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AUTHORS: Mustafa DEMIRKAYA,Bilge AYDIN,Akife DALDA SEKERCİ,Osman GÜLSEN

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Effects of Osmotic Conditioning Treatments of Lavender (*Lavandula angustifolia*) Seeds on Mean Germination Time and Germination Rate

Mustafa DEMIRKAYA¹, Bilge AYDIN², Akife DALDA ŞEKERCI^{*2}, Osman GULSEN²

¹Erciyes University, Safiye Çıkıkcıoğlu Vocational School, Kayseri, Turkey

²Erciyes University, Department of Horticulture, Kayseri, Turkey

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Abstract: Lavender is an important perfume, cosmetic and pharmaceutical plant worldwide because of its high quality and quantity essential oil content. Besides, it is an important ornamental plant with pleasant fragrance and beautiful vegetative pattern in bush form. In seed propagation, there are some problems such as low germination times and germination rate. The aim of this study was to investigate the effects of some selected osmotic conditioners on lavender seeds. Osmotic conditioning (OC) was performed in seeds with methyl jasmonate (MeJA) (1.0 mM) and seaweed (*Ascophyllum nodosum*) extract (1:500 seaweed extract) at 20°C for 1 and 2 days. After the treatment, seeds were characterized for germination tests at 25°C. Germination indexes of the seeds, germination rates and mean germination time were determined. Seaweed treatment for 1 and 2 day applications and MeJA treatment for 2 days significantly increased the germination rates in lavender seeds compared to the control. In addition seaweed 2 day treatment and MeJA 2 day treatment also increased the germination index. In conclusion, this study indicated that both MeJA and seaweed treatments had positive effects on germination parameters studied in lavender seeds.

Keywords: Lavender, osmotic conditioning, MeJA, seaweed, germination time, germination rate

1. INTRODUCTION

Lavender (*Lavandula* sp.) is a very important essential oil plant belonging to the *Lamiaceae* family [1]. There are 39 types of lavender, most of which originate from the Mediterranean Basin. There are three important types of lavenders in the world with high commercial value. These are lavender (*Lavandula angustifolia* Mill. = *L. officinalis* L. = *L. vera* DC), lavandin (*Lavandula intermedia* Emeric ex Loisel. = *L. hybrida* L.) and spike lavender (*Lavandula spica* = *L. latifolia* Medik.) [2]. Lavender is an important perfume, cosmetic and pharmaceutical plant grown in diverse climatic conditions of the world because of its high quality essential oil content [1].

Lavender is a perennial plant and may have commercial value for up to 15-20 years. At the tip of the flower, stalks are 15-20 cm long flower spike-cluster axes. There are 6-14 florets in each flower cluster. The fruit is 22 mm long and 1 mm wide. The color of the fruit varies from dark brown to black. 1000 grain weight is about 1 g [3]. The germination rates and germination powers of these small seeds are weak, usually 2-3% being less than 10%.

*Corresponding Author E-mail: akifedalda@erciyes.edu.tr

Propagation of the lavender plant is carried out by means of generative, vegetative and combination of two approaches, as most of the other aromatic plants [4]. However, lavender is a medical and aromatic plant with a low seed germination rate, which is a problem in seed production.

The first step of plant production is seeding and germinating under suitable conditions. However, adverse ecological conditions and technical insufficiencies (low soil temperature, formation of soil layer in soil, etc.) at this stage negatively affect germination. Therefore, seed treatments with various chemicals are applied after harvest and before planting so that the seeds can provide good germination [5].

In previous studies, the possibilities of OC with natural substances such as seaweed as well as chemicals such as polyethylene glycol (PEG), mannitol and various potassium salts have been investigated [6]. Using seaweed extracts, the effects on seed germination were first investigated in beet seeds. It was determined that there was an increase of more than 25% in the germination of beet seeds soaked with seaweed extract for 30 minutes before germination [6].

In some studies, beneficial effects of OC treatment with seaweed extracts on seeds of different vegetable species such as pepper [6], onion and pepper [7] and tomato [8] have been reported. Similarly, MeJA treatments have been shown to positively influence the germination of watermelon [9], pepper [10] and pumpkin seeds [11] at low temperatures.

Osmotic conditioning provides several benefits. For example with the treatments before seeding provide increased germination rate, high product homogeneity, higher quality products and higher yields [12]. Probably, seed treatment triggers physiological properties of seeds such as RNA, protein and DNA synthesis, and the activities of some enzymes such as acid phosphatase, esterase and catalase increases [13]. In addition, treated plants indicate increased level of tolerance to salt and drought stress [14, 15]. In this study, the effects of OC with different doses and durations of MeJA and seaweed extracts on the germination rate and mean germination time of lavender seeds were investigated.

