J. Agric. Food. Tech., 3(5)1-4, 2013

ISSN 2090 – 424X
Journal of Agriculture and Food Technology
www.textroad.com

The Effect of Salinity Stress on Germination and Seedling Growth of Cumin (Cuminum Cyminum L.)

[1]Nasim Roodbari,[2] Mehrdad Lahooti,[3] Shahram Roodbari, [4] Ahmad Aein, [5]Amin ganjali

[1]Faculty of Experimental Science, Kahnooj Branch Islamic Azad University, Kerman, Iran
[2]Associate Professor of Biology Science, Mashhad University of Ferdowsi, Iran
[3] Master of Agricultural Management Agriculture of Jiroft, Iran
[4]Faculty of Agricultural Research Center of Jiroft, Iran
[5]Faculty of Experimental Science, Kahnooj Branch Islamic Azad University, Kerman, Iran

ABSTRACT

Salinity stress is one of the most important environmental stresses limiting economic gains from land to produce plants. In this regard, an experiment was conducted to study salinity and its effect on seed germination of *Cuminumcyminum* in a completely randomized with multi-observational design with 4 treatments (1,5,9 and 13 ds/m NaCl) and 3replications(peteridish) per treatments. Reasults showed that salt stress decreased biomass of primary shoots, roots and germination percentage and other physiological factors in the stage germination.There was no significant difference treatments regarding means variation of fresh weight and root length. However, different salinity levels effect on dry weight, shoot length, root/shoot ratio with $P<0.05$.
Keywords: Salinity, Cuminumcyminum, NaCl, Seed germination, Physiological factor.

INTRODUCTION

Recently, medicinal and aromatic plants have received much attention in several fields such as agroalimentary, perfumes, pharmaceutical industries and natural cosmetic products [1]. Number of medicinal plant in arid and semiarid regions of the country are produced. Despite of the fact that they have a relatively large area of land under cultivation or other reason, few research has been done on different aspects of their farming and breeding. Cumin generally called Cumin and Scientifically named Cuminumcyminum, is one of these products[2] and one of the most important medicinal plants of the Apiaceae family and one of Iran's exports. Considering the specific ecological conditions required for the cultivation of this plant some of its important features have made it necessary to cultivate among which the followings be mentioned: Relatively short growing season of 120-100 days, little water requirement, no interference with the growth of other crops grown in the growing season. Given the above mentioned importance and benefits of the little research conducted on this product in our country. Basic research is essential particularly in the areas of cultivation of cumin seeds[3]. The salinity stress after the drought stress is one of the most important environmental salinity stress of the production of crops and medicinal[4].In the case of farm plants and crops, especially cumin, one of the main obstacles of the reduction of this plant and other crops work is the salinity problem. As a result of the plant's tolerance to salinity and salinity effects on different parts of the plant such as phyziology, morphology, anatomy, chemical composition, amino acid and the elements were not much considerd[5]. Research of the plants ofthe Apiaceae family such as Carrots and Fennelhave shown their sensitivity to salinitywhile the cumin plant is relatively sensitive tosalinity managing stress in its body in the case of low salinity stress based on physiological activities[6].Many scientists, the effect of salinity on reduction of plant growth is attribute to effect of salinity on production of Cytokinin hormone in root and suggested that salinity inhibits plant growth imposed by regulation effect on hormones[5,6].

