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Effects of salinity stress on Seed Reserves Depletion in basil (Ociumum basilicm L.) medicinal plant cultivars

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ABSTRACT: The heterotrophic seedling growth can be considered as the product of three components: (1) initial seed weight, (2) the fraction of seed reserves which are mobilized, and (3) the conversion efficiency of mobilized seed reserves to seedling tissues. In order to consider impact of salinity stress on germination and heterotrophic seedling growth of basil (Ociumum basilicm L.) seedling, we did an experiment in 2011 year. Experimental treatment includes 4 levels of NaCl concentration (o, 50, 100 and 150 mM) and two basil cultivar (KESHKENI LUVELOU and VARAMIN) with 3 times repetitions. The results indicated that salinity stress results in decreased percentage and rate of germination and decreased percentage of normal seedlings. Seedling growth and the fraction of seed reserve mobilization indicated a significant decrease with the advance of salinity. However, the effect of salinity stress on the conversion efficiency of mobilized reserves to seedling tissues was not significant. Thus efforts to improve seedling germination and growth in plant breeding programs should focus on improvement of fraction of mobilized seed reserves.

***Keywords*:** Salinity stress; NaCl; Seed reserve; Basil cultivars

INTRODUCTION

Recently, medicinal and aromatic plants have received much attention in several fields such as agro alimentary, perfumes, pharmaceutical industries and natural cosmetic products. Although, secondary metabolites in the medicinal and aromatic plants were fundamentally produced by genetic processing but, their biosynthesis is strongly influenced by environmental factors. Its means biotic and abiotic environmental factors affect growth parameter. A biotic environmental stresses, especially salinity and drought has the most effect on medicinal plants. Salinity is one of the major environmental factors that limit crop production. Some of areas where under effect by salinity and salt increase steadily, but statistical data show that in includes almost 50% of world fields which is equal to 3 times more than under cultivation areas . Basil (Ocimum basilicum,) is an annual plant belongs to the *Lamiacea* family which has been grown for its essential oil. The essential oil of basil is used to flavor foods, dental and oral products in fragrances, and in medicines.

The different results were dedicated from the effect of salinity stress on the quantitative and qualitative parameters. For instance, it was found that, increasing of salinity stress decreased almost all of growth parameters in sorghum. (Liopa-Tsakalidi, 2010) reported that enhancing salinity treatments lead to growth reduction. It also reduces germination amounts and seedling weight. Ashraf and Orooj reported that salinity treatment lead to reduction of growth and plant developments. Overall, salinity through enhancement of osmotic pressure leads reduction of water absorbance and metabolically and physiological processes will be under its effect. So it cause more delay in germination beginning following by enhancing seed germination duration.

Therefore seedling growth can be limited by decreased mobilization of seed reserve and / or the conversion efficiency of mobilized seed reserves. We have found no published data reporting quantitative effects of salinity stress on the components of seedling growth in basil.

This research considers effect of salinity on early growth (germination and heterotrophic seedling growth) of basil (Ociumum basilicm L.) according to importance of drug plants and salinity field’s extent.

MATERIALS AND METHODS

The experiments were carried out at the Seed Research Laboratory of Islamic Azad University, Iran. Experimental treatment includes 4 levels of NaCl concentration (o, 50, 100 and 150 mM) and two basil cultivar (KESHKENI LUVELOU and VARAMIN) with 3 times repetitions.

To determine seed dry weight and seed moisture content, 25 seeds from each treatment in three replications were weighed (W1), ground and after drying at 75 ºC weighed again (W2) and seed water content (WC) was calculated as [(W1-W2)/W2]. Initial seed dry weight (ISDW) in each replication was calculated as [W1/(1+WC)].

Treated seeds were germinated between moistened Whatman filter papers, according to rules. 25 seeds per replication were used for each treatment. They considered as germinated when their radicle length was approximately 2 mm or more. After ten days, normal and abnormal seedlings and dead seeds were screened. Normal seedlings were counted and were excised from remnant cotyledons. Dry weight of seedlings and remnant cotyledons were obtained after oven drying at 75 ºC. Germination rate and germination uniformity were assessed according to (Soltani et al., 2001).

Seedling growth components were estimated as outlined by (Soltani et al., 2006). Seed reserve utilization (mg per seed) was calculated as initial seed dry weight minus the dry weight of the cotyledons remnant. Conversion efficiency of mobilized seed reserve into plant tissue was estimated by dividing seedling dry weight to the seed reserves utilization. The ratio of utilized seed reserve to initial seed dry weight was considered as seed reserve depletion percentage.

