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Study of Salinity Stress on Germination and Seedling Growth in Greenhouse Cucumber Cultivars

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ABSTRACT

Salinity has an important role in reduction the growth and yield of cucumber especially in arid and semiarid regions. Salinity can affect on physiological processes (germination to emergence of plant). In order to study the effects of salinity stress on parameters of cucumber germination, the experiments was conducted in a completely randomized design with factorial layout at the laboratory of payame noor university. The factors include salinity in 4 levels (0.5, 4.4, 6.5, 10 dS/m) and Cucumber Cultivars in 5 levels (Keyhan, Danito, Storm, Gohar and Kian) with three replications. After placing the seeds in Petri dishes and adding the saline water, Then they were transferred to the germinator for 14 days with temperatures of 25 degrees and the humidity 30%. The result of analysis showed that there were significant differences between genotypes for all attributes. Also salinity significantly reduced the percentage and speed of germination, wet and dry weights of root and shoot, root and shoot lengths, wet and dry weights of seedling on all studied cultivars. The cultivars defined that Kian, Danito and Keyhan cultivars are the tolerant to salinity and Gohar and Storm is not resistant to salinity.
KEYWORDS: Cucumber Cultivars (Keyhan, Danito, Storm, Gohar and Kian), salinity, germination

1. INTRODUCTION

Salinity in the soil is one of the non-living environmental stresses that effect on production especially in arid and semiarid regions (Grewal, 2010 and Satter et al, 2010). Salinity damage seed germination reduces nodule formation, delay plant growth and reduce crop yields (Jamill et al, 2006). Plants that grow in saline soils have ionic compounds with varied range of dissolved salts concentrations. These salts fluctuate due to changes in water supply, drainage, evartanspiration and the availability of solute. Germination parameter depends on amount and frequency of rainfall and also ability of seeds and growth of seed varieties during soil moisture decrease and osmotic potential (Jamill et al, 2006). The salt prevents seed germination and crop establishment (Flower, 1991). Moreover salt stress can affect germination with osmotic pressure (Satter et al, 2010). Germination and seedling characteristics, which are the most useful criteria, are used to select the level of salt tolerance in plants (Boubaker, 1996). Since saline and alkaline soils are in arid and semi-arid regime of world, there are two ways to use them, 1) Reduction salt concentration in soils that it is not economical in the large scale and 2) usage of different varieties that are resistant to salinity, so that are able to economic produce (Shahbazi and Kiani, 1998). Greenhouse cultivation due of scientific benefits, including the possibility of production throughout the year, saving the primary inputs such as fertilizer, land and labor per unit of production, supply quality products at high prices and reduce environmental pollutants and control of climate and soil conditions has been attend in recent years. In order to produce some gardening crops (such as cucumber and tomato), greenhouse cultivation is alternative method for the traditional ground (Messiah et al, 2008). Cucumber is the most important greenhouse plants in semi-arid areas with saline ground water. So, it is necessary more research on effect of salinity on germination, growth and chemical composition of this plant. Because salinity has negative effects on yield of cucumber and tomato plants by reducing germination, seedling growth, establishment of the plant weak, lower weight and marketable fruits (Sato et al, 2006). Moreover, Haier et al (2006) reported decline fresh and dry weight of tomato in saline conditions. Researches showed that the percentage and speed of germination of all varieties of greenhouse tomatoes delayed and reduced by increasing salinity and whole seedling growth characteristics (fresh and dry weight of roots and stems) were decreased with increasing salinity. Most plants have a lot of genetic variation in tolerance to salinity. Selection and identification of plant varieties tolerant to salinity is the most successful strategies to reduce the effects of salinity on the growth and yield of the plants (Kaveh et al, 2011). So the control of salinity is one key to management of natural resource that ensure stability of production and efficient use of land and also salinity changes the amount of corps and increases the cost of production, therefore the research on the introduction of resistant cultivars to salinity is great importance in both aspects: economically and ecologically (Valydany et al, 2005). On this basis, we investigated different level of salinity on

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new cultivar of cucumber during very sensitive and critical stage such as germination and seedling growth and as a result were introduced resistant varieties to salinity.