Cumin cultivation in crop rotation along with plants such as wheat, barley, sugar beet and cotton confirmed the same matter, too. Although, secondary metabolites in the medicinal and aromatic plants were fundamentally produced by genetic processing but, their biosynthesis is strongly influenced by environmental it means biotic and abiotic environmental factors affect growth parameter, essential oil yield and constituents. Germination stage of plants to salinity is the most critical stage[7]. Because plant growth begins from germination and in order to survive, seed germinatinis required to adapt themselves to their environment and establish in soil. Given that the most sensitive life stage of a plant is germination stage, successfully completing this period will have an important role in the process of establishing the plant [2,3]. In this study, the main of purpose, is determining of the salinity tolerance of cumin seedling characteristics by using NaCl and effect of 4 different levels of salinity stress is investigated on growth parameters, germination and yield in cumin. The

Corresponding Author: Nasim Roodbari, Department of Experimental Science, Islamic Azad University, Kahnouj, Iran. Tel: +989132495746; Mob: +989132495746; E-mail:Roodbari.nasim7@gmail.com.

results of this study can be used by producers of this plant to be able to access desirable quantitative and qualitative properties in order to its optimum applications in industry.

Materials and Methods:

To study the effect of salinity on seed germination cumin, an experiment was performed in greenhouse research Agricultural Research Center of Jiroft in a completely random design a view with 3 replicates and 4 treatments with levels 1, 5, 9 and 13 ds/m salinity NaCl. Storage conditions and growth of germination stage in Germinator machine and the temperature of maximum 26 and minimum 18 ° C[4], 40% relative humidity and 16 h day and 8 h night cycle was boarding. At this stage, Cumin seeds soaked for 24 hours before starting seeds planting [8]to dissolve plant fetal growth inhibitory Chemical that may be in a seed in water and go out of seeds through bio osmosis and increase seed germination [4, 8]. Then, seeds were sterilized under laminar air flow system in the following order with 10% ethanol and 15% sodium hypochlorite for 3-2 minutes each and washed 3 times with sterile water in each stage and too seeds, using forceps, were put and cultivated into petri dishes with dimensions of 9 cm; the seeds were sterilized into a oven at the temperature of 100° C.In order to make the environment for germination moisty the bottom of petri dishes were covered with sterile tissue. After planting seeds in each petri-dish lids after heating with a flame were put on them by moving to agerminator, and germination were recorded daily. Coming the root out the size of 2 mm or more was considered as the criterion for germination. For the salinity, the salinity levels of 1, 5, 9 and 13 dS/ m was used. After 10 days of planting seeds, factors of seed germination, shoot length, root length, shoot length to root, root and shoot dry weight were measured. Root and shoot lengths were measured with a millimeter ruler and to obtain root and shoot dry weight, seedling was placed for 72 h at 75 ° C in the oven and then the dry was measured and with a laboratory balance with an accuracy of 0/001 gr and the investigating factors were compared with each other the optioned data were analyzed using the statistical program SAS[9]and Duncan's multiple range test was used for mean values and significance level of 5%.

RESULTS AND DISCUSSION

Characteristics of the germination stage:

Determining the percentage of cumin seed germination in all treatments with different salinity levels of 1, 5, 9 and 13 ds/m indicates that by increasing salinity levels, seed germination is reduced. Reduction of seed germination in salty environments is mainly due to increased ion osmotic pressure in seed germination and impairment and reducing of the absorption of water by seeds due to the high salt concentration[4].Some results of research on various crops such as barley and sorghum[5,7], rape [10], wheat[11], rice[12] and Pea[6] suggests that seed germination can reduced due to the effect of salinity stress. This study showed that the seedling fresh weight was not significantly different between treatments (P>0/05). The test results confirmed the results shown by Paryda and colleagues not observing significantly increased levels of sodium chloride salinity in wet cotton[13].The reason for this can be seen from the negative effects of salinity on showing down the plant metabolism[1].The results of (Table1) shows that the levels of salinity in the experiment had a significant effect on seedling dry weight($p<0/05$)so that with increasing salinity, seedling dry weight has decreased. Some of studies, have also reported significant differences in the effect of salinity on seedling dry weight($P<0/05$) that is consistent with This study. The research done by Zidan and Elewa[14] showed that the effect of salinity on cumin caused by different levels of sodium chloride, seedling dry weight was reduced by increased salinity. They suggested that cumin can tolerate low to moderate concentrations of salinity. Bahush and Esfahani studying different levels of salinity in rice cultivars showed that seedling dry weight and water content in different cultivars are significantly different from each other [12]. Experimental results indicated that there was a significant difference between treatments($p<0/05$) regarding length of the shoot(fig 1).The significant differences may be due to ion toxicity and physiological drought caused by salinity stress. Maximum length of shoot was associated with an average of 3.08 cm was related to the first treatment and the lowest with an average of 2.06 cm was related to the last one. According to the results of this research, Cumin seeds have a low resistance to high salinity. Another reason for significant decrease in length of shoot, due to salinity might be cells shrinking and decreasing the cell numbers. In addition, the assimilate allocation changed from shoot to root in saline condition[12]. Saberi and Rashed Mohassel investigated the effect of different levels of NaCl salinity on germination and showed that the shoot length of wheat cultivars reduces with increasing salinity [11]. The results of another study conducted in 2003 on canola cultivars showed significantly decreased stem length with increasing salinity[15]. The differences the effect of salinity on root length in different treatments applied in salinity levels of 1, 5, 9 and 13 ds/m was not significant(Table 1). The present study confirms the results of many researchers Including Aminpoor and Aghayi exploring the effect of salinity on the germination of alfalfa cultivars; they indicated that root length decreased with increasing salinity[16]. The results of the present study showed that there is a significant difference between treatments($P<0/05$)regarding the

