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Abstracted and Indexed

Effect of flooding, high temperatures and pH on germination behavior of two Iranian Knapweed (*Centaurea depressa* M. Bieb.) populations

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Abstract

To study the response of seed germination of *Centaurea depressa* in different conditions, three separate experiments were conducted. The first one, investigated the effect of high temperatures in ten levels (25, 60, 80, 100, 120, 140, 160, 180, 200 and 220°C); the second one, tested the effect of different acidity at seven levels (4, 5, 6, 7, 8, 9 and 10) and the third experiment, studied the different flooding duration at five levels (0, 1, 2, 4 and 8 days), on percentage and rate of germination, root and shoot length and dry weight of seedlings in two populations of Karaj and Ahvaz. Increasing flooding duration in Karaj and Ahvaz resulted a sort of reduction on before mentioned traits in both populations; so that 4 days flooding of seeds in both populations completely stopped its growth. Two seed populations germinated in all levels of acidity treatments. The maximum of germination observed in pH=7 and the minimum percentage of germination in Karaj (9.5%) and Ahvaz (11.5%) population observed respectively at 10 and 4 acidity rates. Also increasing temperature leaded a negative impact on aforementioned traits; so that, these traits get to zero point at 120 ^{0}C temperatures in both populations of Karaj and Ahvaz.

Keywords: Acidity, Centaurea depressa, flooding, germination, high temperature

Introduction

Weed known as a plant that grow and develop undesirably in the farmland to cope with original crop, which brings waste in quantity and quality of the crop yield. Recognition of effective environmental factors on biology and emergence of weed is necessity for appropriate management in this term. *Centaurea depressa* known as a common weed in cereal field and the intensity of its damage is high through the cereal field (Esmaeili *et al*. 2005). This weed has some specific traits like divergent stalk, seed reproduction and so forth. The region of its territory covers the arctic hemisphere and it is seen in Iran, Iraq and Pakistan in profusion and also it seems in wildly form at European countries (Shoeb *et al*. 2004).Seed emergence and rudimentary seedling development is the crucial process in plants growth cycle (Khan and Gulzar 2003). Weed thriving in the emergence and developing stage can immensely anticipate or distinguish its life in the natural and arable ecosystems. Germination process can affect by different environmental factors like alternative temperature, pH, soil acidity and so forth (Chauhan and Johnson, 2007; Chachalis and Ready, 2000). Therefore, recognition of effective emergence factors is essential and in convergence of appropriate weeds management. Approximately 12% of world′s arable lands and one million hectare of Iranian arable lands have flooding irrigation, attributes to the high rate of raining, high level of aquifer, flood, low soil penetration and low land slope (Blokhina *et al*. 2003; Malik *et al*. 2002). In this case the oxygen availability in soil and rhizosphere is reduced intensively and soil face lack of oxygen (Hypoxia) or oxygen deprivation (Anoxia) difficulty. The soil seeds content physiologically need oxygen to be alive or be able to germinate. When there is no oxygen, the aspiration processes, krebs cycle, electron transmission cycleand glycolysis function interrupt and ultimately results will be two ATP (instead of

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36 ATP produced in the aerobic situation). Without sufficient ATP tonoplast is incapable to transmit proton actively into the vacuole and gradually protons leak into the cytoplasm. Hence, the cytoplasm acidity increased and the natural stability of that will be dissipated (Blokhina, 2000; Huang and Wilkinson, 2000; Malik *et al.* 2002). Not only this abnormal situation interrupts the cytoplasm metabolism, but also increases the Pyruvate D-carboxylase (PDC) production compared to Lactate D-hydrogenise (LDH). It also reported that in wheat seedling root growth reduction occurred rather than shoot development. The root dry weight proportions responded to this stresses rather than shoot dry weight (Huang and Wilkinson, 2000; Pezeshki, 2001).On the other hand flooding stress leads less developing leaf surface brings prematurity and downfall for underage leaves (Kozlowski, 1997). Acidity or pH is the further effective parameter for weeds germination (Chachalis and Reddy, 2000).

Dominantly pH provided appropriate accessibility of soil nutrients. In the lowest pH elements like Cl, P and K is leached from soil texture or become insoluble. In the highest pH levels the lack of P, Fe, Mn and other nutrient elements might be seen (Seeber, 1976). Chachalis and Reddy (2000) reported over the 59% of *Campsis radicans* seeds germinated at 5 to 9 pH range while at 4 to 10 pH range germination totally ceased. Zhou *et al.* (2005) assessed the appropriate pH range for *Solanum sarrachoides* just about 6 to 8. Chejara *et al*. (2008) reported 90% of *Hyparrhenia hirta* seeds germination at neuter pH and subsequently its germination rate reduced to 65% at 4 to 10 pH level. Conversely in the most of the world regions especially in Asia and Africa, farmers ignite the remained crops in the field in order to wiping out the lands from previous cropping and weeds with the aim of anticipating the forward cropping (Roderet al. 1997). The study in order to investigate the effects of upper temperatures on *Digitaria longiflora* (Retz) Pers. Showed increasing temperature till 80 ^{0}C for 5 minute could not reduce the percent of weed germination, whereas the upper temperatures cause significant percentage reduction in weeds germination, so that no seed germination seen at 140 ^{0}C (Bhagirath *et al*. 2008).

