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Effect of different treatments on dormancy breaking of wild oat (*Avenafatua*)

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Abstract

To study the effect of different treatments on dormancy breaking of *Avena fatua* eight experiments based on randomized complete design (RCD) with five replications were conducted in the Arsanjan Islamic Azad Univetrsity, Fars province. Dormancy breaking treatments included the application of different concentrations of gibberellin, sulfuric acid, warm water, stratification(chilling), scarification, different temperatures, rinsing, and the use of ethanol. The results showed thatthe highest percentage of germination was found in the stratification period of 2 to 3 weeks at 2-5 ° C in which germination rate was over 70%. Gibberellin application with a concentration of 600 ppm led to wild oat braking dormancy with the the maximum seed germination of 36%.The wild oat seeds exposure to sulfuric acid also led to dormancy breaking where the highest germination of 36 % was obtained by a 8-hour seed expoure. The results of concentration of sulfuric acid showed that the highest seed germination was 42% in treatment via concentration sulfuric acid 15%. In addition, our findings indicated that rinsing, warm water application, constant temperatures were not effective treatment forwild oat dormancy breaking.

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Introduction

The crop- weed interaction is widely affected by a population's ability to acquire resources (Bench Arnold, 2000). Two features contribute to such ability (Harper, 1977): (1) Faster growing time than any other competitors, and (2) The ability to grow large numbers of seedlings. A glance at the various articles and books clearly shows there is no consensus over the definition and significance of dormancy. Wild oat (*Avenafatua*) is one of the most important weeds in cereals and summer crop farms that charge a high annual cost for weed control throughout the world. Wild oat is found in small grain cereals, especially wheat.

Baskin (2004) stated that most seeds are not able to germinate after being produced and exposed to favorable growing conditions. In fact, these alive seeds are dormant. When treated with 75% sulfuric acid for 10 minutes, seed germination increased to 31.9%. Baskin (1985)found that the ash from burning plant stems is a good decomposer for germination inhibitors in seeds of several species of herbs. The germination of *Eriophyllumsp* and *Phacelia* species was increasedby adding a small amount of *Adenostomafasciculatum* to the planted seeds. Harper (1959) defined seed dormancy as “seed non-germination under favorable environmental conditions”. Dormancy may occur in most of plant bio forms such as in seeds, tubers, rhizomes, and shoots. Dormancy is probably a feature that is acquired during evolution by natural selection for ability to survive in different environmental conditions. Some evidence suggests that dormancy is associated with climate changes occurred during history of the earth and the spread of plant species on Earth. Dormancy is used as a strategy by the seed to start germination as soon as there is no risk of premature death of the seedling by natural factors (Finer & Thompson, 2005).

Some dormant seeds require a number of morphological changes in order to be able to germinate. In others, a part of the seed will undergo physiological changes. Under natural conditions, the needed changes are made gradually through various combinations of aeration, moisture, heat, and light. The dormant seed germination can be stimulated at a reasonable time by modeling key conditions of natural environments in laboratory or nursery settings (Baskin and Baskin, 1986).

Adansoniadigitata seeds have a hard shell, so less than 20% of such seeds usually will germinate. Danto *et al*., (1995) increased the seed germination by 90% placing them in concentrated sulfuric acid for 6 to 12 hours for 20 days. Mechanical scarification (removing a small portion of the shell) was also found to accelerate the seed germination, so that the process was completed in six to eight days. However, this caused the necrosis of 10% to 25% of embryos as a result of the rapid imbibition (Dantio *et al*., 2005).

TP seed coat as a factor inhibiting germination can be investigated. When the seeds were treated with sulfuric acid 75% for 10 minutes, germination rate increased up to 31.9% (Arsine *et al*., 2009).

