



Effects of ecological condition on seed germination of horizontal cypress in Hyrcanian forests

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ABSTRACT

Horizontal cypress is an endemic conifer species of Hyrcanian forest which grows in special sites with Mediterranean climate in this area. The study was conducted to evaluate the effect of irrigation, seed source, growing media, and sowing time on seed germination of horizontal cypress in the Pilembera nursery located in West Guilan Province. The seeds were collected from three different seed sources in west (Roodbar), middle (Hassanabad), and east (Aliabad) of Hyrcanian forests. Seeds were sown in two different times (February and March) in four soil compositions (different combinations of soil, manure, and sand), irrigated by three different periods (every day, every three days, every five days), in a complete randomized block designs. The results showed maximum seed germination and highest seedlings height in Hassanabad and Aliabad which were sown in March in pots containing soil mixed with manure, irrigated every day. According to the results, successful seedling production of horizontal cypress is highly depends on seed origins and seed sowing time.

Keywords: Seed germination, Cypress, Nursery, Iran.

INTRODUCTION

Several studies have been conducted so far on the landscape designing and introducing native species in Iran. In this regard, selection of adapted species with optimal survival and growth traits should be considered (Khademi *et al.* 2005). Study about the approaches to increase the level and success rate of seedlings production and afforestation of appropriate multi-purpose species is a necessity during the recent years, due to the increasing trends of forest degradation (Ranal & Santana 2006). Seedling traits at the time of their initial growth in nursery often act as a critical factor in determining the outcomes. Planting of the vigorous seedlings are among the important factors in the success of plantations. Therefore, it should always be tried to provide the best possible situation for seedlings development in nursery. The growth and quality of seedlings normally produced in nurseries is a result of interaction between environmental factors (humidity, heat, light, food, and planting method), internal and physiological (stored carbohydrates, hormones and resistance to frost) factors (Khan 2003). Improvement of the germination status is one of the most appropriate strategies to boost the quality and quantity of seedlings (Brito *et al.* 2004; Ranal & Santana 2006) which produced by optimizing the physical condition of the soil to enhance seed germination, root growth and yield of the plants (Oliet *et al.* 2005; Nambiar & Fife 2007). Growing media is among the affecting factors on growth and survival of plants and can increase the success of afforestation (Mossadegh 1996). Qualitative and quantitative growth of seedlings produced in the forest nurseries is influenced by factors such as irrigation, seed sowing time, and weeding.

Sowing time affects the emergence and germination of viable seeds (Driessche *et al.* 2004; Jink *et al.* 2006) in addition to the diameter and height of plants (Johnson 1990; Luoranen *et al.* 2006). Irrigation is effective on the area and number of leaves, survival, height, diameter, growth of seedlings (Harrington *et al.* 2033; Boyerr & South 2004) and calcium supply in stems and leaves (Fotelli *et al.* 2000; Nagakura *et al.* 2004). Seed source testing is often implemented to determine the best origin of the seeds in terms of survival and growth of seedlings (Lavendar 1984). Also, Both temperature and water deficit conditions significantly affected the seed germination (Soltani 2011).

The aim of this study was to evaluate the effects of seed provenance, sowing bed, irrigation period and sowing time on seed germination and seedling height of horizontal cypress in nursery. *Cupressus sempervirens* is an endemic conifer species which is drought-resistant in forest ecosystems with Mediterranean climate. It is also an important species for natural forests rehabilitation and development programs in addition to landscape design projects. Given species specific needs for seed germination requirements and behavior (Brady & Weil 1990), it is necessary to be acknowledged about *C. sempervirens* successfully seedling production.

MATERIALS AND METHODS

The study area

Horizontal cypress seeds were provided by the Caspian forest tree seed center (CFTSC) which is responsible for seed supplying of state and private nurseries in the Hyrcanian forests. The initial quality (physical and physiological traits) of the seeds were determined in the CFTSC laboratory based on ISTA (International Seed Testing Association) rules. Then, seeds were randomly divided to equal sizes for each replicate of treatments. Seed beds were prepared of a composition of soil, sand and manure, based on the proposal recommendations (Table 1). Experimental area was in Pilembara nursery which is located in Paresar town, Guilan Province, Iran (long. 49° 4' 5" E and lat. 37° 36' 52" N) and 5 meters height above sea level (Fig. 1). The average annual rainfall was 2140 mm and average annual temperature was 16.5°C based on the Ombrothermique chart. There is no dry season in the area.