ratio of shoot / root(fig 3).Enferad and colleagues reported that the shoot / root ratio decreased due to affect of salinity on canola[17]. The results of the study found that the use of up to 5 ds/m salinity has no effect on germination of cumin. One of the most important physiological reasons for these results might be due to salinity effect on osmotic adjustment and salt accumulation in plant tissues. Considering that all growth indices and biological and grain yield of cumin decreased in sequence of increasing salinity levels, it could be concluded that cumin can not classified as a salinity tolerant plant. It should be mentioned that high soil salinity levels (EC= 12.4 ds/m) and fine textured soil (loamy clay) might impressed the results and magnified the adverse effects of salinity of irrigation water on plant growth and yield.

Table 1-Comparisonofdifferent levels of salinity on the germination characteristics

Salinity (ds/m)	Shoot length(cm)	Root length(cm)	Seedling wet weight(gr)	Seedling dry weight(mg)	Shoot /root ratio
1(S_1)	3.08[a]	5.25[a]	0/6 [a]	44[a]	0.59[a]
5($_{S2}$)	2.9[a]	5.21[a]	0.56[a]	37.67[ab]	0.57[a]
9($_{S}$3)	2.4[ab]	5.38[a]	0.46[a]	33b[c]	0.44[b]
13(S_4)	2.06[b]	5.6[a]	0.43[a]	28.3[c]	0.37[b]
Significance	*	ns	ns	*	*

[a,b,c]different superscripts in a raw differ significantly. ns= no significant,* Significant (P<0.05).