In addition, Terminaliasuperba seeds showed good germination rates when they were treated with concentrated sulfuric acid (95% to 98%) or with 5.25% sodium hypochlorite. However, as this method is expensive, it is affordable only for large nurseries or for research purposes. Sulfuric acid and sodium hypochlorite will unstiffen the seed pericarp and make the water spread uniformly and the embryo develop freely in all directions. Seeds that were treated with sulfuric acid showed fungal infection than seeds not treated so. While the seeds treated with sodium hypochlorite did not show any fungal infection. One possible explanation is that the acid treatment would increase seed metabolites and provide a nutritional basis for the germination of fungal spores. It has been suggested that dipping Terminaliasuperba seeds in concentrated sulfuric acid (95% to 98%) at room temperature for 15 minutes and then rinsing them with running water for 15 minutes is the best treatment to enhance Terminaliasuperba seed germination and thus it is recommended for large nursery and research

laboratories (Arsine *et al.*, 2009).

Based on what was mentioned, one of the main objectives of this study is to evaluate the effect of mechanical, physical, and chemical treatments on dormancy breaking of *Cynodon dactylon* and *Avena fauta* seeds.

Materials and methods

Experimental design

To explore the impact of different treatments on dormancy breaking of wild oat seeds, eight experiments based on randomized complete design (RCD) with five replications were conducted in 2013 as follows: 1) gibberellin test (by rate of: 0, 100, 200, and 400 ppm), 2) gibberellin test (by rate of: 0, 400, 600, 800, and 1000 ppm), 3) different time of seeds storage in 15% sulfuric acid (for0, 6, 8 and 10 hr.), 4) seeds storage in different sulfuric acid concentrations (control, 5, 10, and 15%), 5)Seeds storage in different sulfuric acid and ethanol concentrations (control, concentrated sulfuric acid for 5 minutes, concentrated sulfuric acid for 10 minutes, concentrated sulfuric acid for 15 minutes, 96% ethanol for 12 hours, and 96% ethanol for 6 hours and 2% potassium nitrate for 48 hours), 6) Seeds storage at different temperatures (alternative temperature and fixed temperatures of 10, 15, and 20 ºC), 7) Seeds storage at 2-5 ºC for different time periods (control, 10, 20, 30, 40, and 50) and 8) Combining rinsing and chilling (control, rinsing with water for 24hr, rinsing with water for 48 hr, rinsing with water for 72 hr, chilling at 2-5 ºC for one week, chilling at 2-5 ºC for two weeks, chilling at 2-5 ºC for three weeks, and combined rinsing and chilling (rinsing for 48 hours plus one week chilling).

Plant material

Wild oat seeds were collected in May before the wheat harvesting from farms in Pasargadae in the same crop year and were kept in bags at room temperature until the test process. After collecting seeds, 9-cm petri dishes were sterilized. Then, 20 seeds were placed in each petri dish. In addition, two layers of filter paper were placed in each petri dish. Seeds disinfection was performed using 50% hydrochloric acidfor 10 minutes. Then, based on treatments, 5 ml of water was added to each petri dish. The petri disheswerekept at room temperature to perform daily samplings.However, it should be noted the seed germination conditions were considered for was 21 days. After seed germinating, the traitsgermination rate, radicle length, shoot length and fresh weight in each petri dish were measured and data were subjected to ANOVA using SAS 9.1. The means were compared via Duncan's test at 5% significance level.

Results and discussion

Effectsof Gibberellin on Wild Oats Germination

Comparison of means for different concentrations of gibberellin on germination rate in the first experiment showed that the germination rate was zero at a concentration of 100 ppm and that the germination started at concentrations of 100 ppm and higher. Besides, germination rate was 9% and 23% at the concentrations of 200 and 400 ppm, respectively. The gibberellin application was found to meet chilling requirements for wild oat germination and dormancy breaking. It is noteworthy that the application of 400 ppm gibberellin resulted only in a 25% germination rate. Dezhkam*et al.*,(2010) conducted a study to determine factors affecting the elimination of seed dormancy and enhancement of wild mustard germination. The results showed no effect of scarification and stratification treatments and gibberellic acid treatment efficiency with alternative temperatures such that GA3 treatment with a concentration of 100ppm improved germination by 55% while GA3 treatment with 8-hour alternatives increased germination up to 85%.