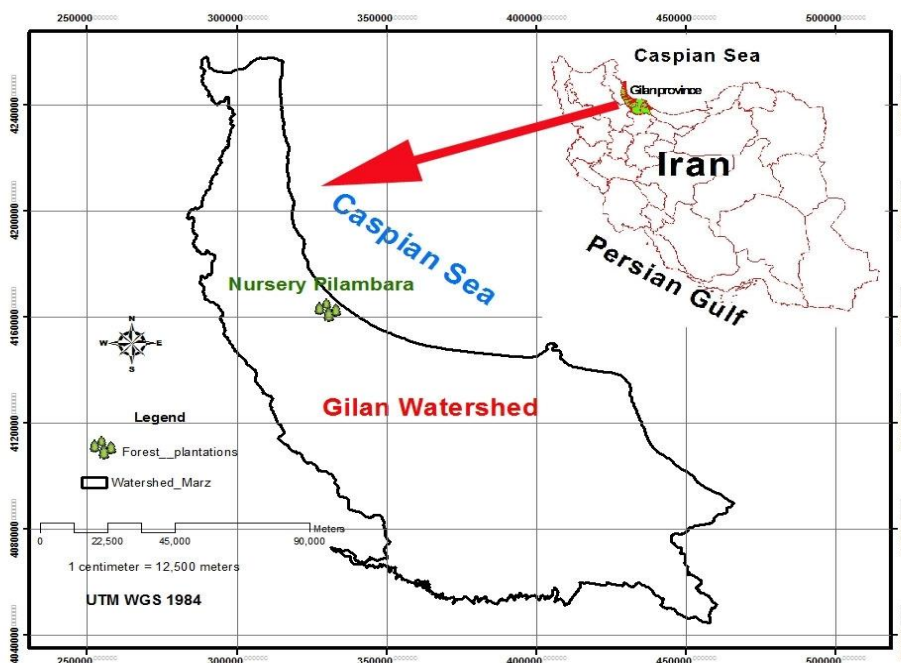


Fig. 1. Geographic map of the study area (31).

Analysis method

A completely randomized factorial experiment was designed with four treatments including four levels of growing media (Table 1), three different provenances in the west (Roodbar), middle (Hassanabad) and east (Aliabad) of Hyrcanian forests, three different irrigation periods (every day, every three days, and every five days) and two

seed sowing dates (February and March) each with five replicates (of 6 pots 20 × 15 cm). The experiment included of totally 2160 pots (a row of outer pots were removed due to the side effects).

Seeds were disinfected by Vitavax (2 ppt). Numbers of germinated seeds and seedling's height were measured in each of the pots, during growing season. Normality of data and the homogeneity of variances tested by Kolmogorov-Smirnov and Levene's tests, respectively. Independent t-test and ANOVA were used for evaluation of data, while comparing means were done by Duncan test. Statistical analyses were performed using SPSS (Ver. 20.0) and graphs drawn by Excel (Ver 2010).

Table 1. Different combinations of growing media used in this experiment.

Sowing Bed	Soil	Manure	Sand	Abbreviation
0	1	1	1	1:1:1
1	1	1	2	1:1:2
2	1	1	4	1:1:4
3	0	0	1	0:0:1

RESULTS AND DISCUSSION

Analysis of variance (ANOVA)

The initial quality of the seeds including moisture content, purity, seed weight, and seed germination were analyzed in seed laboratory of the Caspian Forest Tree Seed Centre (Table 2). The results showed that treatments were effective ($P \leq 5\%$) on seed germination and seedling traits of horizontal cypress (Tables 3 and 4). The highest differences for seed germination were seen in two treatments, sowing time and seed provenances respectively compared to the other treatments. However, irrigation periods and sowing time exhibited the highest effects on seedling height of horizontal cypress.

Table 2. Initial quality of the cypress seeds from different provenances.

Seed provenance	Germination (%)	Humidity (%)	Purity (%)	TSW (gr)
Roodbar	15.2	11.8	90.4	7.87
Aliabad	16.4	9.6	93.9	6.97
Hassanabad	21.8	10.3	91.9	7.19

Table 3. Results of One-Way ANOVA for effects of different treatments on seed germination of horizontal cypress.

Treatments	df	F	Sig ($P \leq 5\%$)
Irrigation periods	2	4.958	< 0.007
Sowing beds	3	9.459	< 0.001
Seed provenances	2	42.699	< 0.001
Sowing times	1	42.864	< 0.002

Table 4. Results of One-Way ANOVA for effects of different treatments on seedling height of horizontal cypress.

