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Influence of Stratification on Seed Germination of *Pterocarya fraxinifolia* (Poiret) Spach, a Relic Tree Species

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Abstract: In the present study, the effect of stratification on the germination of *Pterocarya fraxinifolia* seed was studied. Collected seeds were cold stratified without a medium at moist low temperature for 0, 3, 5 and 7 weeks at a constant temperature of 4±1°C or warm stratified for 3 weeks at 20°C for 8 h and 4°C for 16 h (20/4°C). After each stratification duration, the seeds were placed in a germination chamber at a temperature regime of 8 h at 30°C plus 16 h at 20°C (30/20) in darkness and Germination Percentages (GP) and germination rates (PV) were determined. 3, 5 or 7 weeks of cold stratification without a medium broke the seed dormancy and produced more than 90% germination. Germination rate was the highest after 5 or 7 weeks of cold stratification. The present study reveals that *Pterocarya fraxinifolia* has seed dormancy and 5 weeks of cold stratification without a medium is necessary to maximize seed germination percentage and germination rate.

Key words: Germination performance, seed dormancy, seed stratification

INTRODUCTION

Pterocarya fraxinifolia (Poiret) Spach is known as a classical example of an Arcto-Tertiary relic element growing in the lower-altitude forest of the Hyrcanian and Euxinian province of the Euro-Siberian Region (Zohary, 1973; Browicz, 1989; Frey *et al*., 1999). The species has a wider range in the Irano-Turanian Region (Yaltirik, 1993; Akhani and Salimian, 2003). *Pterocarya fraxinifolia* is found as scatter trees or small groups due to human pressure in southeastern Turkey and on river banks of northern Turkey (Kayacik, 1981; Davis, 1982; Anşin *et al*., 1998; Avsar and Ok, 2004).

Pterocarya fraxinifolia is a beautiful (landscape or ornamental) tree and because of its wide crown, pendulous fruiting spikes and large pinnate leaves also an attractive garden and street plant (Akhani and Salimian, 1993). The species has long been cultivated in European gardens (Wijnands, 1989), but not in Turkey.

Propagation from seeds ensures that genetic diversity is maintained by allowing genetic recombination to occur through sexual reproduction. The genetic diversity makes possible the survival and the natural evolution of species in continually changing environmental conditions (Piotto and Noi, 2003). Regeneration from seeds is the most often used and cheapest method of propagation in many ornamental and forestry species. But, seed of many trees and shrubs are dormant at maturity. The mechanism of seed dormancy that prevents germination at undesirable times varies among species. Seed dormancy results from the embryo coverings (pericarp, testa, endosperm) and/or embryo (Bradbeer, 1998; Bewley and Black, 1994; Leadem, 1996). Stratification, scarification and gibberellins have a promotive effect on the germination of many species of angiosperms and gymnosperms (Bonner *et al*., 1994; Tilki and Çiçek, 2005; Chien *et al*., 2006).

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Pterocarya fraxinifolia is considered to have dormant seeds (Young and Young, 1994) and most of the seeds were empty in small populations (Avşar, 2002). The aim of this research was to examine the effect of stratification without a medium on germination of the relic species of *Pterocarya fraxinifolia* seed.

MATERIALS AND METHODS

Mature fruits of *Pterocarya fraxinifolia* were collected from its natural habitat of Alapli, Turkey (lat. 41°07' N, long. 30°19' E, alt. 10 m a.s.l.) in October 2006. The climate on the seed collection site is mild with humid summers. Annual precipitation averages approximately 1140 mm and the temperature averages 13.7°C. Collected fruits were packed in plastic bags and transported to the laboratory where the study was undertaken. The seeds were cleaned and stored in paper bags at 4°C until used.