Effects of Gibberellin on Wild Oats Shoot Length

A comparison of mean scores for different concentrations of gibberellin on shoot length showed the highest concentrations of gibberellin would result in increased shoot length. Besides, the maximum shoot length (6.09 cm) was obtained by the application of 1000 ppm gibberellin (Figure 2). The second maximum length (5.13 cm) was observed by applying gibberellin with a concentration of 800 ppm. However, there was no significant difference in shoot

length between 800 and 1000 ppm concentration and they were placed in the same group (Figure 2). The shoot lengths at a concentration of 400 and 600 ppm were 3.17 and 3.24 cm, respectively, which showed no significant difference (Figure 2). The results also showed that no germination occurred when gibberellin was not applied, so the shoot length wasnotalso recorded. It was also noted that gibberellin contribute to increase in the shoot axial length because of the role of gibberellin hormone inthegrowth of linear shoot length (Ahmadi *et al.*, 2004).

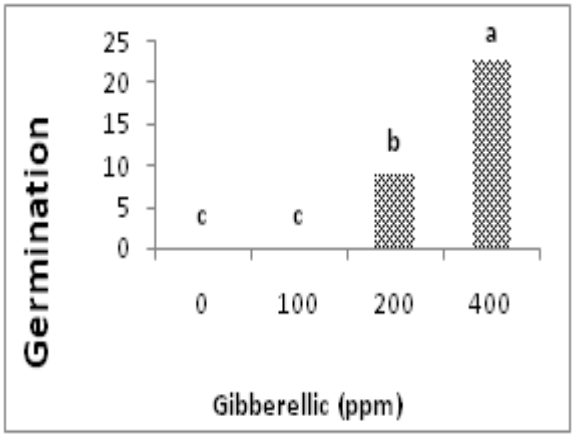

Fig. 1. Effects of Gibberellin on Wild Oats Germination.

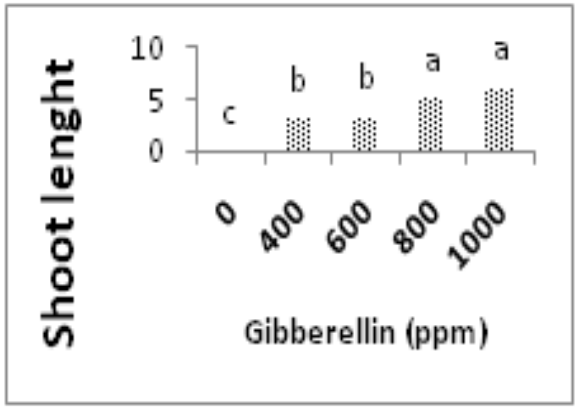

Fig. 2. Effects of Gibberellin on Wild Oat Shoot Length.

Effects of Duration of Exposure to Sulfuric Acid on Wild Oat Shoot Length

The results indicated that wild oat shoot length was influenced by different treatments. The maximum shoot length (3.44 cm) was observed when wild oat seeds were treated by sulfuric acid for 6 hours (see Figure 3). The shoot lengths in the two treatments lasting 8 and 10 hourscm were 1.90 and 1.44 cm, respectively (Figure 3). However, there was no significant difference in shoot lengths and thus they were placed in the same group (Figure 3).The minimum stem length was found in the control treatment. it was also noted that the longer exposure to sulfuric acid leads to a reduction of radicleand shoot lengths as sulfuric acid absorbed in the wild oat crust during exposure can affect radicle and shoot lengths. In addition, sulfuric acid may affect the germination phases of planted seeds.

