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Effects of Water Stress and hydro-priming duration on field performance of lentil

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ABSTRACT: A field experiment was conducted in 2012, to evaluate the effects of hydro-priming duration (P_1, P_2 and P_3: 0, 8 and 16 h, respectively) on field performance of lentil under different irrigation treatments (I_1, I_2, I_3 and I_4: Irrigation after 70, 100, 130 and 160 mm evaporation from class A pan, respectively). Plant height, number of pods and grains per plant, 100 grain weight, plant biomass, grain yield and harvest index decreased with decreasing water availability. Means of all these traits for plants from primed seeds were higher than those for plants from unprimed seeds. However, differences in pods per plant, grains per plant, 100 grains weight and harvest index were not statistically significant. Plant height, biological and grain yields for P_2 plants were significantly higher than those for P_3 and P_1 plants. Thus, hydro-priming of lentil seeds for 8 hours is the best treatment to enhance grain yield of lentil under well and limited irrigation conditions.

***Keywords*:** hydro-priming, grain yield, Lentil, plant biomass, water stress

INTRODUCTION

Lentil (*Lens culinaris* Medik.) is one of the most important legume crops in rain fed cropping systems and it is a tolerant crop to water stress (Sarker *et al.,* 2003). Water limitation is a widespread problem around the world. In arid and semi-arid environments, the water needed for germination is available for only a short period, and consequently, successful crop establishment depends on the rapid and uniform germination and seedling emergence (Fischer and Turner, 1978). Drought stress has also become the major limiting factor on plant growth and yield (Yordanov *et al.,* 2000). Moderate to high drought stress can reduce plant biomass, harvest index and grain yield of plants (Ramirez-Vallejo and Kelly, 1998).

Different techniques could be used to enhance crop yield, particularly under adverse environmental conditions. One of the simple techniques which can improve seedling establishment and consequently crop performance in the field is seed priming (Finch-Savange, 2000; Halmer, 2004). Seed priming induces a range of biochemical changes in the seed that initiate the early events of germination, but not permit radicle emergence, followed by drying to initial moisture (Asgedom and Becker, 2001; Ashraf and Foolad, 2005). One of the simple techniques for priming is hydro-priming (Ashraf and Foolad, 2005; Faruq et al, 2006). Priming by water affects DNA and RNA synthesis, alpha amylase activities and better embryo growth. Improving germination rate, growth consistency, seedling vigor and establishment by hydro-priming may improve field performance of crops (Ruan *et al*., 2002; Basra *et al*., 2005; Abdulrahmani *et al*., 2007). In this way, some of the deleterious effects of water limitation on crop performance may also be overcome by seed priming (Bittencourt *et al*., 2004; Ghassemi-Golezani *et al*., 2008 a, b).

Earlier works showed that the success of seed priming is influenced by the complex interaction of factors including plant species, water potentiality of priming agent, duration of priming, temperature, seed vigor and storage conditions of the primed seeds (Parera and Cantliffe, 1994). Ghassemi-Golezani et al (2008b) indicated that positive effects of seed priming on seed invigoration depended on priming duration. They also reported that aqueous pretreatment for 16 hours has a high effect on grain yield of chickpea. This research was aimed to investigate the effects of hydro-priming duration on field performance of lentil.

MATERIALS AND METHODS

Seeds of lentil (*Lens culinaris*Medik. cv. Kimia) were obtained from Dryland Research Center of Maragheh, Iran. These Seeds were divided into three sub-samples, one of which was kept as control (non-primed, P_1) and two other samples were soaked in distilled water at 20°C for 8 (P_2) and 16 (P_3) hours and then dried back to initial moisture content at room temperature of 20-22°C.

The field experiment was conducted in 2012 at the Research Farm of the Faculty of Agriculture, University of Tabriz, Iran (Latitude 38˚05' N, Longitude 46˚17' E). The area is located at an altitude of 1360 m with the mean annual rainfall of 285 mm. All the seeds were treated with Benomyl at a rate of 2 g kg^{-1} before sowing. Seeds were hand sown in about 4 cm depth with a density of 80 seeds m^{-2} on 14^{th} may 2012. Each plot consisted of 6 rows with 5 m length, spaced 25 cm apart. The experiment was arranged as split plot factorial, based on RCB design with three replications. All plots were irrigated immediately after sowing and irrigations after seedling establishment were carried out after 70 (I_1), 100 (I_2), 130 (I_3) and 160 (I_4) mm evaporation from class A pan. Weeds were controlled by hand during crop growth and development.

At maturity, 10 plants were harvested from each plot and plant height, pods per plant, grains per pod and grains per plant were recorded. Finally, plants of $1m^2$ in the middle part of each plot were harvested and plant biomass and grain yield per unit area as well as harvest index were determined. Analyses of variance of the data and comparison of means at P≤0.05 were carried out, using SPSS software. A figure was drawn by Excel software.

