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Evaluation of Quality and Quantity on Germination and Growth of *Thymus vulgaris* L. under Priming Conditions

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In order to examine the effect of priming on qualitative and quantitative characteristics of germination and growth of the experimental *Thymus vulgaris* L. in cultivation year of 1393 in cultivation lab of agriculture faculty of Shahrekord University. This factorial experiment was done in a completely randomized design with four replications. The factors included the priming temperature (15° & 25°C), the priming time (1/2 & 2/4) and osmo-priming (control, Hydro-priming, 0, -0/3, -0/6, -0/9, -1/2 and -1/5-mega-Pascal) provided by Polyethylene glycol (PEG 6000). The examinable traits included germination percentage and rapidity, the plantlet length and dry weight and the seed ability. The data were analyzed by Minitab software. The average comparison was conducted by LSD test in level of %5. The results revealed that applying the priming with Polyethylene glycol had a significant effect on germination percentage, germination rapidity, and seedling length and seed vigor. In addition, temperature decrease from 25^0 to 15^0 had a significant and positive effect on germination percentage, germination rapidity, seedling length, seedling dry weight and seed vigor. Increasing the time of prime from 12 to 24 hours, the germination percentage, germination rapidity, seedling length and seed vigor were decreased significantly, but it had no significant effect on seedling dry weight. Priming led to monotone-ness in germination and establishment the bushes and increased the control of water absorption in seed during the processes of germination. Determining the appropriate time for priming can reduce the negative effects of stressors such as salinity. Generally, it can be said that seed priming enjoys several benefits and plays an effective role in stimulating the metabolic activities and induction of germination.

Keywords: Polyethylene Glycol, Germination Percentage, Germination Rapidity, Seed vigor.

Nowadays, 50000-700000 herbal species are used in modern and traditional medicine all around the world. As World Wildlife Fund announced, medicinal plants which are classified in wild plants mainly, are regarded as a valuable source of income for rural residents especially in developing countries, but their excessive consumption has endangered them and threatened not only the continuation of most of medicinal plants species but also put the life of people who use them as food or income in danger (Fattahi & Fattahi, 2010). *Thymus vulgaris* L. belongs to *Lamiaceae* family is one of the oldest medicinal and herbal plants and is native of eastern Mediterranean (Gigord *et al*,. 1990).

Seed is the most important and basic part of a plant playing an crucial role in reconstruction, maintenance, transferring the genetic materials of a plant and mechanisms of dispersion, reproduction and survival of a plant in very difficult situations (Ghaderi *et al*,. 2011). In their research, Faroogh *et*

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al (2006) found out that hydro-priming of wheat seeds and osmo-priming with poly have a great effect on percentage and rapidity of germination.

In their research on three species of millet, Riazi *et al* (2006) understood that the best temperature for germination under prime with osmotic potential of -1/2 mega Pascal is 25^0-15^0 C during 12 hours. The seedling primary germination and growth is of vulnerable phases of the plant life cycle especially when the plant suffers from lack of humidity, salinity or coldness (Sharma *et al*, 2013).

Researches on physiological and biochemical responses in phase of germination and seedling primary growth under drought stress can help in understanding the reasons of decreasing the germination rate in natural conditions (Lee *et al*, 2013). Primin g can increase the germination power and growth of the seed in condition of resistance against stress (Bradford *et al*, 1990). Rahimi (2011) revealed that in Cumin, osmo-priming leads to increase of germination percentage, germination monotony and germination resistance against drought stress. Treatment of hydro-priming in 15°c has the most positive effect on germination rapidity and percentage, seedling dry weight, the number of lateral roots and vigor index in stress-less and -4 stress (Osivand *et al*, 2013). The appropriate temperature for priming is reported between 10° c to 35° c and suitable time span is reported between several hours to several weeks depending on the species (Sadeghian & Yavari, 2004; Kaor *et al*, 2005). In an experiment, applying the temperature treatment on germination of thyme (corps and natural mass of Khorasani thyme-Klokov Thymus transcaspicus), the highest percentage of germination for natural and corps mass was reported in 15° c and 20° c respectively (Tabrizi *et al*, 2007).