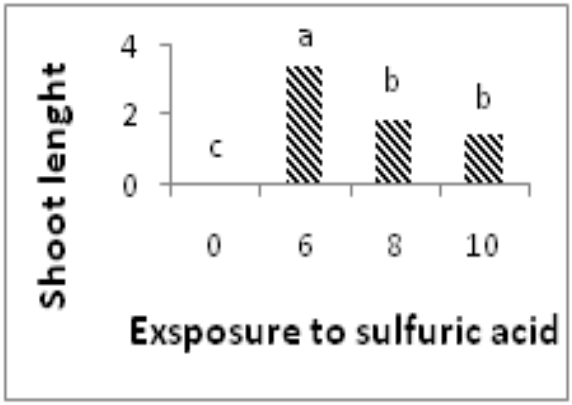

Fig. 3. Effects of Exposure to Sulfuric Acid on Wild Oat Shoot Length.

Effects of different treatments of sulfuric acid, ethanol, and potassium nitrate on germination of wild oats

The maximum germination rate of wild oat with a value of 42% was observed by the application of concentrated sulfuric acid for 15 minutes (Figure 4). However, there was no significant difference between this treatment and other sulfuric acid treatment. The second highest wild oat germination rate was equal to 34% for the application of 96% ethanol for six hours, which was placed in the same category as the concentrated sulfuric acid for 10 minutes (Figure 4). The germination rates in three treatments – concentrated sulfuric acid for 5 min, 95% concentrated ethanol for 12 hours, and 2% potassium nitrate for 48 hours - did not show any significant difference and all three treatments are placed in the same group as shown in Figure 4. The germination rates in these three treatments were 22, 22, and 20%, respectively. The minimum germination rate was found in the control treatment. The result of a study

by Farahbaksh and Sardarian(2010) showed that potassium nitrate with concentration of 0.8 and 0.1 affected the dormancy breaking of Lolium but concentrations of higher than 0.8 had no effect. Different concentrations of gibberellic acid were found to be able to break dormancy. Besides, it was noted that sulfuric acid could break Lolium seeds.

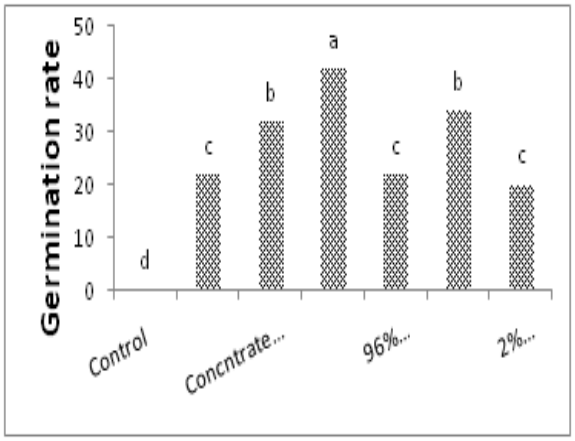

Fig. 4. Effects of different treatments of sulfuric acid, ethanol, and potassium nitrate on germination of wild oats

Effects of Different Treatments of Warm Water and Scarification on Wild Oat Radicle Length

A comparison of mean scores of different treatments of warm water and scarification showed that there was no significant different in radicle lengths between 90 °C warm water for 2 hours and scarification at 5% significance level and both lengths were placed in the same group (Figure 5). No radicle lengths were recorded for warm water treatments for 2 hours and half an hour due to lack of seed germination.

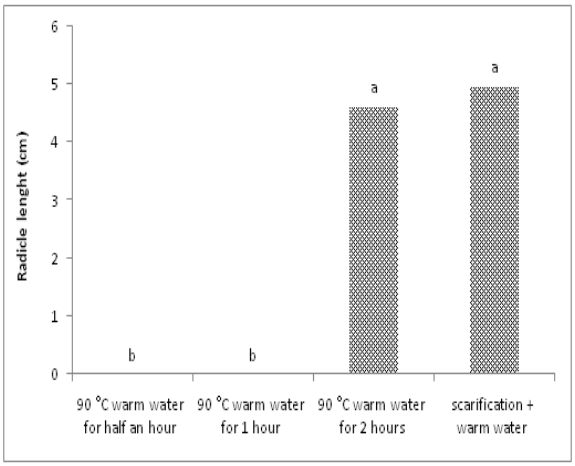

Fig. 5. Effects of Different Treatments of Warm Water and Scarification on Wild Oat Radicle Length.

