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EFFECT OF SOME SEED TREATMENTS ON GERMINATION OF *Sideritis perfoliata* L.

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Abstract: The genus *Sideritis* L. belonging to Lamiaceae family is represented with more than 150 species worldwide.. The genus is represented in Turkey by 46 species and 53 taxon within two sections among which 39 are endemic. Endemism rate (79.5%) in Turkey is quite high because Turkey is one of the two major gene centers of the genus. *Sideritis* species are known among people with different local names such as mountain tea, highland tea, sage, sarıkız tea and tail tea. According to some recent researches, extracts obtained from *Sideritis* species were shown to have antistress, antiulcer, analgesic, antioxidant, antibacterial, anti-inflammatory and insecticidal effects. The interest in and the demand for this plant species has increased particularly due to its antioxidant effect. Seed germination studies of this species have great importance on determination of production strategies of medical and aromatic plants. This study was conducted to determine the effects of some pre-treatments (ethylene, gibberellin, mannitol, seaweed and cold pre-treatment) on germination of *Sideritis perfoliata L.* which is naturally grown in western Anatolia. The study was carried out at 25/15ºC day/night temperature conditions. The experiments were performed according to completely randomized design with 3 replications at Adnan Menderes University, Faculty of Agriculture, Field Crops Laboratory. Significant differences were determined between applications with respect to germination rates and germination vigor values..

Key words: *Sideritis perfoliata,* Lamiaceae, seed, germination speed, germination vigor.

Bazı Tohum Uygulmalarının *Sideritis perfoliata* L.'da Çimlenmeye Etkisi

Özet: Lamiaceae familyasına dahil olan *Sideritis* L. cinsi dünyada 150'den fazla türe sahiptir. Türkiye'de bu cins iki seksiyon altında toplanan 46 tür ve 53 taksonla temsil edilmektedir ve bunlardan 39 taksonu endemiktir. Türkiye *Sideritis* cinsinin 2 ana gen merkezinden biri olduğu için endemizm oranı (%79.5) oldukça yüksektir. *Sideritis* türleri halk arasında dağ çayı, yayla çayı, adaçayı, sarıkız çayı, kuyruk çayı gibi değişik yöresel adlarla bilinmektedir. Son yıllarda yapılan bilimsel araştırmalarda bazı *Sideritis* türlerinden elde edilen ekstrelerin; antistres, antiülser, analjenik, antioksidan, antibakteriyal, antiflamatuar ve insektisidal etkiler gösterdiği tespit edilmiştir. Özellikle antioksidan etkisinin ön plana çıkmasıyla, bu bitkiye karşı olan ilgi ve talep artmıştır. Tohum çimlendirme çalışmaları, tıbbi ve aromatik bitkilerin üretim stratejilerinin belirlenmesinde büyük önem taşımaktadır. Bu çalışma, Batı Anadolu'da doğal yayılış gösteren *Sideritis perfoliata* L. türünde farklı ön uygulamaların (etilen, gibberellin, mannitol, deniz yosunu ve soğuk ön işlem) çimlenme üzerine etkisini belirlemek amacıyla yapılmıştır. Çalışma 25/15ºC gündüz/gece sıcaklık koşullarında yapılmıştır. Denemeler Tesadüf Parselleri deneme desenine göre 3 tekrarlamalı olarak, Adnan Menderes Üniversitesi Ziraat Fakültesi, Tarla Bitkileri Laboratuarında yürütülmüştür. Çimlenme hızı ve çimlenme gücü değerlerinde uygulamalar arasında önemli farklılıkların olduğu belirlenmiştir.

Anahtar kelimeler: *Sideritis perfoliata*, Lamiaceae, tohum, çimlenme hızı, çimlenme gücü.

Introduction

There are more than 150 species at genus of *Sideritis* L. which belongs to Lamiaceae family. It spreads widely temperate and tropical regions of the northern hemisphere as well as the Mediterranean countries till Caucasus, Canary Islands. Spain and Turkey are countries which contain the most *Sideritis* species (Gonzales-Burgos et al. 2011). *Sideritis* genus is represented by 46 species and 53 taxon that belongs to two section and 39 thereof are endemic taxon. Endemism rate (79.5%) of *sideritis* species from Turkey is quite high for being one of the two major gene center (Başer 2002). *Sideritis* species are known among the people with different local name like mountain tea, highland tea, sage, sarıkız tea and tail tea (Baytop 1999). For centuries, Turkish people were used it as a medicinal plant for the treatment of daily diseases (Everest and Öztürk 2005). Also it was used as soothing the nervous system, antiflamate the antispazmatik, carminative, analgezik, sedatives, cough, stomach pain prevention, anticonvulsant and digestive complaints in folk medicine (Kırımer et al. 1999). According to some research in recent years, extracts that obtained from *Sideritis* species have effect as antistress, antiulcer, analjenik, antioxidant,

antibacterial, antiinflammatory and insecticidal effects (Çarıkçı et al. 2012). Especially due to its antioxidant effect, interest and demand for this plant has increased.

