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Borage (*Borago officinalis* L.) Germination under Saline Condition

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ABSTRACT

This experiment was conducted in 2010 at the seed laboratory of Shahrud Agricultural Research Center, Iran, to study the effect of salinity stress on the germination of borage. The experiment was conducted in the form of a randomized complete block design with four replications. Treatments included different levels of salinity stress including 40, 80 and 120 mM NaCl and the control. Results indicated that control had the best germination features with 85% germination percent and 120 mM salinity level resulted in the weakest germination, with germination percent of 70%.

Keywords: seed vigor, NaCl, medicinal plants.

INTRODUCTION

Borage (*Borago officinalis* L.) is a medicinal plant with high value as a forage crop, which is an annual member of the Boraginaceae family. One of the problems that make it difficult to cultivate borage is the poor seed vigor, low germination rate and the variable germination. In the natural environment, different factors such as salinity and drought affect plant germination, growth and yield [7]. Quick germination and stand is a vital characteristic especially under saline or dry condition.

It is important to find the tolerance of different species to the unfavorable environmental condition such as the tolerance to salinity. However, because the field soil condition is variable and is not under control, researchers have tried to develop laboratory methods to study plant seed germination under fully controlled conditions. One of the common tests in laboratories is the evaluation of seeds germination response to different solutions such as NaCl solution [2]. Majdi et al. (2007) found that salinity stress significantly affected the grain yield, plant height and number of capsules in black seed (*Nigella sativa*), however had no effect on the number of lateral shoots [4].

This experiment was conducted with the objective to find the tolerance of borage to different salinity levels.

MATERIALS AND METHODS

This experiment was conducted in 2010 at the seed laboratory of Shahrud Agricultural Research Center, Iran. Experiment was conducted in the form of a randomized complete block design with four replications. Treatments of the experiment were 40, 80 and 120 mM NaCl and the control.

Each petri dish received 10 ml of the solution; petri dishes were packed and were located in 25^{o}C germinator. After 15 days, the number of germinated seeds was counted, and the germination rate, germination percent, radicle length and caulicle length were measured. Data were analyzed using SAS and were subjected to analysis of the variances (ANOVA), and means were compared by the least significant differences (LSD) at P≤0.05.

RESULTS AND DISCUSSION

Results indicated that the control gave the longest (1.78 mm) and 120 mM NaCl gave the shortest (0.93 mm) radicles. The radicle length was significantly the same in 80 and 120 mM NaCl (Table 1). Increasing the salinity level from 0 to 120 mM NaCl reduced the caulicle length from 2.54 mm (in the control) to 0.77 (in 120 mM NaCl). As Table 1 shows, caulicle is the most sensitive measured traits to the increasing salinity stress. This result is in agreement with those obtained by Johnson et al. (1992) [1]. The high sensitivity of caulicle length to salinity stress may be attributed to the reduced transition of nutrients from cotyledons to caulicle under saline condition [6]. Moreover, saline condition disturbs water uptake by seed, resulting in the reduction of plant hormones and enzymes production which consequently inhibits seedling's growth [3, 6]. Malekmohammadi and Niknam (2007) reported that more severe drought stress decreased *Plantago psyllium* and *Plantago major* fresh weight and water content, but increased their soluble sugars and free proline content [5].

Table 1. Effects of different salinity levels on borage germination.

Treatments	Germination Percent (%)	Germination Rate (germinated seeds/day)	Radicle length (cm)	Caulicle length (cm)
Control (0)	85a	0.38a	1.78a	2.54a
40 mM NaCl	79b	0.32b	1.32b	1.99b
80 mM NaCl	76b	0.30b	1.11c	0.80c
120 mM NaCl	70c	0.23c	0.93c	0.77d
Significance	*	**	**	**

Means in a column followed by the same letter are not significantly different at P≤0.01.

Mean comparison indicated that the germination percent was the highest in the control (85%) and the lowest in 120 mM NaCl (70%). Germination rate was also decreased when the salinity level increased in the way that the control had the best germination rate (0.38 seeds/day) and 120 mM NaCl had the slowest germination rate (0.23 seed/day) (Table 1). In another experiment, Majdi et al. (2007) found that salinity stress significantly affected the grain yield, plant height and number of capsules in black seed (*Nigella sativa*), however had no effect on the number of lateral shoots [4]. Salinity is a sever problem in many regions of the world which reduces the quality of soil and limits the number of crops that can be grown in those soils. In saline soils, high pH disturbs water and nutrients uptake, although there is sufficient amount of them in soil [1, 3].

CONCLUSION

Results of this experiment indicated that although borage is somehow tolerant to the saline conditions at the growth stages after germination and emergence, however, it is quite sensitive at the germination. So in saline soils, transplanting can be a solution to the problem.

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