http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 7 (10): 1640-1642, 2004
ISSN 1028 8880

Improvement in Seed Germination of *Arbutus unedo* L.

Fahrettin Tilki
Faculty of Forestry, University of Kafkas, Artvin-08000, Turkey

Abstract: In present study *Arbutus unedo* seeds were stratified at 4°C for different durations (0, 3, 6, 9 or 12 weeks), treated with gibberellic acid (GA_3) (0, 300, 600, or 900 mg L^{-1}) or treated with potassium nitrate (KNO_3) (0, 0.2, or 0.4%) to break dormancy and allow germination. The pretreated seeds were germinated at 20°C under 12 h light. One additional parameter, the effect of light on seed germination was also studied and the seeds treated with 600 mg L^{-1} GA_3 solution or stratified for 12 weeks were germinated at 20°C in the dark or 12 h light. Stratification of seeds at 4°C for 9 or 12 weeks, or treatment of seeds with 300, 600 or 900 mg L^{-1} GA_3 was successfully overcome dormancy in *A. unedo* seeds. Treatment of seeds with KNO_3 did not increase germination and light did not play a main role in the germination.

Key words: Seed pretreatment, dormancy, germination, light

INTRODUCTION

Arbutus unedo L. is distributed almost exclusively in the Mediterranean region in Turkey. This tree has potential use as a landscape plant due to its ornamental features, thus a feasible propagation method should be available.

Regeneration from seeds is the most often used and cheapest method of propagation in many species. However, many *Arbutus* species has dormancy and the various methods are used to overcome dormancy. Stratification, scarification and gibberellins have a promotive effect on the germination of many species of angiosperms and gymnosperms[1-4]. Nevertheless, these methods vary from one species to the other, accentuating the need for formulating species-specific treatments. In naturally dispersed seeds, the chilling requirement is obtained during the winter season; in the nursery the same result may be achieved by keeping seeds at low temperature, generally within a range of between 1 and 5°C, mixed with a moistpeat or sand (cold stratification)[2,5]. Dormancy in which exposure of seeds to chilling or light is required for its termination is often overcome by gibberellins[6]. The role of gibberellic acid in promoting seed germination in some species with dormant seeds has been described by various authors[2,4]. Since species differ in their level of dormancy, determining the optimal level of GA_3 concentration is paramount.

Physiological dormancy is the primary dormancy present in the genus *Arbutus*. Stratification and GA_3 treatment of seeds were shown the effectively to break dormancy and to increase the seed germination in some *Arbutus* species[7-9]. But little work has been done on *A. unedo*. Therefore the aims of the present study was to examine the influence of stratification, KNO_3 and GA_3 on seed germination of *A. unedo* to enhance germination, as well as to evaluate the effects of light on germination.

MATERIALS AND METHODS

Mature ripened fruits were collected in November from Izmir, Turkey. Fruits were soaked in water before seeds were extracted by hand. Seeds were cleaned and stored at 4°C until used and the seeds were randomly sampled for all experiments described.

Several experiments were conducted to determine the effects of different methods on seed dormancy breaking and germination. For cold moist stratification, seeds were soaked in water for 24 h before being mixed with moist sand. The seeds were stratified for 0, 3, 6, 9, or 12 weeks at 4°C. Seeds were germinated in 11 cm petri dishes with two layers of filter paper moistened with distilled water. Petri dishes were placed in a germination chamber at 20°C, under a 12 h light photoperiod.

In order to test the effects of gibberellic acid (GA_3) on the germination of the seeds, seeds were placed on two filter papers moistened with 300 mg L^{-1} GA_3 solution, 600 mg L^{-1} GA_3 solution, 900 mg L^{-1} GA_3 solution or, for the control, distilled water. In another experiment, seeds

Corresponding Author: Dr. Fahrettin Tilki, Faculty of Forestry, University of Kafkas, Artvin-08000, Turkey
Tel: 90 466 2121624 Fax: 90 4662126951 E-mail: fahrettintilki@yahoo.com

were placed on two layers of filter paper moistened with three solutions of KNO_3 (0, 0.2, or 0.4%) in petri dishes. Petri dishes were placed in a growth chamber as described above.

One additional parameter, the effect of light on seed germination was studied using a seed germination chamber. Seeds treated with 600 mg L^{-1} GA_3 solution or stratified for 12 weeks at 4°C were germinated at 20°C in dark and 12 h light.

All the experiments were conducted in Completely Randomized Design using fifty seeds each in four replicated for all treatments. Seeds showing radicle emergence were recorded as germinated and removed from petri dishes, for a period of 30 days. Results were subjected to ANOVA and means were compared by Duncan's Multiple Range Test. Germination percentages were transformed by arcsin prior to analysis.

RESULTS AND DISCUSSION

Only 6% of non-treated seeds germinated and stratification of 3 weeks significantly increased germination (Table 1). Increasing the duration of stratification resulted in a significant increase in germination percentage (GP%) with 9 or 12 weeks allowing for 86 and 84% germination, respectively.

All GA_3 treatments improved germination. Treatment of seeds with 300 mg L^{-1} GA_3 solution was successful in breaking dormancy resulting in 84% germination. Additional concentration of GA_3 did not increase or decrease germination percentage significantly. None of the KNO_3 treatments gave statistically significant improvement over the control (Table 1).