Strong-smelling *Sideritis* species in our country are naturally grows in western and southern Anatolia and has a significant export capacity. Cultivated *Sideritis* species are approximately 3-5 ton and *Sideritis* species that obtained from nature are approximately 1 ton, total 6 ton *Sideritis* species is used both domestic market and export (Özkum 2006; Tuğrul Ay 2012a). Due to both physiological effects and economic reasons *S. lycia* and *S. stricta* species are cultivated in the Antalya region (Göktürk and Sümbül 2002). According to the Red Book of Plants, 40 *Sideritis* species in Turkey aren't included in any category. Today, this situation is not a problem. However it is not guaranteed to be in danger in future years so it will be beneficial if there is study about this issue from now (Ekim et al. 2000; Özgüven et al. 2005; Gümüşçü et al. 2011).

Flora of Turkey has a great potential as medicinal and aromatic plants. Cultivation studies are important for improving diversity at medicinal plants which cultivated. In crop production, the first stages of cultivation are sowing seeds and germinated them in appropriate circumstances. However in this stage the negative ecological conditions, technical faults (low soil temperature, soil cream layer formation) and complications that arising from the structure of the seed affects germination and seedling emergence. Many studies were conducted in order to determine the relationship between seed dormancy and germination (Karakurt et al. 2010).

Some applications are made after harvesting and before sowing in order to break dormancy and provide a proper germination and emergence at seeds that sown in unfavorable condition. These applications include; seeds stratification, classification according to their sizes, wetting before sowing, growth regulators, acids, etching, vitamins, nutrients, or holding in osmotic solution, after germination gelled sowing, coating and banding application which called as priming (Hartman et al. 1990; Hilhorst and Karssen 1992; Ercişli et al. 1999; Yamaguchi and Kamiya 2002; Demirkaya 2006; Karakurt et al. 2010).

Seed germination studies have a great importance in determining strategy of production medicinal plants. This study was carried out to determine the effect of different pre-applications on species of *Sideritis perfoliata* L. that naturally spreading in western Anatolia.

Materials and Methods

This study was conducted at Adnan Menderes University, Faculty of Agriculture, Field Crops Department laboratory in 2014. In this study *Sideritis perfoliata* L seeds were used as material that obtained from the Aegean Agricultural Research Institute.

Table 1. Germination Stimulating Pretreatments

Application No.	Applied Pre-treatments	Doses	Durations
1	Exposed to Hormone **(Ethylene)**	100 ppm	2 hout
2	Exposed to Hormone **(Ethylene)**	200 ppm	2 hout
3	Exposed to Hormone **(Ethylene)**	300 ppm	2 hout
4	Exposed to Hormone **(GA_3)**	100 ppm	2 hout
5	Exposed to Hormone **(GA_3)**	300 ppm	2 hout
6	Exposed to Hormone **(GA_3)**	500 ppm	2 hout
7	Exposed to Sugar Alcohol **(Mannitol)**	0.3 M	2 hout
8	Exposed to Sugar Alcohol **(Mannitol)**	0.5 M	2 hout
9	Exposed to Sugar Alcohol **(Mannitol)**	0.7 M	2 hout
10	Alginic acid stress **(Seaweed)**	%0.1	2 hout
11	Alginic acid stress **(Seaweed)**	%0.2	2 hout
12	Alginic acid stress **(Seaweed)**	%0.4	2 hout
13	Cold pre-treatment	-10°C	5 minutes
14	Cold pre-treatment	-15°C	5 minutes
15	Cold pre-treatment	-20°C	5 minutes
16	Control **(Pure Water)**	No Aplication	

Sideritis perfoliata L. is perennial plant that 20 to 65 cm tall, hairy, upright-growing, woody at the bottom, simple or sparsely branched from the bottom or starting from the upper part (Öz 1999). The seeds are dark brown in color and thousand seed weight 1.25g.

