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Original Research Article

Effects of Osmotic Conditioning Treatments at Different Temperatures on Mean Germination Time and Rate of *Heliotropium greuteri*

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ABSTRACT

***Heliotropium* is a good ornamental plant with pleasant fragrance and beautiful vegetative pattern in the nature. In seed propagation, there are some problems such as extended germination time and low germination rate. The aim of this study was to investigate the effects of some selected osmotic conditioners on *Heliotropium* seeds. Osmotic conditioning (OC) was performed in seeds with humidification, water, methyl jasmonate (MeJA) (1.0 mM) and seaweed (*Ascophyllum nodosum*) extract (1:500 seaweed extract) for 1, 2 and 3 days at 20 °C and 30 °C. After the treatment, seeds were characterized for germination tests at 25 °C and 35 °C. Germination indexes, germination rates and mean germination times of seeds were determined. The treatment of water for 3 days gave the highest germination rate with 23 % when the lowest germination rate (4 %) was determined in the control group. When the mean germination times of *Heliotropium* seeds were examined, the earliest germination was observed humification 2 days treatment (8.3 days). So, OC treatments made with seaweed and methyl jasmonate made positive contributions to the germination of *Heliotropium* seeds.**

Keywords: *Heliotropium greuteri*, MeJA, Seaweed, Osmotic condition

INTRODUCTION

More than 9000 seeded plants are naturally present in Turkey. More than 3.000 of these species are endemic to Turkey (Kence 1992). The *Boraginaceae* family is one of the most important among them. This family has 100 genera and 2.000 species in tropical, subtropical and temperate regions. Within the *Boraginaceae* family, the *Heliotropium* genus show great differences in many of the biological features including habitat preferences, physiognomy and morphological characteristics. This genus contains almost 300 species (Al-Turki et al. 2001). The important diversity center of the genus is South-West and Central Asia. The plants of *Heliotropium* occur in areas with an arid and semi-arid climate, mostly on dry soils, sandy and gravelly deserts, disturbed soils as weeds in cultivated lands and wastelands along riversides (Collenette 1999, Alhani 2007).

Among the people of Turkey, *Heliotropium greuteri* is called 'yoghurt otu', 'bostan otu or 'paslı bambul otu'. Based on our observations in the Kayseri province, these plants are commonly found at ranging from 1,000 to 2,200 meters from sea level in the slopes of Erciyes Mountain. In addition, when changing climatic conditions are considered, it is important to identify ornamental plants with high resistance to drought, characterization and determination of seed germination potentials.

Essential in crop production is the germination of the seed under suitable conditions. However, the negative ecological conditions and technical problems during the germination phase (low soil temperature, formation of soil layer in the soil, etc.) adversely affect this stage. Therefore, seed treatments can be performed with various chemicals after harvest or before sowing to ensure sufficient germination of the seeds (Arin and Kiyak 2003). In previous studies, osmotic conditioning applications were carried out with natural substances and with the help of chemicals and it was reported to have positive effects (Sivritepe 2000). In some studies, OC has been reported to have beneficial effects on germination of seaweed extracts and seeds of different vegetable species such as onions, peppers (Demirkaya 2016) and tomatoes (Demirkaya 2012). Similarly, MeJA treatments have been found to have a positive effect. Similarly, MeJA treatments were found to have a positive effect on germination of Watermelon (Korkmaz et al. 2004), pepper (Demirkaya 2016) and pumpkin seed (Coskun et al. 2016).

Probably, applications to seed affect the physiological properties of seeds such as RNA, protein and DNA synthesis and increase the activity of certain enzymes such as acid phosphatase, esterase and catalase

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(Sivritepe and Demirkaya 2011). Therefore, in this study, the effects of osmotic conditioning applications on germination rate and germination time of *Heliotropium greuteri* seeds.