Material and Methods

Seeds of Iranian Knapweed were collected from several farms in Karaj (Latitude: 35° 50' 24" N, Longitude: 50° 56' 20" E) and Ahvaz (Latitude: 31° 19' 05" N, Longitude: 48° 40' 14" E). Then they were treated with Carbendazim fungicide at 1 per thousand proportions for 5 minute and rinsed with sterilized water and placed in the room temperature for a while in order to be dried (Pahlevani *et al*. 2008). The vitality of *Centaurea depressa* seeds was determined with Tetrazolium chloride test. According to this test 50 seeds of each population in four repetitions soaked in Tetrazolium chloride solvable 1% for about 48 hour and settled at 30°C temperature in darkness (Esno *et al*. 1996). The seeds which became red were alive. In this experiment the vitality rate of Karaj and Ahvaz population was respectively calculated about 94 and 92% (the statistical difference was insignificant). To determine 1000 grain yield, seeds selected randomly according to International Seed Testing Association (ISTA) criteria method and weighted accurately by digital scale. 1000 grain yield of Karaj and Ahvaz population recorded 2.318 & 2.303 g respectively (there were no significant statistical differs).

To investigate the upper temperature effects on percentage of germination, seeds kept in oven with temperatures about 60, 80, 100, 120, 140, 160, 180, 200 and 220 ^{0}C for 5 minutes. Then the percent of seeds germination assessed in germinator under 18.25 ^{0}C and 12/12 (12 hour lightning /12 hour darkness) situation. The remained seed in room temperature (25 ^{0}C) considered as evidence (Bhagirath *et al*. 2008).To investigation the flooding effecton *Centaurea depressa* germination an experiment based on randomized complete block design with four replications was carried out. The first factor was the *Centaurea depressa* population of two regions i.e. Karaj and Ahvaz and the second factor was flooding periods in seven levels (0, 1, 2, 4, 8, 16 & 32 days). To this aim 50 seeds were embedded in petri dishes (with 11 cm diameter) covered with Watman filter paper. Then sterilized water was added to them at 70% of each petri dish depth. To prevent seeds being floated three filter papers were settled on them. Flooding treatment was done at 0, 1, 2, 4, 8, 16 & 32 days. Afterward each treatment was irrigated with sterilized water according to it needs. The seeds, with their radicle exited distinctively from its coat enumerate as a germinated seed. At the end the germination rate of each petri dish were recorded (Baird and Dickens, 1991; Reddy and Singh, 1992; Singh and Achhireddy, 1984). To investigation the acidity effect on *Centaurea depressa* germination an experiment based on randomized complete block design with four replications was carried out. The first factor was the *Centaurea depressa* population of two regions (Karaj & Ahvaz) and the second factor was different acidities at seven levels (pH= 4, 5, 6, 7, 8, 9 & 10).The aforementioned acidity solvable provided according to Chachalis and Reddy method (Chachalis and Reddy, 2000). The seventh acidity solvable assumed as evidence. 50 seeds embedded in petri dishes (with 11cm diameters) with contented filter paper and 8 ml of experimental solvable with pre-determined pH and kept at germinator in alternative temperature about 20/30 ^{0}C (day/night) Pahlevani *et al.*(2008). At the end of experiment (14th day) the germinated seeds counted and the radicles with 2mm or more length accepted as a germinated seeds. The germination percentage calculated according to below formula.

Equation 1: $$GP = 100 \times (\frac{N_i}{S})$$

GP: Percentage of germinating, Ni: The number of germinated seeds in ith day, S: Total number of cultivated seeds

At least, all of the experiments repeated threefold at different times. After initial data analyzing and evaluation of their distribution process, the hypothesis of normal data distribution is investigated. The abnormal data was regulated by logarithmic formula. At least data analysis was done with utilizing the SAS ver. 9.1 Software. The comparison means is assess with LSD test at 5 levels and graphs were draw with Excel Software.