In the experiment as pre-treatments, ethylene (100, 200, 300 ppm), GA_3 (100, 300, 500 ppm), mannitol (0.3, 0.5, 0.7 M), Alginic acid (seaweed) (0.1%, 0.2%, 0.4%) and cold pre-treatment (5 minutes duration -10 ° C, -15 ° C, -20 ° C) were studied. Pre-treatment germination stimulants are given in Table 1. Also pure water was applied as control to determine the effect of pre-treatment and chemicals. Except cold pre-treatment other seeds were immersed in the solutions for 2 hours. Untreated seeds were used as controls. As a germination container plastic petri dishes were used in size as the 8,5 x 8,5 x 1,5 cm. Germination Whatman No. 1 was placed into the Petri dish. 25 seeds were placed in each petri dish and 10 ml of pure water was added and put in a totally dark closet which stable at ambient temperature (25 ± 1ºC). The experiment was established in completely design as randomized factorial experiment design with four replications and a petri dish was used for each application. Seeds were counted daily for 21 days, a seed which radicle outside was recorded as "germinated" (Come 1970; Özcan et al. 2014). It were considered that number of germinated seeds on day 7 as "germination rate" and number of germinated seeds on 21st day as "germination power". Germination rates (%) was calculated using the following formula number of seeds germinated in a petri dish / total number of seeds in a Petri x 100 (Şenel 2005). Observed characteristics were analyzed according to completely randomized design as factorial experimental by TARIST packet program major averages are grouped according to the LSD test.

Results and Discussion

Fifteen different pre-treatments and the control were applied, average values of germination rate and germination vigor of *Sideritis perfoliata L*. seeds obtained in dark conditions and constant ambient temperature of 25 ± 1ºC are given in Table 2. Germination rate and germination vigor of *Sideritis* seeds in pre-treatment values were found statistically significant.

At 7. days (germination rate), the highest germination rate was obtained by 100 ppm GA_3 dose with a maximum value 68% rate, second one was 100 ppm ethylene and 0.3 M mannitol followed it with rate of % 50.67. Germination rates were low at 300 ppm of ethylene (16%) and 0.7 M mannitol (10.67%) when compared to control applications (18.67%). On the other hand -20 ° C for 5 min with cold applications had no germination sign (0%) (Table 2 and Figure 1).

At 21. days, *Sideritis perfoliata L*. seeds (germination power) again with 100 ppm GA_3 dose reached the highest germination rate and 100% germination was observed which means all the seeds germinated. Second highest germination rate 90.67 % which value was obtained with the application rate of 100 ppm ethylene. These two applications also (ppm GA_3 and 100 ppm ethylene) have shown similar 100 effect at 7th day. At 21. days, this was followed by 86.67% of similar statistical group that of 100 ppm ethylene treatment and seeds which were exposed 5 minutes in the cold at -10 °C. The lowest value of the

Table 2. germination values(%) of *Sideritis perfoliata* L. at 7. and 21. days

Applications No.	Applied Pre-Treatments	Germination rate (7th day)	Germination power (21st day)
1	100 ppm Ethylene	50.67 ab	90.67 ab
2	200 ppm Ethylene	29.33 bce	77.33 bc
3	300 ppm Ethylene	16.00 def	66.67 cd
4	100 ppm GA_3	68.00 a	100.00 a
5	300 ppm GA_3	46.67 abc	77.33 bc
6	500 ppm GA_3	25.33 bcdef	50.67 de
7	0.3 M Mannitol	50.67 ab	81.33 bc
8	0.5 M Mannitol	38.67 bcd	52.00 de
9	0.7 M Mannitol	10.67 ef	50.67 de
10	%0.1 Seaweed	29.33 bcde	57.33 de
11	%0.2 Seaweed	30.67 bcde	58.67 de
12	%0.4 Seaweed	26.67 bcde	65.33 cd
13	5 min..-10°C	22.67 cdef	86.67 ab
14	5 min.-15°C	24.00 cdef	49.33 de
15	5 min.-20°C	00.00 f	56.00 de
16	Control	18.67 def	42.67 e
	Ort.	30.50	66.42
	LSD	25.351	18.484