For stratification treatments damaged or unusually small seeds were discarded and the remaining seeds were soaked for 24 h in room conditions (about 20°C). They were drained and placed in a loosely tied plastic bag without a medium (naked stratification) to remove dormancy (Finch-Savage, 1998). The seeds were treated at moist low temperature for 0, 3, 5 and 7 weeks at a constant temperature of 4±1°C and treated for 3 weeks at 20°C for 8 h and 4°C for 16 h (20/4°C). After each stratification duration, the seeds were placed in a germination cabinet.

A total of 200 seeds, 4 replicates of 50 seeds, each was used in all treatments. The seeds were enclosed in Petri dishes on two layers of filter papers moistened with distilled water and placed in the germination chamber at a temperature regime of 8 h at 30°C plus 16 h at 20°C (30/20) in darkness. The seeds were monitored every day and moistened when dry. The seeds were considered germinated when they exhibited 5 mm long radicles.

Germination was counted every day for 28 days. Results were expressed as Germination Percentage (GP) and germination rate. GP was the percentage of live seeds that had germinated at the end of the test and germination rate was calculated and expressed as Peak Value (PV), an index of germination speed which is the highest number obtained when percentage germination is divided by the number of elapsed days (Czabator, 1962).

The percentage data were arc-sine transformed before analysis, the significance of treatments means was tested analysis of variance using SPSS for windows. Where significant differences were identified, means were tested by the Duncan's New Multiple Range Test ($p<0.05$).

RESULTS AND DISCUSSION

In control seeds there were no germination at the end of the test and stratification significantly increased germination percentage and germination rate (Table 1).

Germination percentages were the highest after 3, 5 and 7 weeks of cold stratification (>90%) but 5 and 7 weeks' cold stratification were the quickest way to promote germination speed (PV = 7.0 and 8.75, respectively) and this can potentially reduce seed dormancy and enhance germination. Young and Young (1994) found that *Pterocarya fraxinifolia* had seed dormancy and seeds were germinated after 3 months of cold stratification.

Table 1: Effect of stratification treatments on Germination Percentages (GP) and germination rates (PV) of *Pterocarya fraxinifolia* seed

Treatments	GP (%)	PV	Empty seed (%)	Dead seed (%)
Control	0.00^{c}	0.00^{d}	13	5
3 weeks' warm stratification	38.50^{b}	0.78^{c}	17	49
3 weeks' cold stratification	95.20^{a}	2.82^{b}	11	4
5 weeks' cold stratification	94.30^{a}	7.00^{a}	14	5
7 weeks' cold stratification	93.30^{a}	8.75^{a}	17	6

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

Three weeks of warm stratification was shown to be ineffective for *Pterocarya fraxinifolia* seeds because of pregermination at the end of the stratification period. Also, 3 weeks of warm stratification caused dead seeds (49%) at the end of the test. That's why warm stratification longer than 3 weeks was not studied in the study. The seeds begun to germinate can be easily damaged during sowing.

Avşar (2002) stated that most of the *Pterocarya fraxinifolia* seeds were empty and all unstratified live seeds were not germinated in the test. In the present study empty seeds ranged 11-17% in *Pterocarya fraxinifolia* depending on the pretreatments. Following three cold stratification treatments only 4-6% of the seeds were dead at the end of the germination test. However, about 50% of the warm stratified seeds were dead at the end of the germination test. Shao (1989) found that *Pterocarya stenoptera* had more than 70% germination when treated with a temperature varying from 20°C (or 15°C) to 30°C before stratification.

The present study reveals that *Pterocarya fraxinifolia* has seed dormancy and 5 weeks of cold stratification at 4±1°C without a medium is necessary to overcome seed dormancy and maximize seed germination percentage and germination rate.

REFERENCES

Akhani, H. and M. Salimian, 2003. An extend disjunct stand of *Pterocarya fraxinifolia* (*Juglandaceae*) in the central Zagros Mountains, W Iran. Willdenowia, 33: 113-120.

Anşin, R., H.G. Kutbay and T. Ok, 1998. A relic species of *Pterocarya fraxinifolia* (Lam.) Spach in Turkey. Orm. Muh. Derg., 35: 12-14.