RESULTS AND DISCUSSION

Analysis of variance of the data for yield and yield components (table 1) showed that plant height, biological yield, grain yield per plant and harvest index were significantly affected by irrigation and hydro-priming duration. Pods and grains per plant and 100 grains weight only affected by irrigation intervals, but the effects of hydro-priming durations on these traits were not significant. The interaction of irrigation × hydro-priming duration was only significant for 100 grains weight.

Table 1. Analysis of variance of the data for yield and yield components of primed and unprimed seeds of lentil under different irrigation treatments

Source	Df	Plant Height	Pods per plant	Grains per pod	Grains per plant	100 Grains weight	Plant biomass	Grain yield	Harvest index
Replication	2	13.93	13.65	0.02	7.14	0.37	94.51	7.23	1.49
Irrigation (I)	3	333.61**	380.01**	0.01^{ns}	378.42**	5.65**	8476.06**	392.69**	650.55**
Ea	6	6.44	3.46	0.02	3.80	0.15	94.35	6.86	11.43
Hydro-Priming (p)	2	56.09**	0.23^{ns}	0.00^{ns}	0.17^{ns}	0.79^{ns}	1514.18**	42.65*	2.45**
I*P	6	4.65^{ns}	3.00 ^{ns}	0.01^{ns}	0.48^{ns}	0.88*	358.84^{ns}	4.94^{ns}	6.96^{ns}
Eb	16	4.74	4.35	0.01	3.50	0.31	146.20	11.10	3.25
CV%		13.75	13.88	9.85	8.10	12.3	14.41	14.57	7.74

*,** Significant at p≤0.05 and p≤0.01, respectively

Plant height, number of pods and grains per plant, 100 grain weight, plant biomass and harvest index decreased as water stress increased, leading to loss of grain yield per unit area (Table 2) as a consequence of lower growth rate and ground green cover (Ghasemi-golezani et al. 2010). Increasing intra and inter plant competition for water caused the plants not to be able to produce their maximum biomass. Lower plant biomass under water deficit resulted in production of less and smaller grains and finally lower grain yield per unit area, compared to well-watering. Decreasing harvest index with increasing water stress could be mainly related with larger reduction in grain yield per unit area (Table 2).

Table 2. Means of the yield and yield components of lentil for four irrigation treatments and hydro-priming duration

Treatment	Plant Height	Pods per Plant	Grains per pod	Grains per Plant	100 Grains weight (gr)	Biological Yield (g m^{-2})	Grain Yield (g m^{-2})	Harvest Index (%)
Irrigation								
I_1	22.30^a	22.98^a	1.317^a	31.67^a	5.567^a	119.2^a	30.58^a	32.28^a
I_2	19.79^a	17.43^b	1.286^a	24.47^b	5.267^a	99.19^b	24.96^b	27.82^b
I_3	14.42^b	11.35^c	1.242^a	19.36^c	4.667^b	66.67^c	21.07^c	20.12^c
I_4	8.944^c	8.383^d	1.253^a	17.02^d	4.444^b	54.78^d	14.88^d	13.02^d
Priming								
P1	14.30^c	14.89^a	1.271^a	23.08^a	4.225^a	74.50^b	20.88^b	23.07^a
P2	18.59^a	15.05^a	1.297^a	23.04^a	4.708^a	98.79^a	24.62^a	23.83^a
P3	16.20^b	15.17^a	1.257^a	23.27^a	4.617^a	81.56^b	23.12^{ab}	23.03^a

I_1, I_2, I_3 and I_4: Irrigation after 70, 100, 130 and 160 mm evaporation from class A pan and
P1, P2 and P3: non-primed and hydro-primed seeds for 8 and 16 h, respectively

100 grains weight of plants from primed and unprimed seeds under limited irrigations of I_3 and I_4 was considerably lower than that under other irrigation treatments. Plants from P_2 and P_3 seeds produced largest grains under well watering, but no tangible differences were observed under limited irrigation conditions (Figure 1).

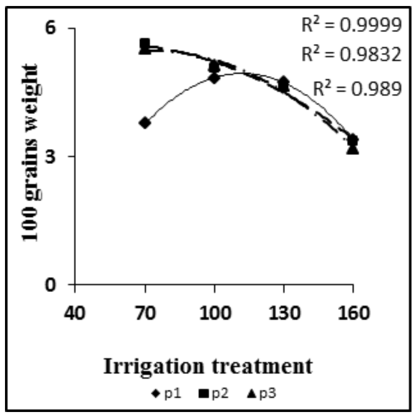

Figure 1. change in 100 grain weight of lentil affected by seed priming and water limitation.
I_1, I_2, I_3 and I_4: Irrigation after 70, 100, 130 and 160 mm evaporation from class A pan, respectively
P_1, P_2 and P_3: non-primed and hydro-primed seeds for 8 and 16 h, respectively.