The electrical conductivity (EC) test, which was only carried out in the KESHKENI LUVELOU cultivar was performed according to the method of (Hampton and TeKrony et al.,1995). Four samples of 25 sound looking, unbroken seeds were weighed, and then each sample was placed in 250 ml of distilled water in a 500 ml Beakers. Beakers were then sealed and kept at controlled temperature of 20 ºC for 24 h. The electrical conductivity of the seed leachates was then measured using an EC-meter. The electrical conductivity of seed leachates was expressed per gram of seed weight as µS cm-1 g-1 for each sample.

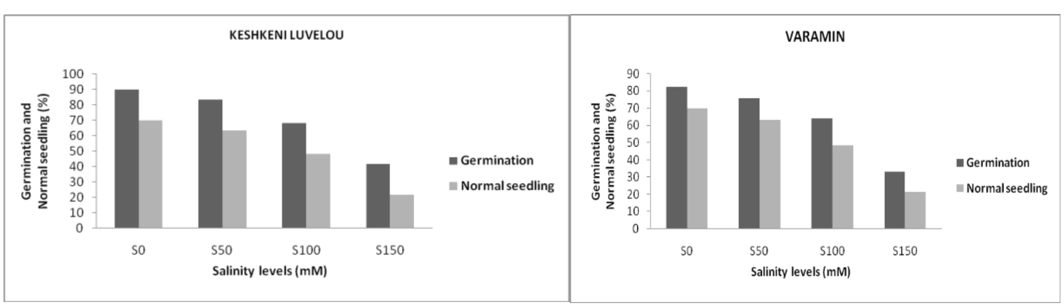
RESULTS AND DISCUSSION

Table 1 represents a summary of the analysis of variance for seed germination characteristics and electrical conductivity test. Salinity stress had significant effects on electrical conductivity and seed germination traits, i.e. maximum seed germination, percentage of normal seedlings, and germination rate and uniformity. Figure 1 indicates the effect of salinity on these traits. Reduced seed germination following salinity stress treatments might have been resulted from the increased solute leakage following imbibitions which is usually accompanied with inevitable exit of some necessary materials for germination and normal seedling growth.

Table 1. F-value from analysis of variance for electrical conductivity (EC), germination uniformity (GU), germination rate (GR), maximum germination (MG) and percentage of normal seedling (PNSL) in KESHKENI LUVELOU and VARAMIN cultivars

	EC	GU	GR	MG	PNSL
KESHKENI LUVELOU	32/11**	65/5**	0/024**	591/91**	110.44**
VARAMIN	-	95/08**	0/020**	468/61**	28.17**

**Significant at 1% level of probability and ns not significant



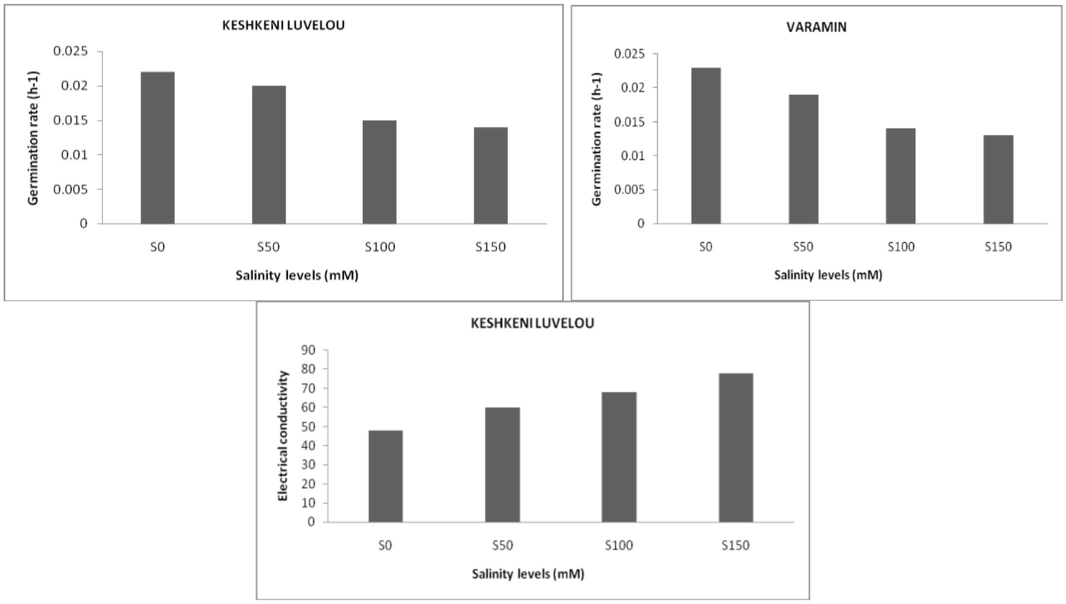


Figure 1. Maximum germination, percentage of normal seedling and germination rate in KESHKENI LUVELOU and VARAMIN cultivars, and electrical conductivity in KESHKENI LUVELOU cultivar

Our results are in agreement with those of (Ruzrokh et al., 2003; Song et al., 2006; Azhdari et al., 2010 and Faheed et al., 2005). Its cause could be more than usual presence of anion, cation which in addition to toxication, decreased water potential that is because of its solubability in water. Ion's so plant can't absorb water and encount to lake of water [15]. We also can say that this reduction in germination race relies on salinity bad effect on some physiological processes which are effective on seed germination [16].