MATERIALS AND METHODS

The study was carried out in 2019 in Kayseri University Safiye Çıkrıkçıoğlu Vocational School Laboratory. *Heliotropium* seeds (*Heliotropium greuteri*) used in this study were collected from natural habitat of Kayseri province. Humidifications, water, seaweed and MeJA treatments (one, two and three days); control (untreated) were used. The seaweed (*Ascophyllum nodosum*) extract (Maxicrop; Maxicrop International Ltd., UK) used in the priming experiments. Seaweed extract was used at a concentration of 1:500 as suggested in Lavandula seeds by Demirkaya et al. (2017). OC treatment with seaweed extract was modified from Sivritepe (2000), for 1, 2 and 3 days at 20 °C and 30 °C. MeJA treatments were conducted according to Demirkaya (2016) with 1,2 and 3 day treatment period and a constant temperature of 20 ºC and 30 °C at a dose of 1.0 mM. After seeding, 7.5 ml of seaweed extract and MeJA solution are placed in each petri dish. After the treatment, seeds were characterized for germination tests at 25 °C and 35 °C. After the OC, the seeds were washed with tap water and then with distilled water, for 3 min. Untreated seeds were used as the control. The percentage of total germination rate of the control and primed seeds was evaluated according to the International Seed Testing Association (ISTA). Therefore, 200 seeds (4 replicates × 50 seeds) per treatment were tested in petri dishes and distilled water was added to each petri dishes when necessary (ISTA 2005). The counting was made by removing the germinated seeds from the medium and the counting were continued until the 21st day (Bekendam and Grob 1979). Mean germination time (MGT) was calculated according to Ellis and Roberts equation (1981): MGT = $\Sigma(Dn)/\Sigma n$ (where D = number of days counted from the beginning of the germination test and n = number of seeds which germinate on day of observation) (Ellis and Roberts 1981). The germination index was calculated according to Copeland and McDonald (2012).

RESULTS AND DISCUSSION

Heliotropium seeds are so small that 1000 grain weight is less than 1 g. The germination rates and germination powers of these small seeds are weak, usually 3-5 %. In this study germination properties of *Heliotropium* seeds treated with various concentrations and duration of MeJA and seaweed extract along with water and untreated seeds were investigated. Germination indexes, germination rates and mean germination times of seeds were determined. Water treatment for 3- and 2-days applications with MeJA and seaweed treatment for 1 day significantly increased the germination rate of *Heliotropium* seeds in both temperature applications compared to control. Similarly, humidification for 2 days and water 3 days of *Heliotropium* seeds significantly reduced for the average germination time in both temperature applications compared to control (Table 1).

Table 1. Effects of osmotic conditioning and humidification applications at different temperatures on germination rate, average germination time and germination index of *Heliotropium* seeds.

Treatments	**Germination rate (%)**		**Germination index**		**Mean germination times (day)**	
	25 °C	**35 °C**	**25 °C**	**35 °C**	**25 °C**	**35 °C**
Control	**3,50 d**	**4.50 d**	**0,17 d**	**0.23 d**	10,75 ab	10.04 ab
Water 1 day	15,00 a-c	15.50 ab	0,86 b	0.91 ab	9,37 ab	9.57ab
Water 2 days	18,50 ab	18.50 ab	1,11 ab	1.10 ab	9,67 ab	9.67 ab
Water 3 days	**22,50 a**	**23.00 a**	**1,42 a**	**1.43 a**	**8,82 a**	9.77 ab
MeJA 1 day	17,50 ab	17.50 ab	0,72 cd	0.98 ab	9,08 ab	9.52 ab
MeJA 2 days	14,50 a-c	14.50 a-c	0,74 cd	0.75 d	10,47 b	10.84 ab
MeJA 3 days	11,00 b-c	12.00 b-c	0,66 cd	0.67 d	9,50 ab	9.77 ab

Seaweed 1 day	16,50 ab	16.50 ab	0,97 ab	1.01 ab	9,22 ab	**8.83 a**
Seaweed 2 days	14,50 a-c	14.50 a-c	0,95 ab	0.95 ab	9,58 ab	9.58 ab
Seaweed 3 days	17,50 a-b	17.50 ab	1,13 ab	1.14 ab	9,71 ab	9.70 ab
Humidification 1 day	4,0 d	4.00 d	0,27 cd	0.27 d	9,58 ab	9.58 ab
Humidification 2 days	12,50 bc	12.50 bc	0,83 a-c	0.86 a-c	**7,80 a**	**8.33 a**
Humidification 3 days	6,00 cd	6.00 cd	0,28 cd	0.30 d	**10,79 b**	**12.46 b**

Overall, this study indicated that water, MeJA and seaweed treatments had positive effects on germination parameters that provided promising results particularly for germination rates and index in *Heliotropium* seeds. The treatment of water for 3 days gave the highest germination rate with 23 %, followed by MeJA for 1 days (17.5 %) and seaweed for 3 days (17.5 %). The lowest germination rate (4 %) was determined in the control group. When the mean germination times of *Heliotropium* seeds were examined, the earliest germination was observed humification 2 days treatment (8.3 days). Similarly, seaweed 1-day treatment (8.8 days) and MeJA 1-day treatment (9.5 days) has good performance. Studies related to *Heliotropium* is very limited. With this study, was determined seed characteristics and germination status of *Heliotropium.* It is important to study the seed characteristics of this plant, which has problems in propagation with seeds. This study is very important in terms of contributing to the literature and guiding the future work. OK treatments made with seaweed and methyl jasmonate positively affected the germination of *Heliotropium* seeds.

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