Treatments	df	F	Sig ($P \leq 5\%$)
Irrigation periods	2	7.886	<0.001
Sowing beds	3	1.825	<0.001
Seed provenances	2	3.717	<0.025
Sowing times	1	4.45	<0.002

Based on the results, the highest germination rate and seedling height observed in seeds from Hassanabad and Aliabad which were grown in sowing bed containing manure, sown in March and irrigated every day. In contrast, seeds from Roodbar which sown in February and irrigated every five days displayed the least germination rate (Figs. 2 and 3).

Based on the results, effects of growing media on seed germination and seedling height of horizontal cypress showed the highest improved physical, chemical and biological properties of soil. So, the greatest success was obtained from the seeds planted in soil mixed with manure and a massive amount of sand (4:1:1). According to

the various studies, organic materials (Malakouti & Homaei 2004; Shibu *et al.* 2006) and microbial decompositions (Ungar 1996; Sheikh & Abdul 2007) which facilitates nutrient absorption by seedlings.

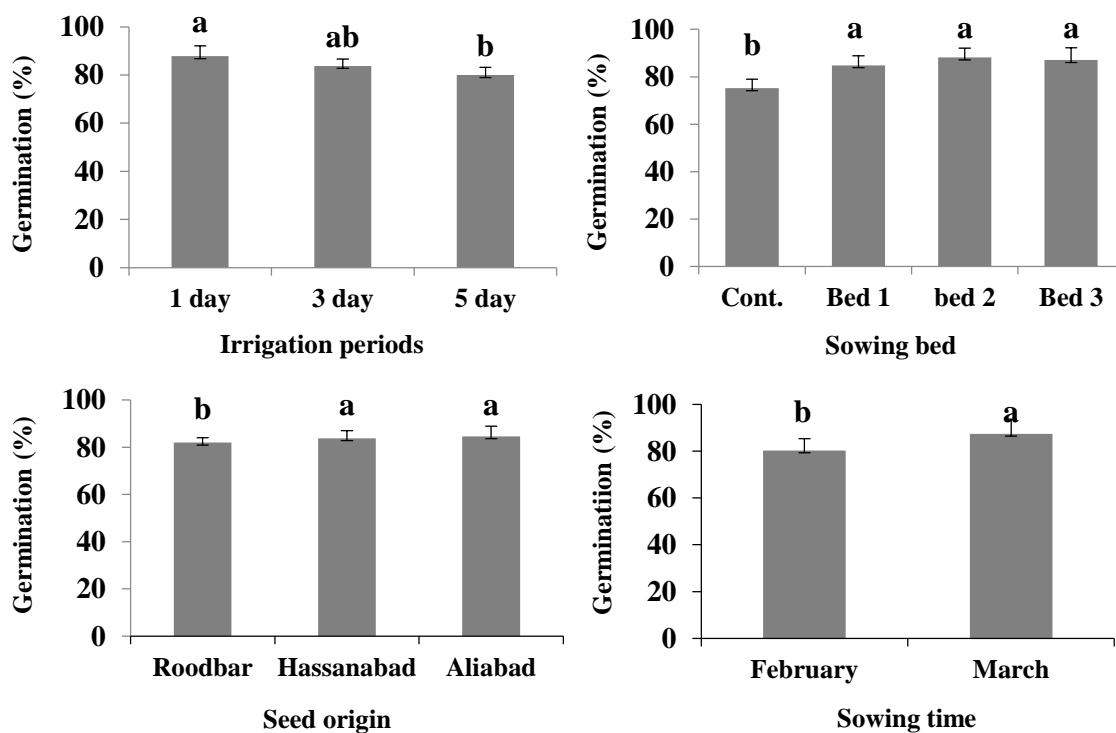


Fig. 2. The effects of different treatments on horizontal cypress seed germination.