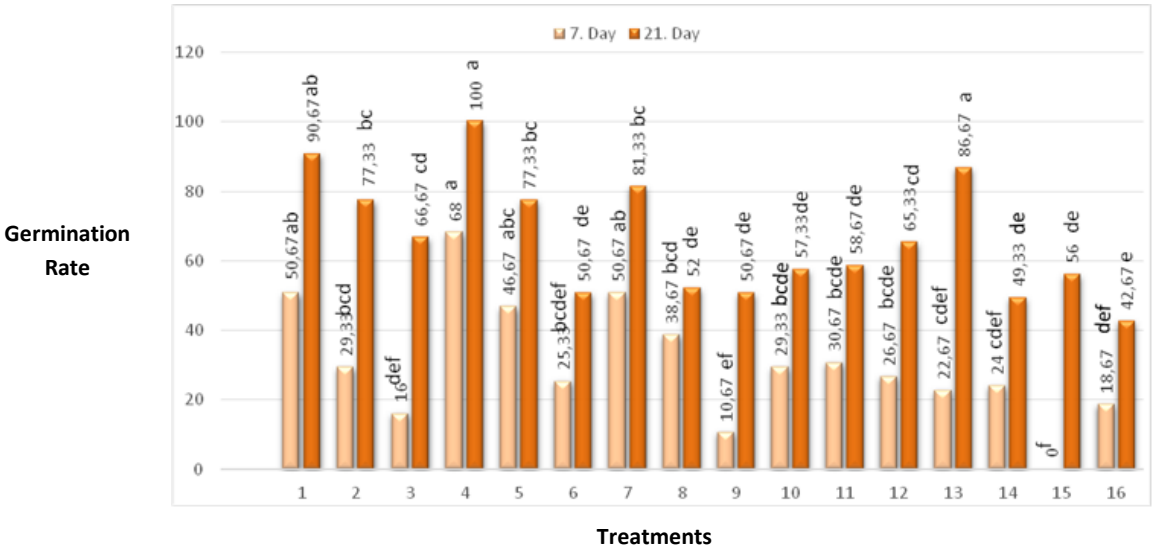

Figure 1. According to different pre-process, performance of *Sideritis perfoliata* L. seeds at 7. and 21 day.

germination rate that 42.67% was obtained with the control treatment and all other treatments gave higher germination rate than control (Table 2 and Figure 1).

According to the different pre-treatment on *Sideritis perfoliata L*. when seed germination values of 7 and 21 days examined together; 7 and 21 day highest germination values obtained by the 100 ppm gibberellic acid dose, 100 ppm of ethylene in both days were found to follow it. Increasing gibberellic acid (200 and 300 ppm) and ethylene (100 and 300 ppm) doses of 7 and 21 days of germination has led to the decline in germination value. A similar situation were observed on 7 and 21 day doses of mannitol (0.5 M and 0.7 M) which caused decrease in germination value. On the other hand the application of seaweed in the dose 0.2% and 0.4% increased the germination rate on 21. day. In seeds that exposed to cold temperatures with decreasing temperature (-15°C and -20°C) has been found to decrease the rate of germination. Control (pure water) that without any aplication gave better germination rate according to some pre-tretments (300 ppm ethylene, 0.7 M. mannitol and 5 min-20°C) but on 21.day control was fall behind within all tretments (Figure 1).

Thanos and Doussi (1995) recorded that 60 to 70% of the seeds of *Sideritis syriaca* ssp. *syriaca* germinated only in the dark at a warmer temperature range (20 to 25°C). At 30°C, only 40% of seeds germinated.

Kozuharova (2009) showed that *S. scardica* seeds treated with gibberellic acid germinated in 80.9% comparing with control.

Uçar and Turgut (2009) recorded that *Sideritis stricta*, *S. perfoliata* and *S. erythratha* seeds treated with different doses of gibberellic acid had germinated very poorly, as 0% in *S. stricta*, 33% *S. perfoliata* and 33% *S. erythrantha* in 5 mg/L gibberellic acid solution. Other doses (10 and 15 mg/L gibberellic acid solutions) had not obtained germination.

Gümüşçü (2014) examined that different gibberellic acid doses (100, 250, 500, 750 and 1000 ppm), stratification and hot water applications effects of germination examined on some endemic *Sideritis* species (*Sideritis congesta* P.H. Davis et Hub.-Mor., *Sideritis condensata* Boiss. et Heldr., *Sideritis leptoclada* O. Schwarz et. P.H. Davis, *Sideritis tmolea* P.H. Davis and *Sideritis libanotica* Labill. ssp. *Linearis*) and GA_3 reported as best practice. For the cultivation, it can be recommended that the seeds must be treated with different doses of GA_3 (especially 500 ppm) Gümüşçü (2014).

According to results that obtained from this study, germination values are quite higher than report of Thanos and Doussi (1995), Kozuharov (2009), Uçar and Turgut (2009) and Gümüşçü (2014). The result differences may be caused by species, genetic structure and ecological conditions.

Conclusion

Sideritis perfoliata L. species is a valuable medicinal plant which naturally spreading in western Anatolia and demanding in recent years. Culture conditions should be accelerated for the study of plant adaptation. In this study, according to results of different pre-tretments on *Sideritis perfoliata L*., best aplication is 100 ppm GA_3 with highest germination power (100%).

Any work about cultivation of different types of *Sideritis* species that spreading in different location of Turkey will contribute to a lack of resolve on this issue.

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