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RESPONSES OF BUR PARSLEY [*TURGENIA LATIFOLIA* (L.) HOFFM.] SEED GERMINATION TO TEMPERATURE

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ABSTRACT

Laboratory experiments were conducted to determine the effect of eight constant temperatures on germination of bur parsley hulled and dehulled seeds under dark conditions. A completely randomized design with four replications was used. Germination counts were made at seven-day intervals for four weeks. For both hulled and dehulled seeds, after one, two, three and four weeks, no significant difference was observed between 15 and 20°C, and the highest germination percentage belonged to the seeds allowed to germinate at these temperature regimes. Temperatures below 15 and above 20°C significantly reduced germination percentages of hulled and dehulled seeds. In general, after 28 days, accumulated germination percentage of dehulled seeds was higher than hulled seeds at all temperature regimes. Results indicated that seeds of bur parsley germinated at temperatures between 5 and 35°C, with optimal germination occurring between 15 and 20°C.

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واکنش جوانه زنی بذر علف هرز ماستونک نسبت به دما

رضا حمیدی و حسین غدیری
به ترتیب دانشجوی سابق کارشناسی ارشد و استادیار بخش زراعت و اصلاح نباتات دانشکده کشاورزی دانشگاه شیراز، شیراز، ایران.

چکیـــده

مطالعات آزمایشگاهی برای تعیین اثر ۸ دمای ثابت بر جوانه‌زنی بذرهای پوست کنده و دست‌نخورده علف هرز ماستونک در شرایط تاریکی و در قالب یک طرح کاملاً تصادفی با چهار تکرار انجام گردید. شمارش بذرهای جوانه‌زده در فواصل هفت‌روزه و به مدت ٤ هفته انجام شد. بعد از یک، دو، سه و چهار هفته، درصد جوانه‌زنی بذرهای پوست کنده و دست‌نخورده در دماهای ۱۵ و ۲۰ درجه سانتیگراد بیشترین مقدار بوده و درصد جوانه‌زنی بذرها در این دو رژیم دمائی نیز اختلاف معنی‌داری نداشت. در دماهای پایین‌تر از ۱۵ و بالاتر از ۲۰ درجه سانتیگراد، درصد جوانه‌زنی بذرهای پوست کنده و دست‌نخورده بطور معنی‌داری کاهش یافت. بطورکلی، در تمام رژیم‌های دمائی، درصد جوانه‌زنی بذرهای پوست کنده بعد از ۲۸ روز بیشتر از بذرهای دست‌نخورده بود. نتایج این بررسی نشان داد که بذرهای ماستونک در دامنه دمای ۳۵-۵ درجه سانتیگراد جوانه زده و بهترین دما برای جوانه‌زدن بذر آن ۲۰-۱۵ درجه سانتیگراد می‌باشد.

Table 1. Effect of different temperatures on bur parsley hulled seed germination†.

Temperature (°C)	Germination (%) after			
	7 days	14 days	21 days	28 days
5	0 e	0 f	14 d	38 c
10	0 e	21 c	32 b	47 b
15	28 ab	41 a	59 a	68 a
20	31 a	40 a	53 a	61 a
25	24 b	29 b	34 b	47 b
30	8 c	10 d	18 c	21 d
35	3 d	6 e	7 e	9 e
40	0 e	0 f	0 f	0 f

† Means within each column followed by the same letter are not significantly different at the 1% level according to Duncan's multiple range test.

Table 2. Effect of different temperatures on bur parsley dehulled seed germination†.

