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THE EFFECT OF ALTITUDE ON BREAKING SEED DORMANCY AND STIMULATION OF SEED GERMINATION OF PERSIAN HOGWEED *(HERACLEUM PERSICUM)*

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Abstract

Persian hogweed is a perennial herb and aromatic plant which has pharmaceutical and fodder values, and the main propagation method of this species is seed. The goal of this study was to investigate the effect of altitude on breaking dormancy and stimulate seed germination of this species. The study was designed and carried out using the test of seed analysis. For our purpose, seeds were collected from three different altitudes (1700, 2200, 2700 masl) in Kojoor area. After initial purification, germination percent (GP) and speed (GS) of each elevation were determined by cold stratification compared to control. According to results, control seeds did not germinate, showing that the seeds of this species need to be treated. Statistical analysis of results showed that there are significant differences between GP and GS of each elevation, as seeds of higher elevation had slower and less germination in longer periods. So, changes in elevation are an effective factor on seed germination characteristics of this species and this factor has to be considered in seed preparation and restoration with this species.

Keywords: Persian Hogweed, seed dormancy, seed germination, stratification

Introduction

Seeds of most species of Persian Hogweed include different types of dormancy according to ecological adaption conditions (Gasemi arian *et al*, 2009). Such phenomenon as a way to avoid of climatic stress is important in maintaining plant species (Ahmadloo *et al*, 2011). Duration of dormancy and optimum conditions for seeds germination depending on the genetic structure and environmental conditions that native plant have will change (Bewley & Black 1994, Amirjani, 2012a, Amirjani, 2012b). The best way to understand these changes is to investigate the variation in seed germination of a species in different environmental modes which the native plant has been in. These differences make it easier to understand the seed (Lohengrin *et al*, 2000, Bello and Igbokwe, 2013). So, the recognition of ecophysiological factors affecting dormancy and creating optimal conditions for plants seed germination to produce and breeding them is necessary (Gasemi arian *et al*, 2009). Robinson (1954) stated that seed germination percentage in many plants of the Apiaceae family is low. Kretshmer (1999) reported that the use of cold stratification to break most of the Apiaceae family plants seed dormancy and species that grow in cold and temperate climatic is necessary. Nielson *et al* (2005) stated that a temperature of 2-4°C for two months to break the seed dormancy of *Heracleum mantegazzianum* in vitro is sufficient. Baskin *et al* (1992) in research on the species *Thaspium pinnatifidum* of the Apiaceae family showed that stratification at temperature of 5°C caused the break in the seed dormancy of this species. Rajabian *et al* (2007) in Evaluation of seeds germination species of *Ferula assa foetida* of the Apiaceae family showed that the seeds of this species at 4°C is the best treatment to break the seed dormancy of this species. Also, Lohengrin & Arroyo (2000) investigated the seed germination and break dormancy of *Phacelia secunda* in four heights above the sea level 1600,2200, 2900 and 3400 meters according to cold stratification treatment, and they concluded that by increasing the height of the sea surface and a cooler environment conditions, seed germination percent decreases age and the time required for dormancy break increased (Spanos *et al*, 2012). Dorne (1981) in comparison also concluded that the germination of seeds obtained from the plant *chenopodium bonushenricus* in two height 600 and 2600 meters above sea level have no similar situations and the highest percentage of germination is for 600m altitude. Research done on species *lomatium dissectum* of the Apiaceae family showed that seed collected from an altitude of 2200 meters above sea level during the cold stratification treatment had lower germination percentage and more time for dormancy break during the cold startification treatment in comparison with seeds collected from an altitude of 1700 meters above sea level (Scholten *et al*, 2009). *Heracleum persicum* herb plant is a perennial and aromatic plant of Apiaceae family (Mozafariyan 2005, Mahmoudi 2011, Mandenova, 1987), which grows in temperate climates with proper moisture and cold winters (Alm 1988, Alm & Jensene, 1993). *Heracleum persicum* is one of the plants with high nutritional value and medicinal properties, including antiseptic, carminative and analgesic (Mahmoudi, 2011). The plant is used after removal in countries such as Turkey, Yugoslavia, Sweden and America (Shahab Por Sorkhabi, 2009). Also, ranchers make animal milk tasty by manual feeding with the yellow leaves of this plant (Jori & Mahdavi, 2010). The main method of reproduction of this species is through seed (Omid beigi, 2007), and in accordance with deep dormancy of the Apiaceae family (International Seed Testing Association (ISTA), 2008). And in order to provide context for the cultivation of this plant, preservation of genetic reserves and export development through medicinal value and spice are considered. The goal of this study is to carry out a survey on the germination and break seed dormancy of this species at different altitudes using cold stratification treatment.