Results and Discussion

The effect of high temperatures on seed germination of two *Centaurea depressa* populations:

Result of high temperatures on seed germination, radicle and shoot length and seedling dry weight of two *Centaurea depressa* populations are observable at figure 1 to 4. By increasing temperature from evidence temperature (room temperature) to 60 ^{0}C the germination rate of two *Centaurea depressa* populations reduced which showed the sensitivity of *C. depressa* against the higher temperatures (Table 1 & Figure 1). By increasing the oven temperature; germination percentage, shoot and root length and seedling dry weight of two populations significantly reduced; so that, these traits get to zero point at 120 ^{0}C temperature in both populations of Karaj and Ahvaz (Table 1). There was significant difference between two populations at 60, 80, 100 & 120 ^{0}C. Moreover Karaj population showed more sensitivity against intensified temperatures (Table 1). The sensitivity of different weed species to such intensified temperature is differed and weeds resistance to higher temperatures can be used as a beneficial tool in their invasion process (Bhagirath *et al.* 2008).

The effect of pH on seed germination of two *Centaurea depressa* populations:

Result showed that two *Centaurea depressa* populations (Karaj & Ahvaz) germinated in all levels of acidity treatments (Table 2 & Figure 5-8). The maximum percentage of germination, radicle and shoot length and also seedling dry weight in both population of Karaj and Ahvaz achieved at 7th acidity level and the minimum percentage of germination in Karaj and Ahvaz population observed respectively at 10 and 4 acidity rates (Table 2). In 7th level of pH and the lower levels, the rate of Karaj seeds germination was significantly rather than Ahvaz population. Whereas, at higher levels of 7th acidity Ahvaz possess this achievement and the rate of Ahvaz germination statistically reported rather than Karaj population (Table 2). According to result of this study, the extent pH range for germination presented that acidity can′t be acted as a limited factor for *C. depressa* growth. There are similar results in this case, which are reported by Golzardi *et al.* (2012), and Abinand Eslami, (2009).

The effect of flooding periods on seed germination of two *Centaurea depressa* populations:

Result showed the germination percentage of two *Centaurea depressa* populations reduced by increasing flooding period length (Table 3 & Figure 9). So that in 4 days flooding period, the germination of two populations reached to zero point. The maximum germination percentage, radicle and shoot length and also seedling dry

Table1. Effect of high temperatures on seed germination radicle and shoot length and seedling dry weight of two *Centaurea depressa* populations

High temperatures	Population	Germination (%)	Radicle length (mm)	Shoot length (mm)	Seedling dry weight (g)
Control	**Karaj**	87.5 a	15.68 b	8.12 b	0.314 a
	Ahvaz	89 a	17.5 a	9.21 a	0.321 a
60	**Karaj**	62 c	11.74 d	6.87 c	0.238 c
	Ahvaz	75 b	13.71 c	7.84 b	0.278 b
80	**Karaj**	47 d	8.75 e	4.67 e	0.157 e
	Ahvaz	58 c	11.08 d	5.67 d	0.192 d
100	**Karaj**	25.5 f	4.87 g	2.54 g	0.104 f
	Ahvaz	37 e	6.68 f	3.68 f	0.146 e
120	**Karaj**	8 h	1.78 i	0.89 i	0.042 g
	Ahvaz	17.5 g	3.34 h	1.67 h	0.087 f
140	**Karaj**	0 i	0 j	0 j	0 h
	Ahvaz	0 i	0 j	0 j	0 h
160	**Karaj**	0 i	0 j	0 j	0 h
	Ahvaz	0 i	0 j	0 j	0 h
180	**Karaj**	0 i	0 j	0 j	0 h
	Ahvaz	0 i	0 j	0 j	0 h
200	**Karaj**	0 i	0 j	0 j	0 h
	Ahvaz	0 i	0 j	0 j	0 h
220	**Karaj**	0 i	0 j	0 j	0 h
	Ahvaz	0 i	0 j	0 j	0 h

Table 2. Effect of pH on seed germination radicle and shoot length and seedling dry weight of two *Centaurea depressa* populations.

pH	Population	Germination (%)	Radicle length (mm)	Shoot length (mm)	Seedling dry weight (g)
4	**Karaj**	21.25 g	3.32 g	1.02 f	0.084 f
	Ahvaz	11.5 h	1.75 h	0.32 g	0.023 h
5	**Karaj**	55.32 d	8.54 e	3.85 d	0.175 d
	Ahvaz	38.75 f	6.32 f	2.91 e	0.113 e
6	**Karaj**	74/75 b	12.89 b	6.32 b	0.24 b
	Ahvaz	59.5 d	10.35 d	5.84 c	0.215 c
7	**Karaj**	85 a	15.54 a	8.12 a	0.29 a
	Ahvaz	81 a	14.37 a	7.86 a	0.274 a
8	**Karaj**	58.5 d	11.75 c	6.11 bc	0.213 c
	Ahvaz	67.75 c	12.64 b	6.62 b	0.223 bc
9	**Karaj**	32.75 f	6.32 f	3.21 de	0.134 e
	Ahvaz	47 e	8.66 e	4.21 d	0.162 d
10	**Karaj**	9.5 h	1.16 h	0.57 g	0.043 g
	Ahvaz	19.5g	3.75 g	1.27 f	0.074 f