(Sidari et al., 2008) reported that salinity is the cause of reduction in germination percentage, race and homogeneity of germination and dry weight of Pinus pinea seedling.

(Sairam et al., 2006) say that salinity is delaying plant growth under reduction of photosynthesis effects, it is cause of closing stomata and reduction of water entrance into the plant and so that it cause duplicate reduction in plant weight.

Rashid et al., 2006) showed that this reduction in dry weight of plumule and radicle which is results of enhancing the salinity concentration is a normal phenomenon and probably it is the result of low water absorbance by germinated seeds.

Table 2 represents a summary of the analysis of variance for seedling growth and its components as affected by salinity stress treatments. The effects of salinity stress on seedling dry weight and seed reserves depletion percentage were significant in both experiments, but not on the conversion efficiency of mobilized reserves. Figure 2 indicates that seedling dry weight and seed reserve depletion percentage decreased significantly (and quadraticaly) as salinity stress progressed. Studying the effect of drought and salinity stresses on seedling growth in wheat, (Soltani et al., 2006) reported that the increase of osmotic pressure leads to reduction of seed reserve mobilization, but no significant differences were found between stressed and non stressed plants with respect to the conversion efficiency of mobilized reserves. The decrease in seed reserve mobilization rate was the cause of decreased seedling growth. They had reported similar results for chickpea seedling growth as influenced by (salinity and seed size, 2001)

Table 2. F-value from analysis of variance for seedling dry weight (SLDW), seed reserve depletion percentage (SRD) and seed reserve utilization efficiency (SRUE) in KESHKENI LUVELOU and VARAMIN cultivars

	SLDW	SRD	SRUE
KESHKENI LUVELOU	813/42**	834/19**	0/033^{ns}
VARAMIN	612/26**	1123/46**	0/392^{ns}

**Significant at 1% level of probability and ns not significant

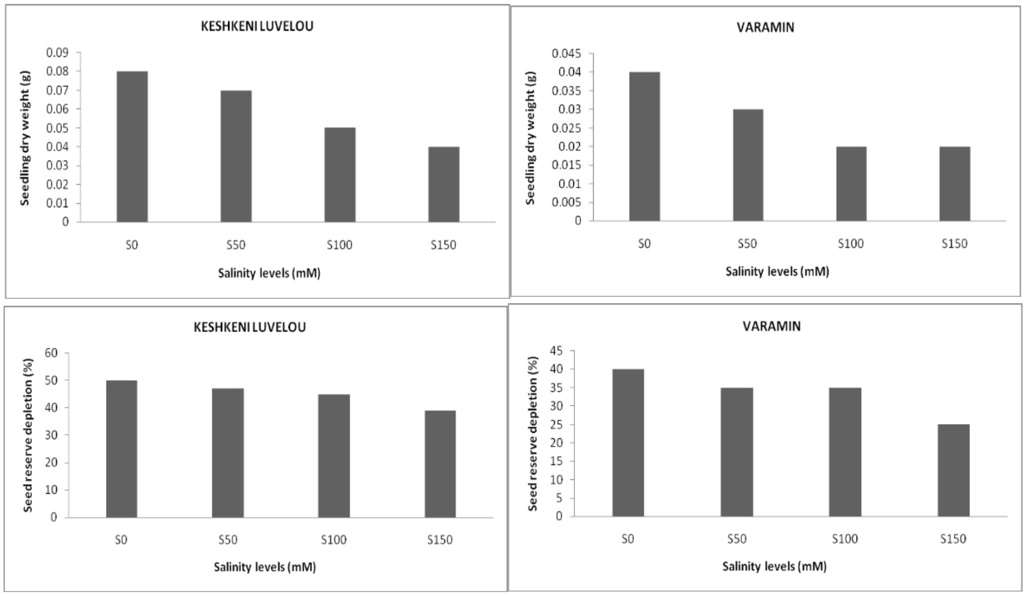


Figure 2. Effect of salinity strees on seedling dry weight, seed reserve depletion in KESHKENI LUVELOU and VARAMIN cultivars

Overall, the results obtained in this study show that salinity results in reduced seedling growth and this is a consequence of decline in weight of mobilized seed reserve (seed reserve depletion percentage), not seed reserve utilization efficiency. Salinity strees has no effect on the conversion efficiency of mobilized reserves. Therefore, sensitive component of seedling growth is the weight of mobilized (utilized) seed reserve and plant breeding efforts or physiological remedies (say chemical application) should be focused on improvement of seed reserve mobilization.

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