

## Seed treatment with GA<sub>3</sub> or stratification enhances emergence of some strawberry tree genotypes – Short communication

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### Abstract

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The strawberry tree is a valuable ornamental plant because of its attractive red fruits in the fall and winter, and pinkish-white flowers in fall. Additionally, its fruits are processed into various products such as jam, marmalade, wine and alcohol. Since, propagation of the strawberry tree is difficult. This study aimed to examine the influence of stratification and GA<sub>3</sub> on breaking seed dormancy and enhancing emergence rate of *Arbutus unedo*. The influence of seed treatment with GA<sub>3</sub> or stratification at 4°C was examined on emergence of five genotypes of strawberry tree (*Arbutus unedo* L.) near the Black Sea in Turkey. Results indicate that emergence rate increased with increasing GA<sub>3</sub> concentration from 300 to 1,200 ppm and stratification duration from 5 to 15 weeks. In all examined genotypes, the highest emergence rate was obtained using 1,200 ppm GA<sub>3</sub> or 15 weeks of stratification. Regardless of the positive effects of the above treatments, seed emergence rates in all genotypes examined in this study were low. Application of GA<sub>3</sub> or stratification of seeds increased emergence percentage in all *Arbutus unedo* genotypes examined in the current study.

**Keywords:** *Arbutus unedo*; generative propagation; dormancy; GA<sub>3</sub>; stratification

Strawberry tree (*Arbutus unedo* L.), which belongs to the *Ericaceae* family, naturally grows in Ireland, Southern Europe, the Western Mediterranean region (Turkey, Greece, Lebanon) and Southern California (ANSIN, OZKAN 1993; YALTIRIK, ERDINC 2002; CHRISTMAN 2003; KARADENIZ, SISMAN 2003). Strawberry tree is an evergreen shrub with white or pink flowers and tinged round, rough red fruits produced at the same time in late fall and early winter (CHESSA, NIEDDU 2004), which gives the plant a great value as an ornamental plant (CHRISTMAN 2003). In addition, the fruits are rich in vitamin C (BAYTOP 1984; SAKAR et al. 1991; ALARCOE-E-SILVA et al. 2001).

However, to introduce this plant into both fruit and landscape industry, a feasible propagation

method must be developed. This is because *Arbutus* species have seed dormancy (KARAM, AL-SALEM 2001; TILKI 2004). In many cases, viable seeds do not germinate even under favorable environmental conditions. This phenomenon is termed seed dormancy (TAIZ, ZEIEGER 2002). Seeds are important for propagation of woody plants intended for ornamental or forestry markets. Seed germination is influenced by internal factors causing dormancy including seed coat factors, embryo factors or inhibitors (AGRAWAL, DADLANI 1995). There are different methods to overcome dormancy, which vary from species to species, such as heating (HERRANZ et al. 1998), stratification, scarification (NARBONA et al. 2003) and gibberellin application. Stratification and GA<sub>3</sub> treatments of seeds were effective to

break dormancy and increase seed germination in some *Arbutus* species (ROY 1974; KARAM, AL-SALEM 2001). Although some work was done on breaking seed dormancy in species such as *Arbutus andrachne* L. and *Arbutus menziesii* (KOSE 1998; KARAM, AL-SALEM 2001; HARRINGTON, KRAFT 2004), less data are available for *Arbutus unedo* (KOSE 1998; TILKI 2004). The aim of this study was to examine the effect of stratification and GA<sub>3</sub> on breaking seed dormancy and enhancing emergence of *Arbutus unedo*.

## MATERIALS AND METHODS

Mature fruits were collected in November 2005 from five genotypes (57A01, 57A02, 57A07, 57A15 and 57A22) growing in the natural habitat. These were genotypes selected by a selection program from the native strawberry tree population grown in the Central Black Sea Region of Turkey (CELIKEL et al. 2008). To separate seeds from fruits, fruits were soaked in water for 1 day to soften pulp and they were rubbed between fingers to separate seeds from pulp. The seeds were washed and air dried for 2 days. The viability tests were made on four representative samples including 25 seeds each by the 2,3,5-tri-phenyl-tetrazolium method (Ista 1993). The seeds were soaked in water for 24 h, and the seed coat was removed. The seeds were then soaked in a 1% solution 2,3,5-tri-phenyl-tetrazolium chloride for 24 h at 24°C in an incubator. The seeds were bisected longitudinally and examined under a microscope. Seeds with embryos stained red were considered viable. In the current study, seeds of all genotypes exhibited 100% viability.