Materials and Methods

In order to perform this test, plant seeds of *Heracleum persicum* in the summer of 2010 were collected from fields with heights 1700, 2200 and 2700 meters above sea level, located in zone Heights Kojoor, in the West province of Mazandaran in Iran. The longitudes of fields were (51º, 49´, 39"), (51º, 48´, 03"), (51º, 46´, 05") and latitudes (36 º, 16´, 01"), (36 º, 17´, 2"1), (36 º, 18´, 37"). 10 different basic plants of this species from different heights (Bonner, 1994) were collected. The seeds were mixed together and sent to the laboratory Caspian Forest Seed Centre in Amol. After initial purification for cold stratification treatment, the 400 pure seeds from different heights were randomly selected. They were soaked in cold water for 48 hours. Then put in 4 repeated 100 Triad in sterile sand and wet stratification, they were transferred to a

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temperature of 3-5 ° C (ISTA, 2008). Also, seeds of each of the heights with cold stratification treatments were not applied, only ones with an environment temperature (20-25 ° C) were used as control. To ensure that the sand is wet in order to determine the germination rate of the seeds once a week, the sand is irrigated and stirred. The germinated seeds were counted and recorded. To determine the germination speed of seeds in each treatment method, the following formula was used:

$$GS=\sum\left(\frac{n}{Dss}\right)$$

Where:
GS: germination speed (number of germinated seeds per day)
n: in each counted the number of germination seeds
DSS: the start of the experiment for the number of days (Maguire, 1962)

And to determine the germination percentage, the following formula was used:

$$GP\ (0/0) = \frac{\sum n}{N} \times 100$$

Where:
GP: germination percentage
N: total number of seeds (Bewley & Black, 1994).

Analysis of data

The determination of the effect of altitude was performed on seed germination speed and percentage of *Heracleum persicum* using variance analysis (ANOA) and Duncan test. Statistical analysis was carried out using the software SPSS.ver 17. Data from non-treatment seeds (control) did not show any significant statistical analysis for germination.

Results

A – germination percent

Germination was not observed in control seeds at different heights, showing that dormancy exists in the seeds of this species. According to variance analysis (Table 1), the effect of altitude on seed germination percent was statistically significant at 1%. So, the highest percentage average of seed germination is at the rate of 80% for altitude 1700 and the lowest 52.5% for the altitude 2700 meters above sea level (Table 2). Also, the results show that for increasing altitude of sea level prolonged time of germination, because at this time the seeds of this species at altitude of 1700 meters above sea level needed 5 weeks while that with altitude 2700 meters above sea level needed 7 weeks (Figure 1).

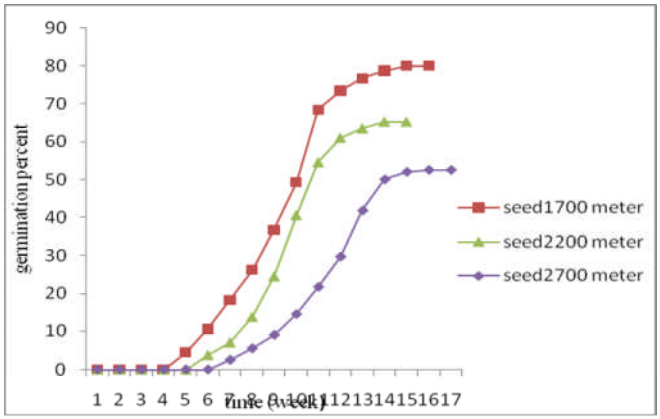

Figure 1 - Effect of altitude on seed germination percent *Heracleum persicum*

B-germination speed

According to variance analysis (Table 1), the effect of altitude on germination speed was statistically significant at 1%. The results show that increase in the altitude of sea level decreases the germination of speed (Figure 2). Comparison with the Duncan test shows results that the germination speed average of 1.25 germinated seeds for the altitude 1700 in a day and the lowest levels 0.64 germinated seeds per day for the altitude 2700 meters above sea level (Table 2).