Table 3.Effect of flooding on seed germination radicle and shoot length and seedling dry weight of two *Centaurea depressa* populations

Flooding (days)	Population	Germination (%)	Radicle length (mm)	Shoot length (mm)	Seedling dry weight (g)
0	Karaj	92 a	16.32 a	9.32 a	0.284 a
	Ahvaz	89 a	16.87 a	8.12 ab	0.271 a
1	Karaj	74 b	12.54 b	7.14 b	0.214 b
	Ahvaz	58 c	9.12 c	4.32 c	0.152 c
2	Karaj	42 d	5.12 d	2.14 d	0.094 d
	Ahvaz	23 e	2.67 e	1.021 de	0.034 e
4	Karaj	0 f	0 f	0 e	0 f
	Ahvaz	0 f	0 f	0 e	0 f
8	Karaj	0 f	0 f	0 e	0 f
	Ahvaz	0 f	0 f	0 e	0 f

Means within a column followed by the same letters are not significantly different at the %1 level according to Duncan's multiple range tests.

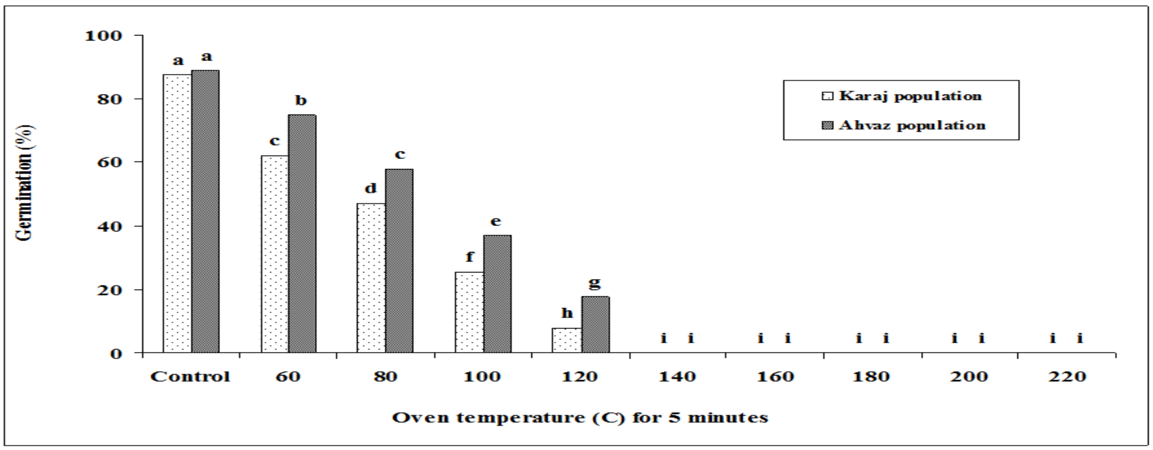

Figure 1.The effect of high temperatures on seeds germination of Karaj and Ahvaz *Centaurea depressa* population.

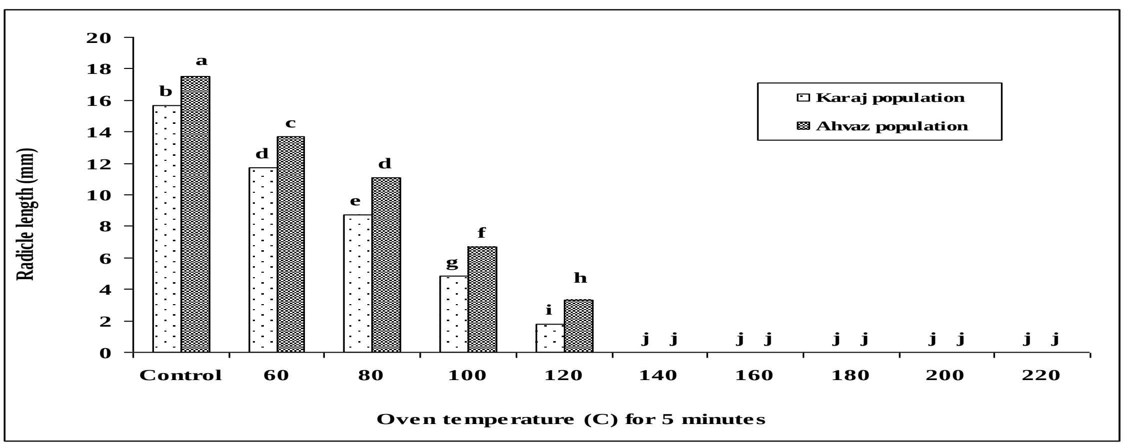

Figure 2.The effect of high temperatures on radicle length of Karaj and Ahvaz*Centaurea depressa* population