Germination percentage of the seeds stratified for 12 weeks or treated with 600 mg L^{-1} GA_3 solution did not show significant differences between light and dark treatment at 20°C (Table 2).

Cold moist stratification was very successful in breaking dormancy of seeds as was reported by Roy[7] and Huxley *et al.* [10]. Although Huxley *et al.* [10] reported that *Arbutus* seeds require four to six weeks of stratification Karam and Al-Salem[9] stated that at least 10-12 weeks of stratification was needed to overcome dormancy in *A. andrachne* seeds. The present study showed that *A. unedo* seeds required 9 weeks of stratification.

Germination percentage of the seeds treated with GA_3 was similar to that of seeds stratified for 9 or 12 weeks at 4°C. This implies that treatment of seeds with GA_3 may substitute for cold stratification as was reported for *Prunus persica, Corylus avellana*[11] and *Arbutus andrachne*[9]. GA_3 was shown to enhance seed germination in several species[12-14] and to overcome physiological dormancy in seeds with dormant embryos[4,8]. Germination percentage of *A. andrachne* decreased as concentration was increased above 500 mg L^{-1}. In this study, treatment of seeds above 500 mg L^{-1} did not reduce germination in *A. unedo* seeds.

Table 1: Germination percentage of *A. unedo* seeds as affected by stratification, GA_3 and KNO_3.

Stratification (week)	GP (%)	GA_3 (mg L^{-1})	GP (%)	KNO_3 (%)	GP (%)
0	6a	0	6a	0	6a
3	36b	300	84b	0.2	10a
6	50c	600	89b	0.4	7a
9	86d	900	82b		
12	84d				

Mean values for each experiment having different letter are significantly different ($p<0.05$)

Table 2: Germination percentages of *A. unedo* seeds in the light and dark

	Seed pretreatment	
Germination condition	Stratification for 12 weeks	Treatment with 600 mg L^{-1} GA_3
12 h light	84a	89a
0 h light	82a	85a

Means in the column followed by the same letter are not significantly different ($p<0.05$)

In conclusion, the study revealed that the seeds were found dormant and dormancy can be attributed to physiological inhibitory mechanisms of germination. Stratification of seeds for 9 or 12 weeks, or treatment with 300 mg L^{-1} GA_3 can successfully overcome dormancy in *A. unedo* seeds and light does not play a main role in the germination.

REFERENCES

1. Pitel, J.A. and B.S.P. Wang, 1985. Physiological and chemical treatments to improve laboratory germination of western white pine seeds. Can. J. Res., 15: 1187-1190.
2. Bradbeer, J.W., 1988. Seed Dormancy and Germination. Blackie and Son Ltd. London.
3. Leadem, C., 1990. The role of plant regulators in the germination of forest tree seeds. Plant Growth Regulators, 6: 61-93.
4. Bewley, J.D. and M. Black, 1994. Seeds: Physiology of Development and Germination. Plenum Press, New York.
5. Bonner, F.T., J.A. Vozzo, W.W. Elam and S. Land, 1994. Tree Seed Technology Training Course. USDA Forest Service GTR-SO-106, New Orleans, LA.
6. Hilhorst, H.W.M. and C.M. Karssen, 1988. Dual effect of light on the gibberellin and nitrate-stimulated seed germination of *Sisymbrium officinale* by red light and nitrate. Physiologia Plantarum, 67: 285-290.

7. Roy, D.F., 1974. *Arbutus menziesii* Pursh. In: Seeds of Woody Plants in the United States (Schopmeyer, C.S. Tech. Coord.), USDA Forest Service, Agricultural Hand Book 450. Washington, D.C., pp: 226-227.
8. Hartmann, H.T., D.E. Kester and F.T. Davies, 1990. Plant Propagation: Principles and Practices. 5th Edn. Prentice Hall, USA.
9. Karam, N.S. and M.M. Al-Salem, 2001. Breaking dormancy in *Arbutus andrachne* L. seeds by stratification and gibberellic acid. Seed Sci. Technol., 29: 51-56.
10. Huxley, A., M. Griffiths and M. Levy, 1992. The New Royal Horticultural Society Dictionary Gardening. The Macmillan Press Limited, UK.
11. Jarvis, B.C., B. Franklin and J.H. Cherry, 1968. Increased nucleic acid synthesis in relation to the breaking of dormancy of hazel seed by gibberellic acid. Planta, 83: 257-266.
12. Pitel, J.A. and B.S.P. Wang, 1988. Improving germination of basswood (*Tilia americana* L.) seeds with gibberellic acid. Seed Sci. Technol., 16: 273-280.
13. Laura, V.A., A.A. Alvarenga and M. Arrigoni, 1994. Effects of growth regulators, temperature, light, storage and other factors on the *Muntingia calabura* L. seed germination. Seed Sci. Technol., 22: 573-579.
14. Subodh, R., R.S. Samant and U. Dhar, 1998. Treatments to improve germination of four multipurpose trees of central sub Himalaya. Seed Sci. Technol., 26: 347-354.