Two experiments were conducted to determine the effects of GA<sub>3</sub> application and stratification on seed dormancy breaking and emergence. The GA<sub>3</sub> experiment was carried out on four geno-

types (57A01, 57A02, 57A07 and 57A22). Seeds were soaked in 10 ml GA<sub>3</sub> solutions at 300, 600 or 1,200 ppm for 24 h. Seeds in the control treatment were soaked in 10 ml water. The stratification experiment was carried out on all genotypes. The seeds were mixed with moist perlite and put in a small plastic cup in a refrigerator at 4°C for 5 or 15 weeks. Seeds in the control were not subjected to low temperature. In both experiments, the seeds were sown in seed trays filled with a mixture of 1 perlite:1 peat (v/v) and were placed in a growth room at 24°C under continuous light. One gram per liter methyl 1-(butylcarbamoyl)-2-benzimidazole carbamate (benomyl) solution was incorporated into the perlite-peat mixture and fine perlite used for stratification. Emergence was recorded during 60 days.

For each experiment, treatments were arranged in a completely randomized design with four replicates per treatment and 25 seeds per replicate. Data for each experiment were subjected to analysis of variance (ANOVA) using SAS (Statistical Analysis System, 1995, SAS Institute, Cary, N.C.). Duncan's multiple range test was used to compare means. Emergence percentages were transformed by arcsin prior to analysis.

## RESULTS AND DISCUSSION

**GA<sub>3</sub> application:** GA<sub>3</sub> improved emergence (Table 1). Emergence rate increased with increasing GA<sub>3</sub> concentration. Some researches suggested that GA<sub>3</sub> may substitute for cold stratification and reported that GA<sub>3</sub> increased the germination percentage of *A. andrachne* and *A. unedo* (KOSE 1998; KARAM, AL-SALEM 2001; TILKI 2004). KOSE (1998) reported a high germination percentage in *A. unedo* seeds treated with 400 ppm GA<sub>3</sub>. KARAM and AL-SALEM (2001) also indicated that treatment of

Table 1. Emergence (%) in different genotypes of *Arbutus unedo* L. as affected by treatment of seeds with different concentration of GA<sub>3</sub>

Concentration	Genotype			
	57A1	57A2	57A7	57A22
Control	1.06 <sup>d*</sup>	1.00 <sup>d</sup>	2.05 <sup>d</sup>	3.25 <sup>d</sup>
300 ppm	2.07 <sup>c</sup>	2.00 <sup>c</sup>	7.15 <sup>c</sup>	11.00 <sup>c</sup>
600 ppm	4.10 <sup>b</sup>	4.05 <sup>b</sup>	14.25 <sup>b</sup>	16.50 <sup>b</sup>
1,200 ppm	6.00 <sup>a</sup>	13.05 <sup>a</sup>	25.00 <sup>a</sup>	34.75 <sup>a</sup>

\*means followed by different letters within columns differ significantly ( $P < 0.05$ )

Table 2. Emergence (%) in different genotypes of *Arbutus unedo* L. as affected by duration of seed stratification

Stratification duration	Genotypes				
	57A1	57A2	57A7	57A15	57A22
Control	0.00 <sup>c*</sup>	0.00 <sup>c</sup>	0.00 <sup>c</sup>	0.00 <sup>c</sup>	0.00 <sup>c</sup>
5 weeks	7.43 <sup>b</sup>	17.25 <sup>b</sup>	23.75 <sup>b</sup>	4.15 <sup>b</sup>	2.00 <sup>b</sup>
15 weeks	17.20 <sup>a</sup>	20.25 <sup>a</sup>	42.50 <sup>a</sup>	30.80 <sup>a</sup>	19.75 <sup>a</sup>

\*means followed by different letters within columns differ significantly ( $P < 0.05$ )

*A. andrachne* seeds with 250 or 500 ppm GA<sub>3</sub> was successful in breaking dormancy and resulted in 83–86% germination. Furthermore, TILKI (2004) reported that treatment of *A. unedo* seeds with 300, 600 or 900 ppm GA<sub>3</sub> improved germination percentage and the highest was 84% using 300 ppm GA<sub>3</sub>. Among the genotypes tested, the highest emergence rate was obtained from 57A22 (34.75% in 1,200 ppm) while the lowest emergence rate was obtained from 57A2 and 57A1 (1.00 and 1.06% in control, respectively).

**Stratification application:** There was no emergence of seeds that were not subjected to stratification (Table 2), although the seeds were viable, which indicates that the seeds were dormant. Increasing stratification duration increased emergence rate for all genotypes. KARAM and AL-SALEM (2001) noticed that increasing cold stratification duration resulted in a significant increase in germination percentage in *A. andrachne*, with 12 or 16 weeks resulting in 86% or 87% germination, respectively. HARRINGTON and KRAFT (2004) obtained 87% germination after 40-day cold stratification and lower than 2% without stratification in *A. menziesii*. TILKI (2004) also found a significant increase in germination percentage in *A. unedo* with increasing duration of cold stratification, and stated that there was no significant difference in germination percentage between 9 (86%) and 16 (84%) weeks of stratification. It was reported that *Arbutus* seeds require 4–6 weeks of stratification (HUXLEY et al. 1992). In the current study, the highest emergence percentage (42.50%) was obtained when seeds of genotype 57A7 were stratified for 15 weeks.