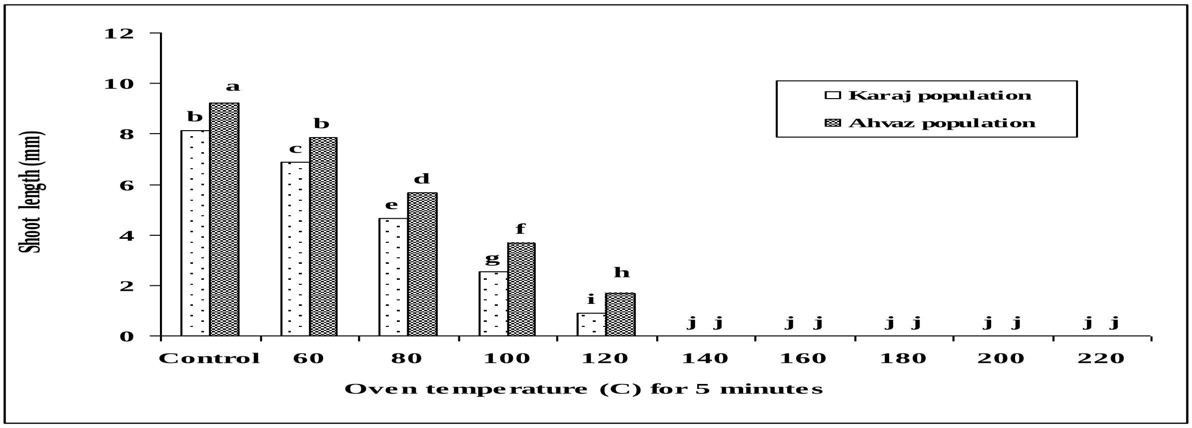

Figure 3.The effect of high temperatures on shoot length of Karaj and Ahvaz *Centaurea depressa* population

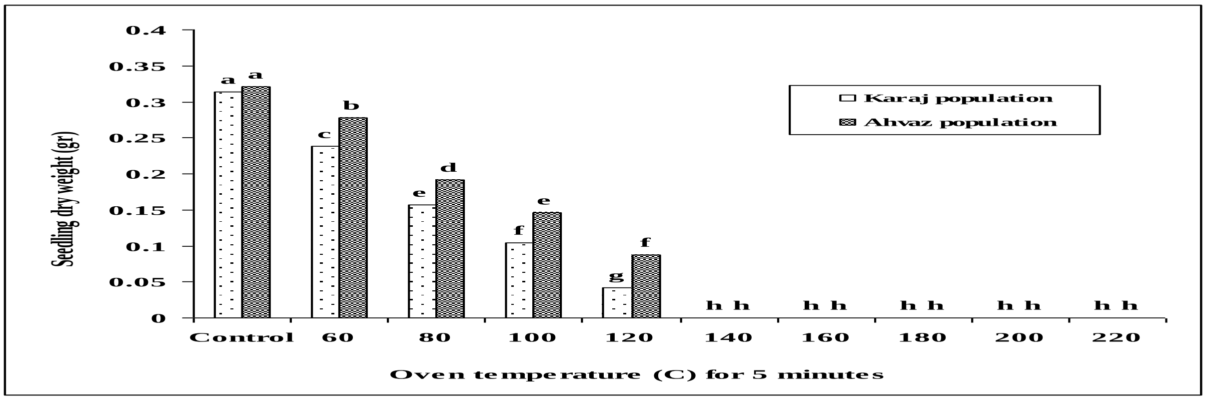

Figure 4. The effect of high temperatures on seedling dry weightof Karaj and Ahvaz *Centaurea depressa*