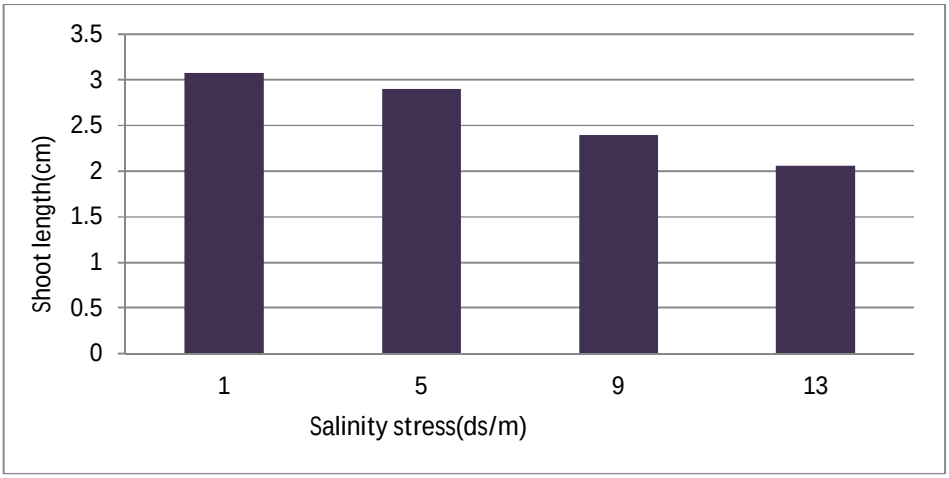

Figure 1 - Comparison of Shoot length(cm) at different levels of salinity stress

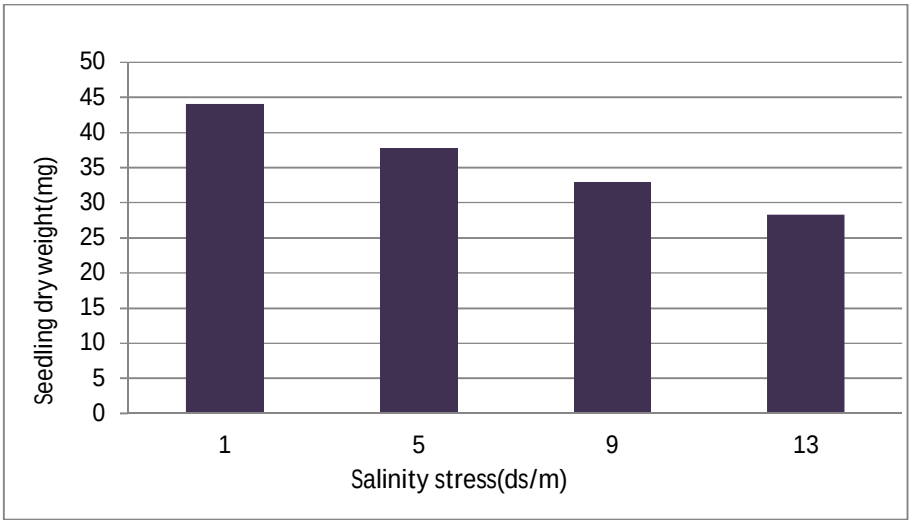

Figure 2- Comparison of Seedling dry weight(mg) at different levels of salinity stress

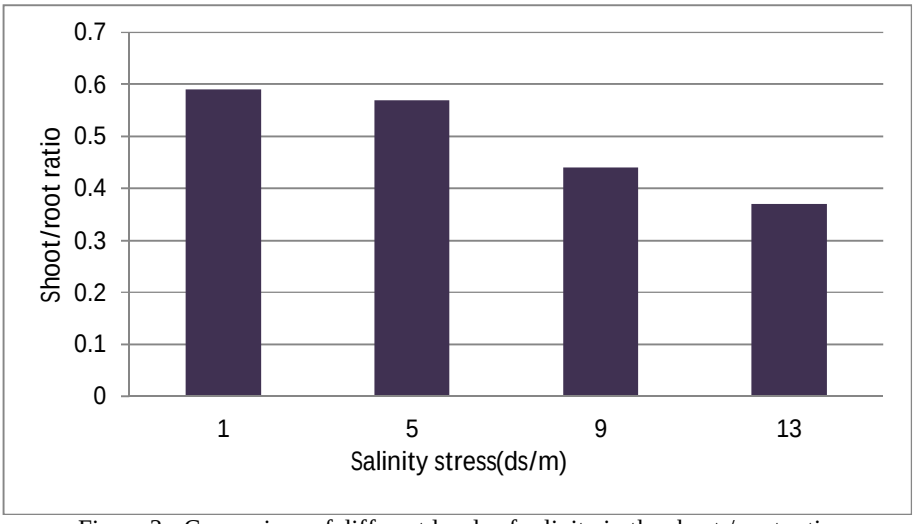

Figure 3 - Comparison of different levels of salinity in the shoot / root ratio

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