Means of all traits for plants from primed seeds were higher than those for plants from unprimed seeds, but these differences for pods per plant, grains per plant, 100 grains weight and harvest index were not statistically significant. Plant height, biological and grain yields for P_2 plants were significantly higher than those for P_3 and P_1 plants. The highest and the lowest grain yields per unit area were obtained from P_2 and P_1 plants, respectively. However, differences in grain yield between plants from P_2 and P_3 seeds and also between P_3 and P_1 plants were not statistically significant (Table 2).

Hydro-priming of seeds for 8 hours before sowing improved field performance of lentil, as reflected in higher plant height, biological and grain yields per unit area. Grain yield of plants from primed seeds for 8 h (P_2) was 17.91% and 6.09% more than that of plant from unprimed (P_1) and primed seeds for 16 h (P_3), respectively. The superiority of hydro-priming for 8 hours in improving grain yield per unit area mainly resulted from higher plant height and consequently biological yield, compared with P1 and P3 treatments (Table 2). Therefore, the resultant effects of priming depends on duration of seed soaking, beyond which it could be damaging to the seed or seedling (Ashraf and Foolad, 2005; Ghassemi- Golezani et al., 2008b). Thus, optimal time of hydro-priming for lentil seeds is about 8 hours, which can be successfully applied to enhance grain yield of lentil in the field.

REFERENCES

Abdulrahmani BK, Ghassemi-Golezani K, Valizadeh M, Feizi-Asl V. 2007. Seed priming and seedling establishment of barley (*Hordeum vulgare* L.). J Food Agri Environ 5:179-184.

Asgedom H, Becker M. 2001 . Effects of seed priming with nutrient solutions on germination, seedling growth and weed competitiveness of cereals in Eritrea. In: Proc. Deutch Tropentag, University of Bonn and ATSAF. Margraf Publishers Press, Weickersheim.

Ashraf M, Foolad MR. 2005. Pre-sowing seed treatment: A shotgun approach to improve germination, plant growth and crop yield under saline and non-saline conditions. Adv Agron 88: 223-271.

Basra SMA, Afzal I, Rashid AR, Farooq M. 2005. Pre-sowing seed treatment to improve germination and seedling growth in wheat (*Triticum aestivum* L.). Cadernode PesquisaSér. Bio Santa Cruz Sul 17: 155-164.

Bittencourt MLC, Dias DCFS, Dias, LAS, Araújo EF. 2004. Effects of priming on asparagus seed germination and vigor under water and temperature stress. Seed Sci Technol 32: 607-616.

Demirkaya M, Okcu G, Atak M, Cikili Y, kolsarici O. 2006. Seed treatment to overcome salt and drought stress during germination in sunflower (helianthus annuus L.). Eur J Agron 24: 291-295.

Farooq M, Basra SMA, Rehman H. 2006. Seed Priming enhances emergence, yield, and quality of direct-seeded rice. Crop Manag & physiol 3:42-44.35: 15-29.

Finch-Savange WE. 2000. Influence of seed quality on crop establishment, growth and yield. In Seed quality: Basic mechanisms and agricultural implications. The Haworth Press, New York

Fischer RA, Turner NC. 1978. Plant productivity in the arid and semiarid zones. Ann Rev Plant Physiol 29: 277-317.

Ghassemi-Golezani K, Aliloo AA, Valizadeh M, Moghaddam M. 2008a. Effects of different priming techniques on seed invigoration and seedling establishment of lentil (*Lens culinaris* Medik). J Food Agri Environ 6:222-226.

Ghassemi-Golezani K, Sheikhzadeh-Mosaddegh P, Valizadeh M. 2008b. Effects of hydro-priming duration and limited irrigation on field performance of chickpea. Res J Seed Sci 1:34-40.

Ghassemi-Golezani K, Zafarani-Moattar P, Raey Y, Mohammadi A. 2010. Response of pinto bean cultivars to water deficit at reproductive stages. J of Food Agri Environ 8:801-804

Halmer P. 2004. Methods to improve seed performance in the field. In: Benech- Arnold RL, Sanchez R (eds) Handbook of Seed Physiology. Food Product Press, New York

McDonald MB. 20002. Seed priming. In: Black M, Bewley JD (eds) Seed Technology and Its Biological Basis. Sheffield Academic Press, England

Parera CA, Cantliff DJ. 1994. Presowing seed priming. Hotric Rev 16: 109-141.

Ramirez-Vallejo P, Kelly JD. 1998. Traits related to drought resistance in common bean. Euphytica 99: 127-136.

Ruan S, Xue Q, Tylkowska K. 2002. Effects of seed priming on germination and health of rice (*Oryza sativa* L.) seeds. Seed Sci &Technol 30: 451-458.

Sarker A, Erskine W, Singh M. 2003. Regression models for lentil seed and straw yields in Near East. Agri and Forest Meteor 116: 61-72.

Yordanov I, Velikova V, Tsonev T. 2000. Plant responses to drought, acclimation and stress tolerance. Photosynthesis 38: 171-86.