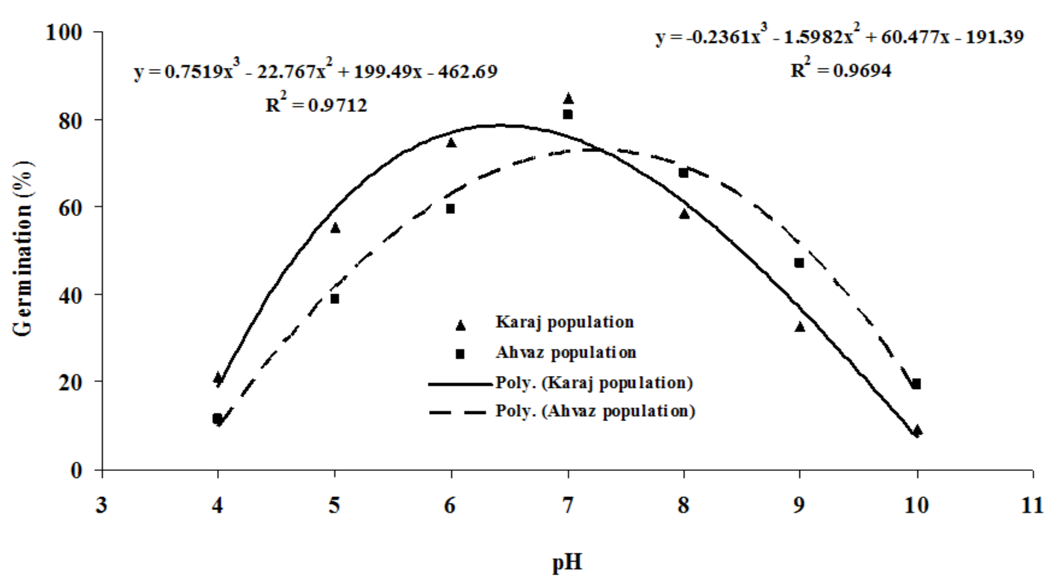

Figure 5.The effect of acidity on seeds germination of Karaj and Ahvaz *Centaurea depressa* population

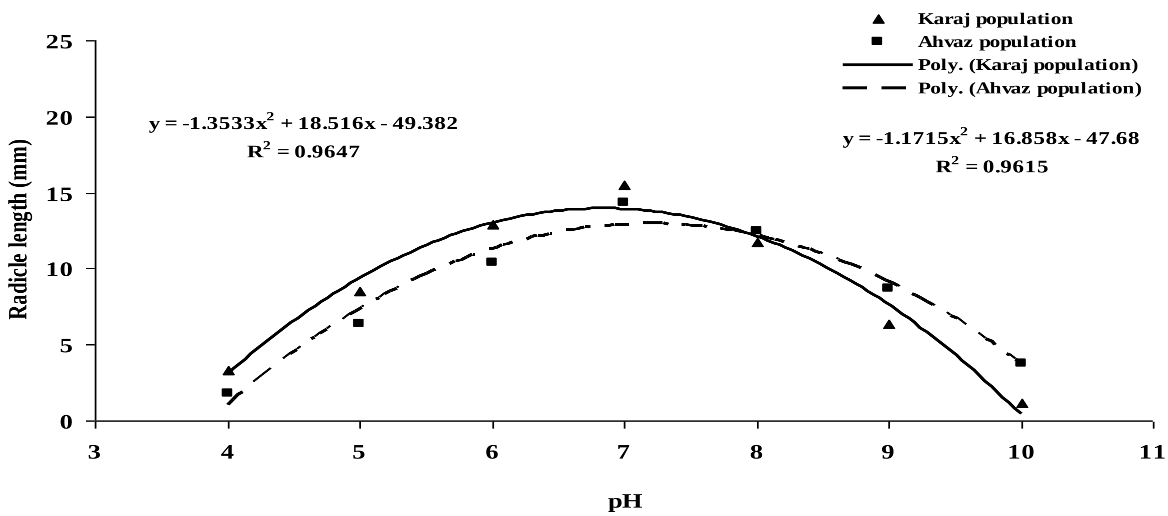

Figure 6.The effect of acidity on radicle lengthof Karaj and Ahvaz *Centaurea depressa* population.

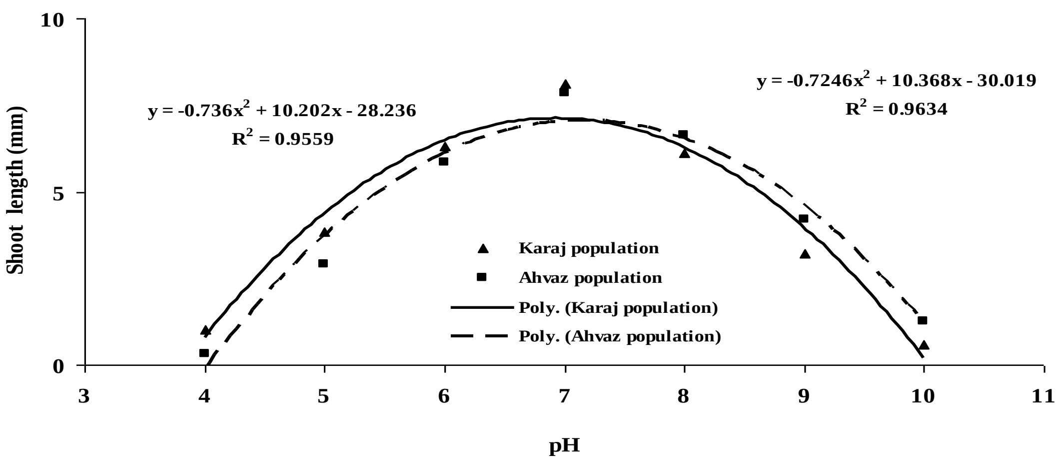

Figure 7. The effect of acidity on shoot lengthof Karaj and Ahvaz *Centaurea depressa* population