Avşar, M.D., 2002. Some seed and fruit properties of two populations of *Pterocarya fraxinifolia* (Poiret) Spach in the vicinity of Kahramanmaras. II. Ulusal Karadeniz Ormancilik Kongresi. 15-18 May Artvin, Turkey, pp: 589-594.

Avsar, M.D. and T. Ok, 2004. A new distribution of Caucasuan wingnut (*Pterocarya fraxinifolia* (Poiret) Spach) in the Kahramanmaras region, Turkey. J. Environ. Biol., 25: 45-50.

Bewley, J.D. and M. Black, 1994. Seeds: Physiology of Development and Germination. Plenum Press, New York, pp: 421.

Bonner, F.T., J.A. Vozzo, W.W. Elam and S.B. Land, 1994. Tree seed technology training course. USDA Forest Service GTR-SO-106. New Orleans, LA., pp: 160.

Bradbeer, J.W., 1998. Seed Dormancy and Germination. Blackie and Son Ltd., London, pp: 146.

Browicz, K., 1989. Chorology of the Euxinian and Hyrcanian element in the woody flora of Asia. Plant Syst. Evol., 162: 305-314.

Chien, C.T., S.Y. Chen, S.H. Chang and J.D. Chung, 2006. Dormancy and germination in seeds of the medicinal Asian tree species *Phellodendron amurense* var. *wilsonii* (Rutaceae). Seed Sci. Technol., 34: 561-571.

Czabator, F., 1962. Germination value: An index combining speed and completeness of pine seed germination. For. Sci., 8: 386-396.

Davis, P.H., 1982. Flora of Turkey and the East Aegean Island. Vol. 7, Edinburgh Univ. Press, Edinburgh, pp: 947.

Finch-Savage, W.E., 1998. Farm Woodland Tree Seed. Horticulture Research International, Wellesbourne, Warwick CV35 9EF, UK., pp: 27.

Frey, W., H. Kurscher and W. Probst, 1999. Flora and Vegetation, Including Plant Species and Larger Vegetation Complexes in Persia. In: *Encyclopedia iranica*, Yarshater, E. (Eds.). New York, pp: 46-63.

Kayacik, H., 1981. The systematic of trees. Vol. 2: *Angiospermae*. I.U. Orman Fak. Yayin No. 2766/287, Kurtulmus Matbaasi, Istanbul, pp: 337.

Leadem, C., 1996. A Guide to the Biology and Use of Forest Tree Seeds. Land Management Handbook 30. Province of British Columbia. Victoria, BC, Canada, pp: 20.

Piotto, B. and A.D. Noi, 2003. Propagation of Mediterranean trees and shrubs from seed. APAT, Roma, Italy, pp: 108.

Shao, B.B., 1989. Effects of stratification and temperature variation on the germination of seeds of ten different trees. Seed Sci. Technol., 2: 4-7.

Tilki, F. and E. Çiçek, 2005. Effects of stratification, temperature and storage on germination in three provenances of *Fraxinus angustifolia* subsp. *oxycarpa* seeds. Turk. J. Agric. For., 29: 323-330.

Wijnands, D.O., 1989. *Pterocarya*. In: The European Flora 3, Walters, S.M., J.C.M. Alexander, A. Brady, D.O. Brickell, J. Cullen, P.F. Green, V.A. Matthews, N.K.B. Robson, P.F. Yeo and S.J. Knees (Eds.). Cambridge, pp: 20.

Yaltirik, F., 1993. Dendrology-Angiospermae. I.U. Orman Fakultesi Yayin No. 3767/420. Istanbul.

Young, J.A. and C.G. Young, 1994. Seeds of Woody Plants in North America. Diosc. Press, Portland, OR.

Zohary, M., 1973. Geobotanical Foundations of the Middle East 1-2. Stuttgart and Amsterdam.