Temperature (°C)	Germination (%) after			
	7 days	14 days	21 days	28 days
5	0 f	16 d	30 d	44 c
10	20 c	37 c	45 b	63 b
15	55 a	70 a	78 a	86 a
20	61 a	68 a	75 a	82 a
25	42 b	51 b	59 b	65 b
30	13 d	19 d	21 e	24 d
35	7 e	11 e	13 f	17 e
40	0 f	0 f	0 g	0 f

† Means within each column followed by the same letter are not significantly different at the 1% level according to Duncan's multiple range test.

and dehulled seeds, after 1, 2, 3 and 4 weeks, no significant difference in germination percentage was observed between 15 and 20 °C, and the highest germination percentage belonged to the seeds which were allowed to germinate at these temperature regimes. Temperatures below 15 and above 20°C significantly reduced germination percentages of intact and dehulled seeds (Tables 1 and 2). After 7 days, neither the dehulled seeds at 5 and 40°C, nor the hulled seeds at 5, 10 and 40°C germinated. After 14 days, germination percentage of dehulled seeds was 16% at 5°C, while none of the intact seeds germinated at this temperature regime.

In general, accumulated germination percentage of dehulled seeds after 28 days was higher than hulled seeds at all temperature regimes (Table 3). Two factors can be responsible for low germination percentage of hulled as compared to dehulled seeds: i) fruit coat (seed coat) as an important barrier to penetration of water and other essential elements such as oxygen into the seed (6); ii) the presence of some inhibitory substances in the seed coat (9). Natural dehulling of bur parsley seeds in soil could occur over time through the influence of soil factors.

The results of this study indicated that low temperatures (5 and 10°C) are more favorable for germination of bur parsley seeds than high temperatures (35 and 40°C). These results agree with the results obtained by Hageseth and Joyner (10) who showed that high temperatures may denature the enzymes and change lipid phase of seed coat. Since all membranes consist of protein and lipid, the molecular membrane changes must occur in these kinds of substances. High temperature injury may, therefore, involve both lipid and protein

Table 3. Effect of different temperatures on bur parsley accumulated seed germination after 28 days†.

Temperature (°C)	Seed germination %		
	Hulled	Dehulled	Mean
5	38 c	44 c	41 c
10	47 b	63 b	55 b
15	68 a	86 a	77 a
20	61 a	82 a	72 a
25	47 b	65 b	56 b
30	21 d	24 d	23 d
35	9 e	17 e	13 e
40	0 f	0 f	0 f
Mean§	36*	48*	

† Means within each column followed by the same letter are not significantly different at the 1% level according to Duncan's multiple range test.

§ Mean values with an asterisk indicate a significant difference between accumulated seed germination percentages according to Duncan's multiple range test at the 1% level.

changes. This would lead to membrane damage as the cause of direct high temperature injury. A loss of semi-permeability or inactivation of active uptake system at high temperatures could then be due to either (i) excessive fluidity of the lipids, leading to disruption of the lipid layer, or (ii) denaturation and aggregation of the membrane proteins (12).

Bur parsley seed germination in temperature regimes ranging from 5 to 35 °C indicates that this species may germinate over a wide range of soil temperatures. Under natural conditions, this may partially explain why bur parsley often emerges in late winter or early spring. The same phenomenon has been noticed for other species from Umbelliferae such as *Conium maculatum* L., *Heracleum sphondylium* L., and *Torilis japonica* (Houtt.) DC. (16).

Nondormant seeds of weed species are often prevented from germination at a time unfavorable to their survival by the limitation of the environmental factors. The results of this study indicated that, in addition to moisture, the germination of bur parsley seeds may be limited by temperature. If moisture is adequate, a small percentage of both dehulled and hulled bur parsley seeds should germinate in the field within 7 to 14 days, and 14 to 21 days, repectively, when average daily soil temperature is 5°C.

In dryland wheat fields of Fars province, when the average soil temperature reaches 15-20°C (late winter and early spring), winter wheat is in the fully tillered stage. This coincides with germination and emergence of bur parsley in dryland wheat fields which creates the best condition for control by a broadleaf weed killer.

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INTRODUCTION

Seed germination is a complex process involving many individual reactions and phases, each of which is affected by environmental factors such as temperature, moisture, oxygen, depth of burial and sometimes light (17). Temperature is an environmental variable of major importance in limiting the geographic distribution of weeds and crops, determining the time of year during which growth and reproductive development may occur and controlling the rates of plant growth and development (17). The effect of temperature on seed germination can be expressed in terms of cardinal temperatures, that is, minimum, maximum and optimum temperatures at which germination will occur. The optimum germination temperature for most summer annual seeds is between 15 and 30°C (17).