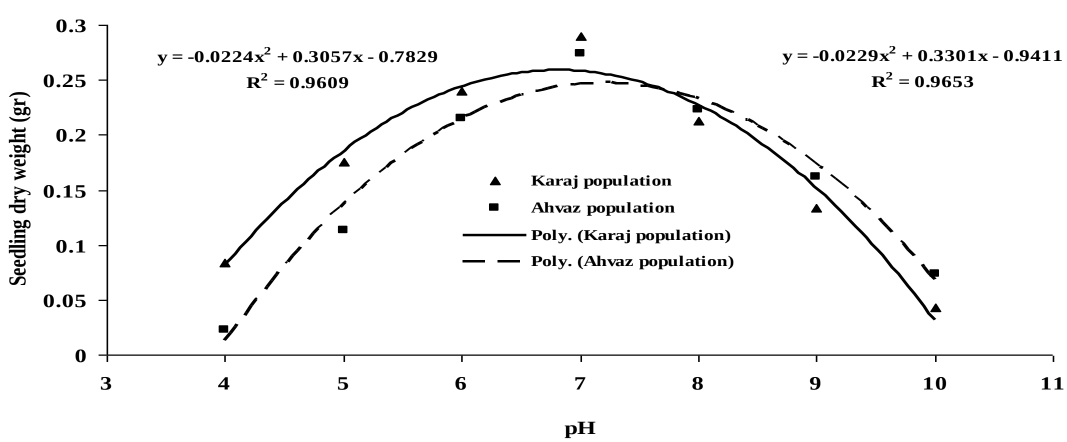

Figure 8. The effect of acidity on seedling dry weight of Karaj and Ahvaz *Centaurea depressa* population

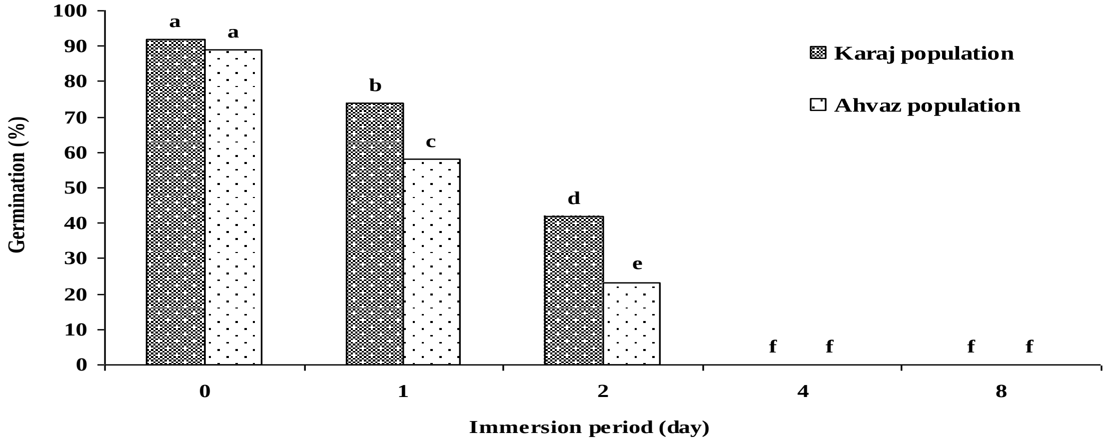

Figure 9.The effect of flooding periods on seeds germination of Karaj and Ahvaz *Centaurea depressa* population

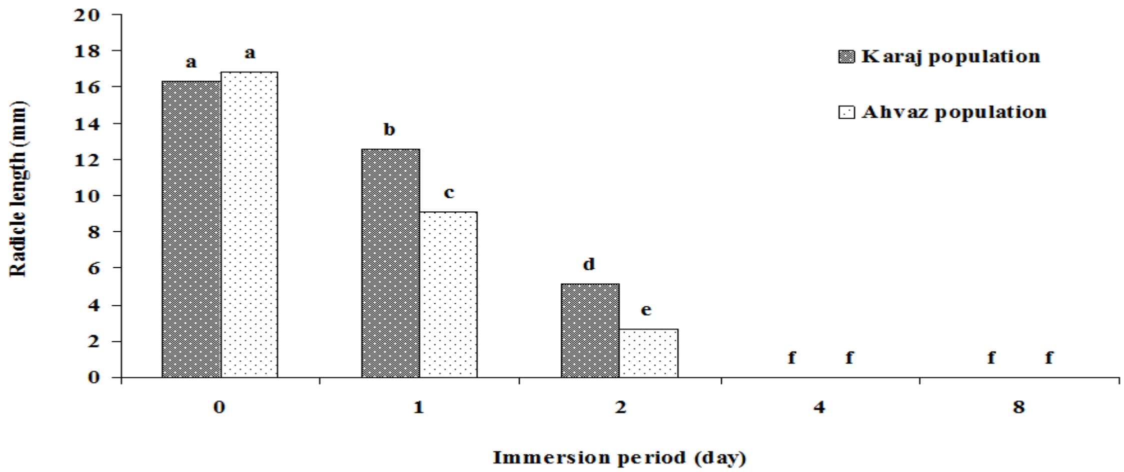

Figure 10. The effect of flooding periods on radicle length of Karaj and Ahvaz *Centaurea depressa* population