MATERIAL AND METHOD

In order to study the resistant of cucumber genotypes to salinity in the germination stage, five known cultivar were selected of this plant in Iran. Experiments were conducted in a completely randomized design with factorial layout in the laboratory of Payamnoor University. The factors include salinity in 4 levels (0.5, 4.4, 6.5, 10 dS/m) and Cucumber Cultivars in 5 levels (Keyhan, Danito, Storm, Gohar and Kian) with three replications. In the first, seeds were disinfected with a solution of 10% sodium hypochlorite and after rinsed with distilled water, the seeds were transferred to Petri dishes containing filter paper. 10 seeds were selected and placed into the Petri dish with 9 cm in diameter. Then Seeds placed in the germinator at 25° C and dark conditions. Seeds were monitored daily and the seeds were considered as germinated seeds that have long roots were more than 2 mm (Kaveh et al, 2011). On the last day (seventh day) were measured rate of germination, root and shoot lengths and weight. After that samples were dried in an oven with a temperature of 70 ° C to Biomass measurements.

RESULT AND DISSCUTION

Analysis of data showed that effect of salinity on germination, root and shoot growth in greenhouse cucumber cultivars were significant at the 1% level (Table 1).

Table 1: Results of variance analysis for studied traits

		Mean square			
S.O.V	**df**	**GP (%)**	**DW (g)**	**RL (mm)**	**PL (mm)**
Repliaction	2	39.7135^{ns}	0.00026^{ns}	1.3701^{ns}	1.4384^{ns}
Cultivar (c)	4	65.7552*	0.00091**	34.042**	7.0369*
Salinity (s)	3	36.7373*	0.00004^{ns}	76.674**	56.4310**
C × S	12	58.6325*	0.00008^{ns}	4.5212^{ns}	2.9883^{ns}
Error	38	15.8134	0.00008	2.285	1.7261

Note: *and ** indicate significant difference at 5% and 1% probability level, respectively, ns: Non- Significant
GP: Germination percentage, PL: Plumule length, RL: Radicle length, DW: Dry weight (Biomass)

Effect of salinity on speed of germination

Salinity reduced germination and delays speed of growth cucumber cultivars. Among the variety of cultivars, the Keyhan had the highest percentage of germination and three varieties of Kian, Gohar and Danito have not significant difference in terms of reducing the speed of germination (Fig 1).

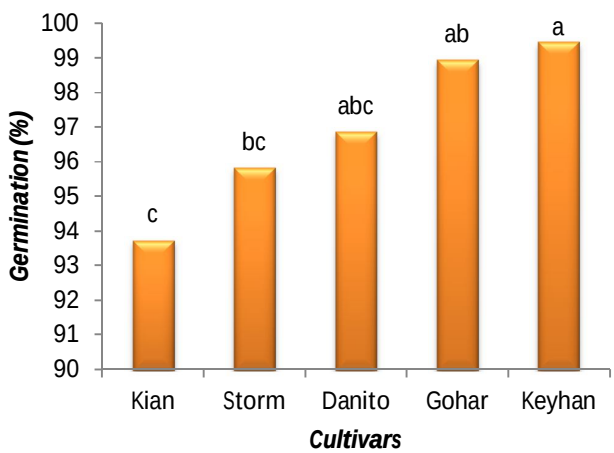

Figure 1: Effect of cultivar on germination

Different levels of salinity had significant effect on seed germination, So that with increase salinity decreased germination. Also result showed that the highest percentage of germination is associated to low levels of salinity (S_0) and increasing of salinity (S_3) germination decreased sharply. Naseri et al (2011) reported that Salinity due to the toxic

effects of specific ions and a high concentration of salts reduces the water potential, which prevents the absorption of water by the seeds. Therefore reduced the speed of germination. As well as Mercedes et al (2005) mentioned that inhibition of seed germination by salinity is relate to the osmotic effect or specific ion toxicity. These results are in full accordance with the results of other researchers (Satter et al, 2010).