2. MATERIAL and METHODS

The study was carried out in the laboratory of Erciyes University, Safiye Çıkrıkçıoğlu Vocational School in 2016. The lavender seeds (*Lavandula angustifolia*) used in this study was purchased from local company Arzuman Ltd., Turkey. The treatments were control (untreated), water, seaweed and MeJA for duration of one and two days. The seaweed (*Ascophyllum nodosum*) extract (Maxicrop; Maxicrop International Ltd., UK) used in the priming experiments was purchased from a local chemical company. Seaweed extract was used at a concentration of 1:500 as suggested in pepper seeds by Sivritepe et al. (2000) [6]. Osmotic conditioning with seaweed extract was modified from Sivritepe (2000) [6] for 1 and 2 days at 20°C. A total of 220 seeds (0.21 ± 0.03 g) belonging to the Arzuman brand are weighted with 0.01 g of seed. MeJA treatments were carried out according to Demirkaya (2016) [10] in a climate chamber with 1 and 2 day treatment period recommended in pepper seeds and a constant temperature of 20°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 OC, the seeds were first washed with tap water for 3 min and then rinsed with distilled water. Untreated seeds were evaluated as the control.

The percentage of viability (total germination rate) of the control and primed seeds was determined according to the International Seed Testing Association (ISTA) Rules except that only 200 seeds (4 replicates \times 50 seeds) per treatment were tested in petri dishes containing wet filter papers and distilled water was added to each treatment group during the test period when necessary [16]. The counting was made by removing the germinated seeds from the medium

and the countings were continued until the 21st day [17]. The mean germination time (MGT) was calculated according to the equation of Ellis and Roberts (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 D .) [18]. The germination index was calculated according to Copeland and McDonald [19].

3. RESULTS and DISCUSSIONS

Lavender seeds are so small that 1000 grain weight is less than 1 g [3]. The germination rates and germination powers of these small seeds are weak, usually 10-20% being less than 30%. In this study germination properties of lavender seeds treated with various concentrations and duration of MeJA and seaweed extract along with water and untreated seeds were investigated. Seaweed 1 and 2 days and MeJA 2 days osmotic conditioning treatments significantly increased the seed germination rates compared to the control. The treatment of seaweed for 2 days gave the highest germination rate with 47%, followed by MeJA for 2 days (46%) and seaweed for 1 day (44%) (Table 1). The water treatment for 1 and 2 days applications resulted in the same germination rates (41%). The lowest germination rate (33%) was determined in the control group.

Seaweed 2 days and MeJA 2 days OC treatments significantly increased germination index. The highest germination index (2.71) was recorded in MeJA 2 days, seaweed 2 days and seaweed 1 day had high germination indices with 2.65 and 2.28, respectively. The water treatment for 1 and 2 days applications resulted in germination indexes of 2.0394 and 1.9094, respectively. Similarly, the lowest germination index (1.554) was determined in the control group (Table 1).

When the mean germination times of lavender seeds were examined, the earliest germination (10.42 days) was observed again in MeJA 2 days treatment. Similarly, seaweed 2 days treatment resulted in 10.78 days, while the water 1 day treatment had 11.95 days of mean germination time.

Overall, both MeJA and seaweed treatments provided promising results particularly for germination rates and index. The results of water treatments were intermediate between the control and MeJA-seaweed treatments. Both MeJA and seaweed treatment increased germination rates more than 10% compared to the control, which may have significant impact on decision making for seed treatment of lavender seeds in commercial propagation.

Table 1. Germination rates, germination indexes and mean germination times of the lavender seeds treated with water, MeJA and seaweed along with control.

| Treatments | Germination rate (%) | Germination index | Mean germination time (day) |
|----------------|----------------------|-------------------|-----------------------------|
| Control | 33 b | 1.55 b | 11.98 a |
| water 1 day | 41 ab | 2.04 ab | 11.96 a |
| water 2 days | 41 ab | 1.91 ab | 12.45 b |
| MeJA 1 day | 38 ab | 1.91 ab | 12.00 b |
| MeJA 2 days | 46 a | 2.71 a | 10.42 a |
| Seaweed 1 day | 44 a | 2.29 ab | 12.12 b |
| Seaweed 2 days | 47 a | 2.66 a | 10.78 a |

* The letters show the differences between the averages according to the LSD test at 0.05 level.

There are studies on the properties of essential oils in lavender [20]. However, studies related to seed characteristics and germination status of lavender is not available. It is important to study the seed characteristics of this species, which has problems in propagation with seeds. This study is very important in terms of contributing to the literature and guiding the future work. Osmotic conditioning treatments made with seaweed and MeJA indicated potential for positive contributions to the germination properties of lavender seed.

4. CONCLUSION

Lavender attracts many people around the world due to its valuable compounds and aesthetic appearance. Their chemical compound varies among the genotypes, therefore selection among highly variable germplasm is very essential for genetic improvement. However, our earlier studies indicated that their seed germination ratios are usually low. Therefore seed treatment with appropriate chemical may provide advantages in terms of increased germination rate and index, etc. In this study, we evaluated various osmotic conditioning parameters such as time and tree different conditioners (water, MeJA and Seaweed) at 25°C. In conclusion, this study indicated that both MeJA and seaweed treatments had positive effects on germination parameters studied in lavender seeds.

Conflict of Interests

Authors declare that there is no conflict of interests.

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