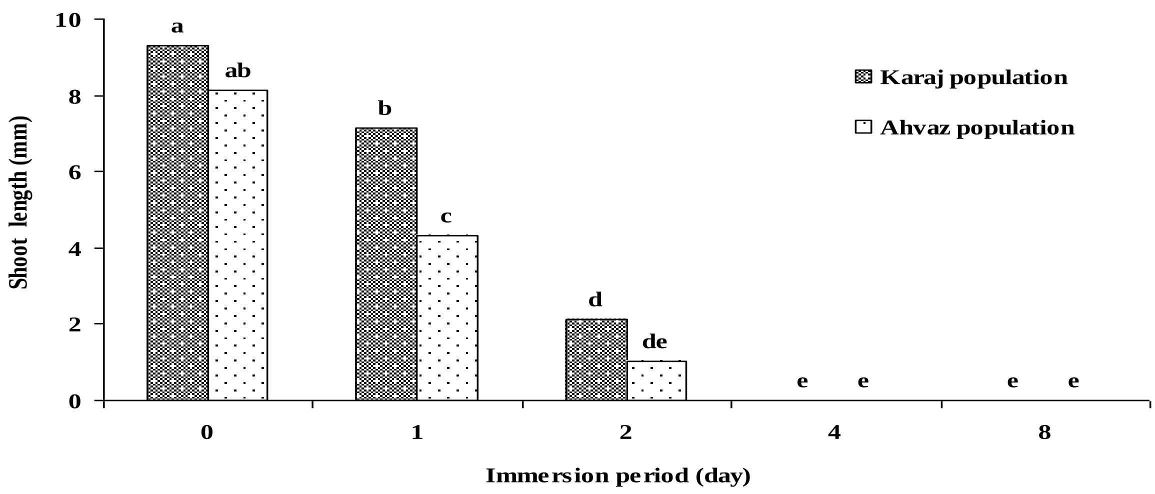

Figure 11. The effect of flooding periods on shoot length of Karaj and Ahvaz *Centaurea depressa* population

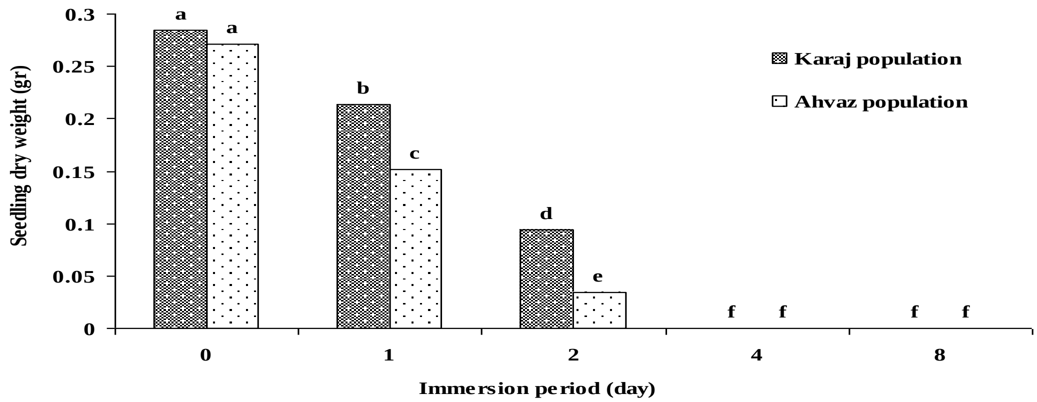

Figure 12. The effect of flooding periods on seedling dry weight of Karaj and Ahvaz *Centaurea depressa*

weight of two *Centaurea depressa* populations observed in evidence treatment (without flooding). In addition, there was no significant difference in this treatment between two populations (Table 3). Result showed in 1 and 2 days flooding treatment that Ahvaz population statistically showed rather sensitivity than Karaj population (Table 3 & Figure 9-12) this represented the higher resistance of Karaj population in increasing the flooding period compared to Ahvaz population. Similar reports presented in order to show the inhibitor effect of flooding on *Morrenia odorata* and *Diodia virginiana* germination (Singh and Achhireddy, 1984; Baird and Dickens, 1991). The general flooding effects include radicle and shoot growth reduction, plant aggregation reduction and seedling vigor reduction (Huang and Wilkinson, 2000; Kozlowski, 1997; Pezeshki, 2001).

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