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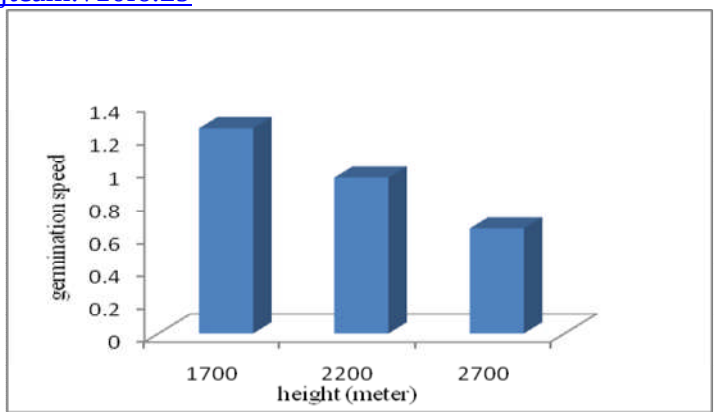

Figure 2 – the Comparison of seed germination speed *Heracleum persicum* at different heights

Table 1: Result of analysis of variance for the altitude effect on the seed germination speed and percent of *Heracleum persicum*

Source changes	Variable sources	F
Altitude	Germination percent	**19.059
	Germination speed	**43.978

Note
: ** indicates significance at the 1% level.

Table 2: Comparison of averages for seed germination percent and speed in various altitudes

Altitude	Germination percent	Germination speed
1700	80 a	1.25a
2200	65.25 b	0. 95b
2700	52.50 c	0.64c

Note: In each different column letters were statistically significant at the 1% level.

Discussion

At different altitudes the seeds without treatment (control) did not show germination, but the results showed that application of cold stratification caused stimulation and break of seed dormancy in this species. The overall Abscisic acid usually causes seed dormancy and Gibberellins are often the cause of breaking dormancy. Chilling, with decreasing amounts of Abscisic acid and increased levels of gibberellic acid in seeds, caused the reach of Gibberellins to the active sites (Bewley & Black, 1994). In other words, the cold stratification, caused accelerated morphological and physiological evolution of seed embryo and thus increase the germination percentage and improve germination speed (Baskin, 1991). Thus stimulating seed germination and breaking of seed dormancy. Therefore, in *Heracleum persicum*, cold stratification can be used. These results and results obtained by (Nielsen *et al* 2005, Baskin *et al* 1992; Rajabian *et al* 2007), based on the positive effect of chilling on seed germination of different species are in comparable. Based on these results, changes in altitude of the collection site affected the percentage and speed of seed germination as shown in the low altitude 1700 metre and altitude 2700 meters above sea level showed the lowest rate. Such differences may be due to different environmental conditions and resources, etc. Factors such as the temperature, soil moisture, wind speed, soil nature and even the incoming radiation varies, and this difference could affect plant development, seed production and germination (Baskin 1998, Tajbakhsh & Ghiyasi 2008). These factors together with the presence of phenolic compounds could result in thick seed coat. Also, the results showed that with increasing altitude above sea level and colder air, the stratification time was increased such that, the time Maximum stratification time for the start of germination, occurred at 2700 m above sea level and least at 1700 m above sea level. Meyer and Monsen (1991) showed that seeds obtained from the higher elevations that possess environmental colder conditions took longer periods to germinate. Their reasoning was that such a function enable them until get to a suitable period for this to take place. Survey results with observations obtained by Dorne (1981) (Lohengrin *et al*. 2000) and (Scholten *et al*. 2009) is consistent with this thinking, as it can be expressed that the altitude is one of the important factors that can affect seed germination percentage and speed of this species. Therefore, According to the results obtained seeds collected from an altitude of 1700 meters above sea level Compared with other the seeds of better quality in order to germinate. So it is best to consider collecting seed from this area.

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