Application of GA<sub>3</sub> or stratification of seeds increased emergence percentage in all *A. unedo* genotypes examined in the current study although it was low compared to the result of other studies (KARAM, AL-SALEM 2001; TILKI 2004), which may be due to the response emergence rate evaluated in our study compared to germination percentage or due to differences in genotypes used.

## References

- AGRAWAL P.K., DADLANI M., 1995. Techniques in Seed Science and Technology. 2<sup>nd</sup> Ed. India, South Asian Publishers Limited: 179.
- ALARCOE-E-SILVA M.L.C.M.M., LEITAO A.E.B., AZINHEIRA H.G., LEITAO M.C.A., 2001. The *Arbutus* berry: Studies on its color and chemical characteristics at two mature stages. *Journal of Food Composition and Analyses*, 14: 27–35.
- ANSIN R., OZKAN C., 1993. Tohumlu Bitkiler (Fenerogam). Trabzon, K.T.Ü. Orman Fak. Yayınları: 512.
- BAYTOP T., 1984. Türkiye’de Bitkiler ile Tedavi (Therapy by Plants in Turkey). İstanbul, İ.Ü. Yayınları: 520.
- CELIKEL G., DEMIRSOY L., DEMIRSOY H., 2008. The strawberry tree (*Arbutus unedo* L.) selection in Turkey. *Scientia Horticulturae*, 118: 115–119.
- CHESSA I., NIEDDU G., 2004. Description of the Strawberry Tree. Available at: <http://www3.unifi.it/uersgen29/ds9.htm>
- CHRISTMAN S., 2003. *Arbutus unedo*. Available at: [http://www.floridata.com/ref/A/arbu\\_une.cfm](http://www.floridata.com/ref/A/arbu_une.cfm)
- HARRINGTON C.A., KRAFT J.M., 2004. Cold stratification of pacific madrone seeds. *Native-Plant-Journal*, 1: 66–74.
- HERRANZ J.M., FERRANDIS P., MARTINEZ-SANCHEZ J.J., 1998. Influence of heat on seed germination of seven Mediterranean Leguminosae species. *Vegetatio*, 136: 95–103.
- HUXLEY A., GRIFFITHS M., LEVY M., 1992. The New Royal Horticultural Society Dictionary of Gardening. London, The Macmillan Press, Ltd.
- Ista, 1993. International rules for seed testing. *Seed Science and Technology*, 21: 160–186.
- KARADENİZ T., SİSMAN T., 2003. Giresun’da yetiştirilen bir kocayemiş (*Arbutus unedo* L.) tipinde biyolojik özellikler (The biological characteristics of a type of strawberry tree grown in Giresun in Turkey). *Ulusal Kivi ve Üzümsü Meyveler Semp*: 47–49.
- KARAM N.S., AL-SALEM M.M., 2001. Breaking dormancy in *Arbutus andrachne* L. seeds by stratification and gibberellic acid. *Seed Science and Technology*, 1: 51–56.
- KOSE H., 1998. Studies on the germination of some woody ornamental plants existing in Turkish Flora. 1. *Arbutus unedo* L. and *Arbutus andrachne* L. Anadolu. *Journal of Aegean Agricultural Research Institute*, 8: 55–65.

- NARBONA E., ARISTA M., ORTIZ P.L., 2003. Seed germination of *Arbutus unedo* L. (*Ericaceae*). *Acta Botanica Malacitana*, 28: 73–78.
- ROY D.F., 1974. *Arbutus menziesii* Pursh. (Pasific Madrone). In: Seed of Woody Plants in the United States. Washington, USDA.
- SAKAR M.K., BERKMAN M.Z., CALS I., RUEDY P., 1991. Constituents of *Arbutus andrachne*. *Fitoterapia*, 62: 176–177.
- TAIZ L., ZEIEGER E., 2002. *Plant Physiology*. 3<sup>rd</sup> Ed. USA, Sinauer Associates, Inc.: 544–546.
- TILKI F., 2004. Improvement in seed germination of *Arbutus unedo* L. *Pakistan Journal of Biological Sciences*, 7: 1640–1642.
- YALTIRIK T., ERDINC S., 2002. Trees. Istanbul, The Foundation of Challenge with Erosion, Forestation and Protection of Natural Resources of Turkey: 32.

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