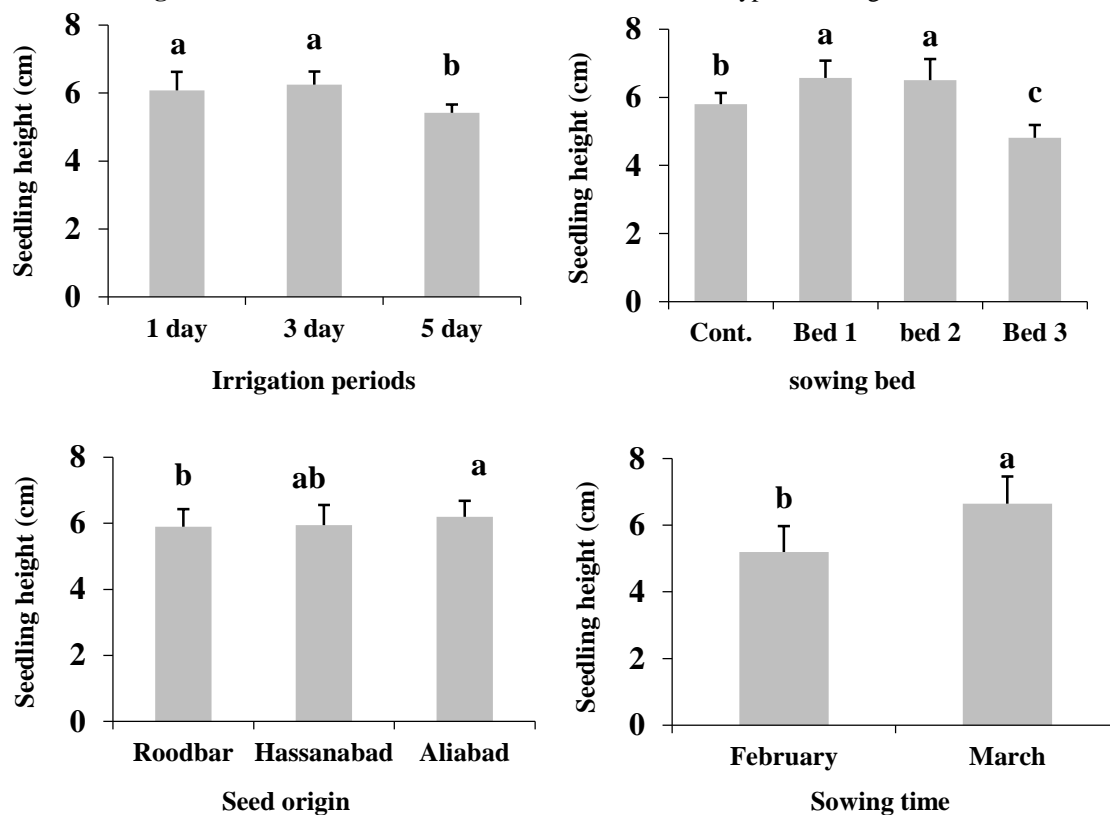


Fig. 3. The effects of different treatments on horizontal cypress seedling height.

Analysis of treatments

Besides, their effects on germination, growth, and biomass, make favorable conditions for seedling growth. Results of a study on *Dalbergia sissoo* (Sheikh & Abdul 2007) about the effects of soil mixed with manure (3:1) indicated that improved structure, more moisture permeability, adequate ventilation of the soil and oxygenate of seeds leads to root development as an indicator of better conditions compared to poor soil in terms of the organic substances. Kiani (1999) also claimed that the stem and root dry weight of *Pinus taeda* seedlings (potted and bare root), increased using a composition of the soil, sand, and decayed manure (1:2:4). The latter results are in line with Khasa et al. (2005) who concluded that increased soil nutrient ingredients including phosphorus, potassium and calcium, is effective on the growth rate and seedling yield in woody boreal species due to growth of enzymatic activity and protein synthesis (Jacobs et al. 2005; Navarro et al. 2006). Tabari et al. (2004) also reported that cypress seedlings grew in loam-clay soil had higher survival and growth rate and more nutritional elements compared to seedlings grew in sand mixed with soil, due to better development of root in light soils. Several investigations such as Isik (1986), Chauhan et al. (1996) Todaria and Negi (1995) have reported that seeds of a given species collected from different sources or elevations have different germination, growth (performance) and production efficiency. In other words, germination and survival rate in colder (higher elevations) areas are less than warmer (lower elevations) ones (Yosef-zade et al. 2007). The results of present study also indicated the impacts of seed source on seed germination and height of cypress seedlings. The highest success rate observed in the seeds collected from Aliabad and Hassanabad. Tabandeh et al. (2007) and Espahbodi et al. (2006) also studied about the effects of seed source elevation on seed germination, seed viability and growth traits of *Sorbus torminalis* seedlings. Furthermore, Alvaninejad et al. (2010) reported that the seed source had significant effects on height, number of shoots, and plant biomass of Persian oak seedlings. Heydari et al. (2016) also found different treatments effects on survival and growth of wild almond.