Effects of Different Treatments of Rinsing and Chilling on Wild Oat Seedling Fresh Weight

The maximum fresh weight of seedlings (0.68 g) was observed in two-week chilling. However, there was no significant difference between three chilling treatments concerning the fresh weight of seedlings and there were positioned in three groups (Figure 6). In addition, the lowest fresh weight of seedlings was related to rinsing treatments as the germination rate was equal to 0 (Figure 6). Baskin *et al.*, (1995) in several reportsshowed that different Erythorumand Osmorhizaspeciesfrom Umbelliferusfamily possess different degrees of physiological dormancy which is broken by the application of appropriate chilling periods. Many scholarsstated that the chilling reduces the content of abscisic acid but increasegibberellic acid content so that both hormones change either simultaneously or a balance of both hormonesend dormancy (Ortega, 2007).Besides, inhibitors are effective in the dormancy of seeds with chilling requirements (Copland & McDonald, 1995). In such seeds, washing or soaking can remove soluble inhibitors from the shell or embryo and increase seed germination rate (Bandy and Island, 1982). Our findings showed wild oat seed has soluble material in the shell and thus no change was seen in the germination rate as a result of rinsing.

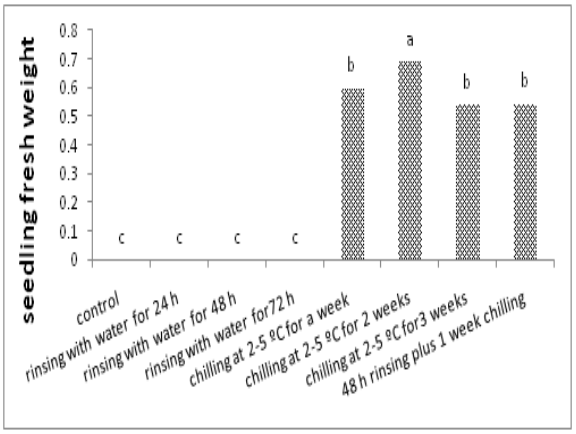

Fig. 6. Effects of Different Treatments of Rinsing and Chilling on Wild Oat Seedling Fresh Weight**.**

Different chemicals used in different studies to break dormancy include potassium nitrate, sodium hydroxide, tiora, sulfuric acid, nitric acid, and ethanol (Chang and Song, 2000). Rinsing would remove inhibitors solved in the water the seed shell or

embryo. As shown by some studies, abscisic acid is the most important inhibitor inside the seed whose concentration is reduced somewhat by soaking and washing. Mahmoud Zadeh *et al.*,(2005) and Amooaghaie (2006) found that washing and soaking have no effect on germination, a finding thatis consistent with our results.

Conclusion

Wild oat is one of the most important cereals weeds wild, especially wheat seed whose seed is characterized by extreme dormancy. Recognizing physiological, cellular, and molecular aspects of dormancy is of great help in finding effective ways to break dormancy and reduce seed density in farming soils. Chemical and physiological mechanisms involved in seed transition from non-dormancy into a dormant state have not been fully understood. Naylor (1996) reported the presence of the gibberellin hormone in dormant wild oat seeds. In addition, Bioli and Black (1978) confirmed the role of gibberellin hormones in the synthesis of alpha-amylase enzyme in aleurone cells of Poaceae seeds useful for starch digestion. Beilin and Foley (1994) reported the presence of new proteins in the wild oat non-dormant seeds that played a role in seed dormancy. Fincher (1989) showed that gibberellin hormone affects the expression of alpha-amylase enzyme gene. Rao and Raju (1985) reported the radial growth in cotyledon epithelial cells of after water absorption in wild oat non-dormant seed as a factor of seed dormancy. According to the above documentations, it can be concluded that there are many reasons that account for the wild oat seed dormancy. Our findings revealed that chilling treatment at 2-5 °C is the best way to break wild oat seed dormancy. However, other treatments such as rinsing and keeping the seeds in warm water had no effect on the seed dormancy. Although the use of sulfuric acid and gibberellin increased germination rate, it was not the same as germination rate achieved by chilling treatments.