Germination responses of many weed seeds to temperatures have been examined by researchers (1, 2, 3, 5, 11, 13, 18, 19, 20, 21). Mann *et al.* (13) studied the effects of temperature on seed germination of bur cucumber (*Sicyos angulatus* L.), an annual species from Cucurbitaceae and found that bur cucumber seed germination occurred at temperature regimes ranging from 15 to 35°C with optimum germination occurring from 20 to 30°C.

The extreme temperature range for the germination of weed seeds varies with the species. In laboratory experiments, Cardina and Hook (4) showed that Florida beggarweed [*Desomdium tortuosum* (S.W.) DC.], an annual species from the Leguminosae family, germinated between 18 and 38°C with a broad optimum of 21 to 38°C. Horak and Wax (11) showed that the optimum germination of big root morningglory [*Ipomoea pandurata* (L.) G.F.W. Meyer] occurred at 20 and 25°C. Shaw *et al.* (20) examined the

effects of constant temperatures including 20, 25, 32, 35, 40, and 45°C on seed germination and emergence of redvine [*Brunnichia ovata* (Walt.) Shinners], a species from Polygonaceae in petri dishes and soil, respectively. They found that optimum temperature for germination and emergence of this species in either petri dishes or soil was 35°C. Reduction in germination and emergence occurred at constant temperatures above or below this temperature. No germination or emergence occurred at temperatures above 40 or below 25°C.

Biswas *et al.* (3) reported that temperature had a pronounced effect on the germination of Florida pusley (*Richardia scabra* L.), a herbaceous species from Rubiaceae family. None of the seeds germinated at temperatures of 10 and 15°C. The germination percentages increased with the increase in temperature up to 30°C and then decreased. Only 1% of the seeds germinated at 40°C.

Bur parsley is a dominant weed in most dryland and some irrigated wheat fields in Fars province (7, 8, 15) and its natural population has been reported in rangelands and many other parts of Iran (14). It is a summer annual weed, from Umbelliferae, reproducing by seed (15). The seed is achene, greenish to gray, covered with sharp spines that make it a nuisance to man and animals and help disperse the seed (15).

Little or no information is available on seed germination of bur parsley. Visual observations by authors indicated that bur parsley seeds germinated in early spring, and that as many as 3-60 seedlings may emerge per square meter of Bajgah dryland winter wheat fields. An understanding of the basic requirements for seed germination is essential to determine the best control measures. Therefore, study of the biological characteristics of this weed is of the utmost importance. In the present investigation,

experiments were initiated to study the effect of constant temperatures on germination of bur parsley seeds.

MATERIALS AND METHODS

Mature seeds of bur parsley were hand collected in September 1989 from the Experimental Station of College of Agriculture, Shiraz University, located in Bajgah valley, 16 km north of Shiraz, Iran. They were stored at room temperature. The experiments were performed in laboratory starting October 1989.

To determine the cardinal temperatures for germination, the seeds were treated with 10% (v/v) sodium hypochlorite for 5 min and then rinsed with distilled water and left to dry out at room temperature. Hulled and dehulled (by hand) seeds (achenes) were placed in 9-cm sterilized petri dishes on two sheets of Whatman No. 2 filter papers and moistened with 5 ml of distilled water. Petri deishes were then placed at eight constant temperature regimes (5, 10, 15, 20, 25, 30, 35 and 40°C) in a germinator under dark conditions. A completely randomized design with four replications was used. Each replicate consisted of 100 seeds (4 petri dishes of 25 seeds each). Germination counts were made at 7-day intervals for 4 weeks. Data were subjected to analysis of variance and means were compared using Duncan's new multiple range test.

RESULTS AND DISCUSSION

Tables 1 and 2 show bur parsley seed germination percentages as affected by different constant temperature regimes. For both hulled