MATERIALS AND METHOD

The present research was done in cultivation Lab of Shahrekord University (latitude: northern 32° and 21 minutes, longitude: eastern 50° and 49 minutes, altitude: 2050 m above sea level) in 2014. In order to examine the effect of priming on qualitative and quantitative characteristics of germination and growth of *Thymus vulgaris*, an experiment was done in cultivation Lab of Shahrekord University in 2014.

In order to determine the best time and temperature of priming and examine the effect of priming on qualitative and quantitative characteristics of germination and growth of *Thymus vulgaris*, this factorial experiment was done in a completely randomized design with four replications. The factors included priming temperature (15° C & 25° C), priming time (12 and 24 hours) and osmotic potential of osmo-priming solution (without prime, 0, -0/3, -0/6, -0/9, -1/2 and – 1/5 mega Pascal). For providing the required osmosis solution, PEG6000 was used whose amounts were calculated by Michel & Kaufman's (1973).

Ψ s = -C (1.18 ×10-2) - C 2 (1.18 ×10 -4) + CT (2.67 ×10 -4) + C 2T (8.39 ×10 -7

In which:

Ψ s= osmosis potential (bar)

C= material thickness (g)

T= temperature (°C)

Phases of Experiment

To conduct the experiment, for each treatment, 0/5 g of a disinfected seed was put inside a disinfected disposable container. Then, according to the level of treatment and time of prime, it was kept in 20 mm of PEG solution with required potentials during 12 0r 24 h. the seeds are disinfected as following:

a) The seeds are washed with distilled water,
b) The washed seeds are put in ethanol 70% for 10 s,
c) The seeds are washed with distilled water again,
d) The seeds are put in hypochlorite sodium 40% for 10 m,
e) The seeds are washed with distilled water at least for 4 or 5 times. They are 2. Put in a disinfected container and, then, primed.
f) According to the prime time span (12 & 14 h), the treatments are put in required temperature (15° & 25° C).

After that, the seeds are exposed to running water for 5 m, washed with distilled water for 3 times and put in room temperature to be dried (Jee *et al*, 2009).

In order to examine the germination and indexes related to it, 400 g of seed is planted in 90 mm-Petri dishes by method of in 4 replications TP and put in germinator under 25° C for 10-14 days in

Table 1. Analyzes of variance (mean squares) of studied characteristics

Germination rapidity	dry weight (mg)	Vigor seedling	Gernination index Percentage	Length seedling (cm)	Df	S.O.V
72.171**	0.0002419$^{n.s}$	6817**	76.238**	0.3614*	6	priming (p)
1006.127**	0.0000143$^{n.s}$	43183**	14.286**	4.2432**	1	temperature (c)
51.488**	0.0000571$^{n.s}$	45908**	*5.143*	4.8223**	1	time (t)
37.242**	0.0001617$^{n.s}$	2211$^{n.s}$	2.286n.s	0.2422$^{n.s}$	6	P×c
7.418$^{n.s}$	0.0001525$^{n.s}$	2892$^{n.s}$	3.143*	0.3144$^{n.s}$	6	P×t
17.367*	0.0000143$^{n.s}$	11088**	0.0n.s	1.3202**	1	C×t
11.284*	0.0000231$^{n.s}$	1118$^{n.s}$	3*	0.1077$^{n.s}$	6	P×c×t
4.427	0.0001	1449	1.238	0.1628	84	Error

Table 2. Comparison the means of experimental treatments on studied characteristics

Germination Rapidity	Germination percentage	Dry weight Seedling (mg)	Vigor index	Seedling Length (cm)	Priming (Mpa)
28.4ce	92.3c	0.2c	376.7bc	4.1a	control
31.1ab	96.9a	0/2ab	420.3a	4.3a	hydropriming
32.4a	97.4a	0.2a	410.3ab	4.2a	-0.3
29.7bc	93.6b	0.2cd	391.9abc	4.2a	-0.6
26.8de	93.5b	0.2bd	366.1c	3.9a	-0.9
29bd	93bc	0.2ad	368.6bc	4a	-1.2
26.5e	91.9c	0.2d	383.9abc	4.2a	-1.5
Temperature effect (°C)					
32.1a	94.4a	0.2a	407.9a	4.3a	15
26.1b	93.7b	0.2a	368.6b	3.9b	25
Time effect (hour)					
29.8a	94.3a	0.2a	408.5a	4.3a	12
28.5b	93.9b	0.2a	368b	3.9b	24

a photoperiod of 16-hour-lighting and 8-hour darkness. The germinated seeds are calculated daily. The base of germination is considered exit of 2 mm the radicle (Ista, 2011). Finally, the seedling length and dry weight are measured and the following indexes calculated. To determine the dry weight, the plant materials are kept in 75° C for 24 h (Guan *et al*, 2009).