References

Adams CA. 2003. A comparative study of seed morphology, dormancy, and germination of four closely-related Aristolochia. University of Kentuck. 452 p.

Amooaghaie R. 2007. Effect of gibberellin and wet cold on seed dormancy breaking. Science and Technology of Agriculture and Natural Resources **11(4),** 471-481.

Arnold RB. 1990. Temperature effects on dormancy release and germination rate in Sorghum halepense (L.) Pers. seeds: a quantitative analysis. Weed Research **30(2),** 81-89. http://dx.doi.org/10.1111/j.13653180.1990.tb01690.x

Aydin I, Uzun F. 2001. The effects of some applications on germination rate ofgelemen clover seeds gathered from natural vegetation in Samsun. Pakistan J ournal of Biological Science **4,** 181¬183.

Baskin CC, Meyer SE, Baskin JM. 1995. Two types morphophysiological dormancy in seeds of two genera Osmorhiza and Erythronium with an Arcto-Tertiary distribution pattern. American Journal of Botany **82,** 293-298.

Baskin JM, Baskin CC. 1985. The annual dormancy cycle in buried weed seeds: A continuum. BioScience **35,** 492–498. http://dx.doi.org/10.2307/1309817

Baskin JM, Baskin CC. 2004a. A classification system for seed dormancy. Seed Science and Research **14,** 1–16. http://dx.doi.org/10.1079/SSR2003150

Baskin JM, Baskin CC. 2004b. Classification, biogeography, and phylogenetic relationships of seeddormancy. In Pritchard, H. (Ed.) Seed conservation: turning science into practice. Kew, The Royal Botanic Gardens.

Baskin JM, Baskin CC. 1986. Changes in dormancystatus of Fraseracaroliniensisseeds during overwintering on parent plant. American Journal of

Botany **73,** 5–10.
http://www.jstor.org/stable/2444271

Benech-Arnold RL. 2000. Environmental control of dormancy in weed seed banks in soil. Field Crops Research **67(2),** 105-122.
http://dx.doi.org/10.1016/S0378-4290(00)00087-3

Copeland LO, Mc Donald MB. 1995. Principals of seed technology. Third Edition. Chapman and Hall, New York.

Dezhkam H, Dezham M. 2010. The impact of different treatments on seed germination and dormancy of wild mustard. Fifth National Conference of New Ideas in Agriculture, 3-5 July Jahrom, Iran.

Farahbakhsh A, Sardarian F. 2010. The impact of different treatments on lolium seed dormancy. Fifth National Conference of New Ideas in Agriculture, 3-5 July Jahrom, Iran.

Fenner M, Thompson K. 2005. The ecology of seed. Cambridge University Press. 260 p.

Harper JL. 1977. Population biology of plants. Academic Press. 982 p.

Hatami Moghadam Z, Zeinali A. 2008. Effectiveness of pre-chilling and chemical and mechanical scarification on breaking the dormancy of abutilon striatum seeds. Electronic Journal of Crop Production **1(1),** 17-37.

Naylor JM. 1966. Dormancy studies in seed of Avenafatua 5. on the response of aleuronic cells to gibberelic acid. Canadian Journal of Botany **44,** 19-22.

Sardarian F. 2010. Oat seed dormancy breaking using gibberellic acid and potassium nitrate. Fifth National Conference of New Ideas in Agriculture, 3-5 July Jahrom, Iran.