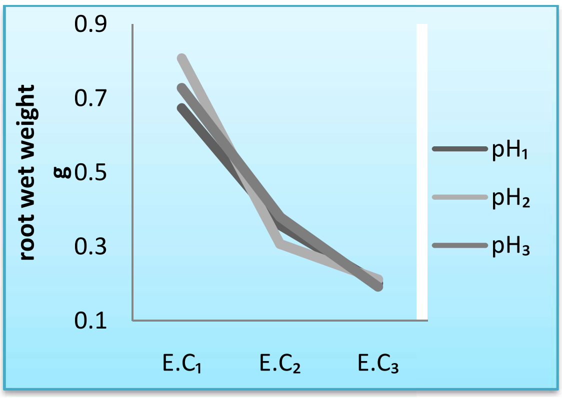

Figure 23. Effect of interaction pH & E.C on root wet weight

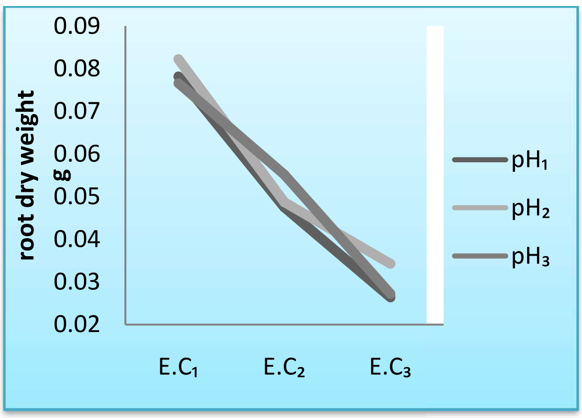

Figure 24. Effect of interaction pH & E.C on root dry weight

Interaction between pH and E.C on germination percentage, root length, root wet and dry weight were significant at 5% level (Table 1). The most effective treatment of seed germination was observed in interaction pH=8.2 and E.C=10 g/L (Figure 21). The longest root length and dry weight was pH=6.5 and E.C=10 g/L (Figure 22 and 24). Also the highest level of root wet weight was pH=8.2 and E.C=10 g/L (Figure 23). Karimi *et al.,* 2011 was reported that salinity had significant effect on dry weight. Bybordi and Tabatabaei, (Bybordi and Tabatabaei, 2009), Tunçtürk and colleagues (Tunçtürk *et al.,* 2011) and Akram and colleagues (Akram *et al.,* 2007) showed that salinity stress was reduced radicle wet and dry weight. Hussain and colleagues (Hussain *et al.,* 2008) stated that salinity stress tolerance is associated with decreased absorption of sodium ions. Turhan and Ayaz, (Turhan and Ayaz, 2004) found that, salinity with the effect on cell division and plant metabolism germination decreased, they also found that the inhibitory effect of sodium chloride on germination and suction sodium chloride of ions depends of the hypocotyl. Reviews of [Shahid and colleagues (Shahid *et al.,* 2011), Kaya and Ipek, 2003 (Kaya and Ipek, 2003) and Mohammed and colleagues (Mohammed *et al.,* 2002)] showed that germination percentage decreased with increasing salinity stress. Noor and colleagues (Noor *et al.,* 2001) The Effect of Salinity on radicle length showed that these attributes influence than the shoot length and concluded radicle length that the most sensitive part of the plant to the stress, they also found that under salt stress Cytokinin hormone function stops in the radicle, so that the radicle length is criterion used to measure the salinity stress tolerance in plants. Hussain and colleagues (Hussain *et al.,* 2011) Tolerance to salinity stress due to differences in genetic diversity knew.

The experiment results indicated that cultivar KSC703 was the best variety in compare with other cultivars in this experiment under stress condition of salinity and pH and KSC704 was more sensitive. It was also observed that pH=6.5 has the best pH for corn germination as pH = 8.2 has shown most negative affect on it. pH = 6.5 was decrease the root length, root wet weight and root dry weight and the highest growth rate was obtain at pH=7.5. Results also proved the negative effect of salinity on seed germination, root length, root wet weight and root dry weight.

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