The measured indexes

Equation1: $GR = \Sigma Ni/Ti$

Germination rapidity (Agraval, 2004)

Ni= number of the germinated seed at Tth day

Ti= number of days after germination started

Equation 2: GP = (number of germinated seeds / total number of seeds) × 100-

Germination percentage (Bav *et al*, 2011)

Equation3: Vigor index=Standard Germination (%) × Seedling Root length (cm)

Seed vigor (Karta & Bekl, 2012)

Finally, the data are analyzed by Minitab software and the means are compared by LSD test at level of %5.

DISCUSSION

Effect of osmo-priming

Examination of the variances analysis of the experimental data (table 1) revealed that applying priming has a significant effect on germination percentage, germination rapidity and seed vigor of *Thymus vulgaris* L. (≤ 1/0). In addition, it has a significant effect on seedling length (p≤0/5).

The most rate of germination percentage mean was shown in hydro-priming treatment and -/03 mp (table 2), the most rate of germination rapidity in hydro-priming treatment and -/03 mp (table 2), the most dry weight of seedling in hydro-priming treatment and -/03 mp (table 2) and the most seed vigor in hydro-priming treatment and -/ 03 mp (table 2).

Effect of temperature

Examination of the variances analysis of the experimental data (table 1) revealed that applying the thermal treatment has a significant effect on germination percentage, germination rapidity, and seedling length and seed vigor of *Thymus vulgaris* L. ($p \leq 1/0$).

The most rate of germination percentage mean was shown in treatment of prime temperature of 15° C (table 2), the most rate of germination rapidity in treatment of prime temperature of 15° C (table 2), The most rate of seedling length in treatment of prime temperature of 15° C (table 2) and The most rate of seed vigor in treatment of prime temperature of 15° C (table 2).

Effect of prime time

Examination of the variances analysis of the experimental data (table 1) revealed that applying the treatment of prime time has significant effect on germination percentage, germination rapidity, and seedling length and seed vigor of *Thymus vulgaris* L. ($p \leq 1/0$).

The most rate of germination percentage mean was shown in treatment of prime time of 12 h (table 2), the most rate of germination rapidity in treatment of prime time of 12 h (table 2), The most rate of seedling length in treatment of prime time of 12 h (table 2) and The most rate of seed vigor in treatment of prime time of 12 h (table 2).

Priming effect

It seems that the prime treatment leads to shortening the time from cultivation to germination and, finally, to monotones in seeds growth and accelerating in germination providing more time for using environmental resources and, as a result, producing more vigorous seedlings. Bradford *et al*, 1990; Rahimi, 2013; Lee *et al*, 2013; Faroogh *et al*, 2006 found similar results.

Temperature effect

It seems that in low temperatures, because of limitation of the available oxygen in solution around the seed, the means of germination and time of seedling emergence are reduced but other characteristics including germination rapidity, germination percentage, seedling length and dry weight and seed vigor increased. In seems that, during prime, high temperatures have detrimental effects on germination and damage to the seed by stimulating the radicle to go out. It is notable that if temperature increase and applying the prime occur at the same time, there will be more stimulation for germination. Riazi *et al*, 2007; O sivand *et al*, 2013; Sadeghian & Yavari, 2004; Kaor *et al*, 2005; Tabrizi *et al*, 2007 found similar results.

Time effect

It seems that under the stress conditions, the hydraulic conductivity of water into the seed is reduced and, as a result, the physiologic and metabolic processes are affected. By applying the priming in lesser time, the seed can take its required water for primary metabolic activities for germination and growth in a short time reducing the negative effects of high osmotic potential. Riazi *et al*, 2007; Sing & Agraval, 1995; Sadeghian & Yavari, 2004, Kaor *et al*, 2005 found similar results.

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