Sowing time is another important factor on seed germination and seedling growth of different species either in pots or bare root seedling production (Thompson 1984). In present study, the effect of sowing time on seed germination and seedling height of horizontal cypress was significant. So that, the highest success rate in both traits observed in seeds sowing in March. Heydari et al. (2011) in a study about the effect of sowing time (December and March) on the survival rate of Persian oak found that seeds sown in December had a lower survival rate as a result of weather condition. However, they expressed that sowing time had no effects on seedlings height and growth. Gholami (2007) also found similar results on the height of pistachio seedlings. Morris et al. (2000) reported significant differences on a review about seed sowing treatments, irrigation, and shade on the Mahogany species (*Swietenia macrophylla*), although emphasized that the seeds sown later, exhibited lower survival rate. Mc Creary (1990) assessed the effect of seed sowing time (20 October, 19 November, 22 January, 22 February, and 20 March) of two oak species (*Quercus douglasii* and *Q. Lobata*) in California and reported that seeds which were sown earlier, emerged sooner and displayed higher average height as well as survival rate, since due to benefiting more rainfall and soil moisture. Gautam et al. (2003) in a study on *Pinus radiata* reported that irrigation has a significant effect on diameter growth of seedlings. In the present study, the effect of irrigation period on seed germination and seedlings height of the horizontal cypress seeds from different origins was significant. So that, the best result was obtained with daily watering period. Soofizadeh et al. (2009) on the contrary, reported that the frequency of irrigation period had no effect on height of Arizona cypress seedlings due to the ecological characteristics.

CONCLUSIONS

In conclusion, we evaluated the effects of seed source in addition to irrigation periods, growing media, and sowing time on seed germination and seedling height of horizontal cypress which is an endemic conifer species of Hyrcanian forest and is highly considered for forest rehabilitation programs and landscape designing. The interactions of seed source and treatments significantly influenced seed germination and seedling height of horizontal cypress. Based on the results, it can be said that although horizontal cypress as a Mediterranean species is resistant to harsh environmental conditions, however, at seed germination stage, the presence of water (irrigation) and nutrients (soil composition) in soil is so effective on the quantity and quality of seeds germination and seedlings growth. Furthermore, successful seedling production is highly depends on seed origins and seed sowing time. However, a series of environmental and physiological factors are involved in this process.

ACKNOWLEDGMENTS

This work was related to a MSc. Dissertation of the Agricultural Faculty of Islamic Azad University, Rasht, Iran and authors are dedicated to the great soul of Ms. Federa Mirsaleh Gilani who despite of her serious illness, tried her best to promote science and knowledge.

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Received: Aug. 14. 2019 Accepted: Jan. 16. 2020

DOI

Article type: Research

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اثر شرایط اکولوژیکی روی جوانه زنی بذر زربین در جنگل‌های هیرکانی

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(تاریخ دریافت: ۹۸/۰۵/۲۳ تاریخ پذیرش: ۹۸/۱۰/۱۶)

چکیده

سرو زربین یکی از گونه‌های سوزنی برگ بومی جنگل‌های هیرکانی است که در عرصه‌هایی ویژه با شرایط اقلیمی مدیترانه‌ای رویش دارد. تحقیق حاضر با هدف ارزیابی تاثیر تیمارهای دور آبیاری، منشا بذر، نوع بستر و زمان کاشت روی جوانه‌زنی بذر این گونه در نهالستان پیلمبرا واقع در غرب استان گیلان انجام شد. بذرهای از سه منشا مختلف در غرب (رودبار)، میانه (حسن آباد چالوس) و شرق (علی آباد) جنگل‌های هیرکانی تهیه و تحت تاثیر تیمارهای مختلف زمان کاشت (بهمن و اسفند)، نوع بستر کاشت (شامل ترکیب‌های مختلف خاک، کود حیوانی و ماسه) و دور آبیاری (هر روز، هر سه روز و هر پنج روز یکبار) بر اساس طرح بلوک کاملاً تصادفی کاشته شدند. نتایج نشان داد، بیشینه جوانه‌زنی بذر و رشد نهال در بذرهایی با منشا حسن آباد و علی آباد که در اسفند ماه در ترکیب خاک و کود حیوانی کاشته شده بودند و هر روز آبیاری می‌شدند، اتفاق افتاد. بر اساس نتایج تحقیق، تولید نهال موفق سرو زربین تا اندازه زیادی به منشا بذر و زمان کاشت بستگی دارد.

* مؤلف مسئول

Bibliographic information of this paper for citing:

Mirsaleh Gilani, F, Eslami, A.R., Naseri, B, Badr, F 2020, Effects of ecological condition on seed germination of horizontal cypress in Hyrcanian forests. Caspian Journal of Environmental Sciences, 18:171-179

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