Effect of salinity on root and shoot length

Variance analysis of data showed that the effect of salinity on root length of cucumber varieties were significant at the 1% level. Among the studied cultivars, Maximum lengths of root were belonging to Kian, Keyhan and Danito, So that difference of them were significant with Gohar and Storm cultivars. Storm cultivar had the lowest root length (Figure 2).

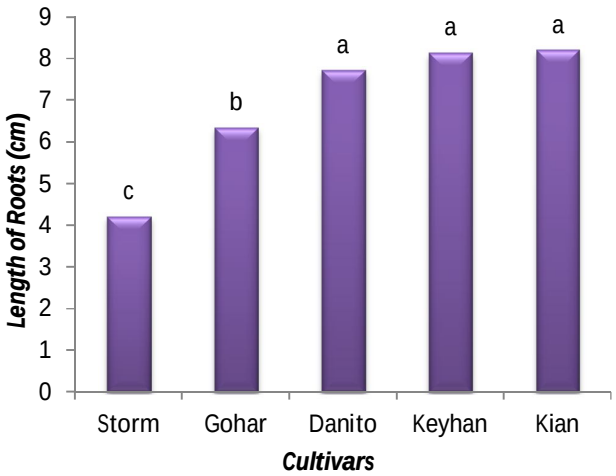

Figure 2 : Effect cultivar on length of roots

In terms of salinity, S_0 (without salt) had the highest root length and S_3 (10 ds/m) showed the lowest root length. Naseri et al (2011) and Kaveh et al (2011) showed that root length with increasing salinity levels be more affected than shoot length. Neuman (1995) indicated that Salinity prevent root growth quickly and thus inhibit water and essential mineral absorption of soil. Although the root length of the Danito cultivar (7.35 mm) was higher than other cultivars, the difference was not significant with Keyhan and Kian. Gohar and Storm varieties had the lowest shoot length (5/78, 5/91mm) respectively (Figure 3).

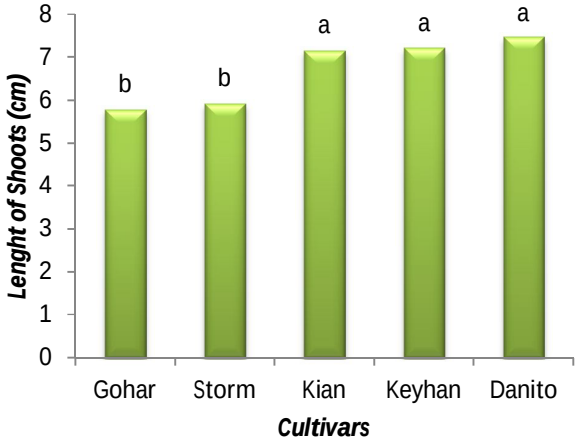

Figure 3 : Effect cultivar on length of shoots

Also result shows that the difference in length of shoots is quite significantly in the different levels of salinity and it declined with increasing salinity. This difference suggests that increasing the salinity have a significant impact on the length of root and shoot compared to other traites measured (Table 1). The roots and shoots length are important parameters in plant. Because of roots have direct contact with soil and absorb water from the soil and shoot conduct it to

the parts of the plant. Therefore, length of shoots and roots is a good scale for responses of plant to salinity(Jamill et al, 2006). Thus salinity reduces growth, cell size and the result due to exit of water from the plant cell and reduced the size of plant organs (Kaveh et al, 2011).

Effect of salinity on plant weight

Analysis of data (Table 1) shows that the total biomass of the varieties of greenhouse cucumber reduced with increase salinity. In the among of cultivars, Danito and keyhan have the highest biomass and the Gohar with 0.432 gr was lowest biomass. The main reason of yield decreas was effect of salinity and toxic of ions on growth of plant.

CONCLUSION

Identification and using greenhouse cucumber varieties resistant to the salinity is one of the strategies to reduce the negative effects of salinity on germination and plant growth. Among the studied cultivars, Keyan and Danito were identified as the most tolerant cultivar to salinity and Ghohr was and non-salt tolerant. Thus we can use these cultivars as the dominant factor in breeding programs of increasing salinity.

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