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Reducing Drought Stress Effects in Germination and Establishment Stage of Cumin (*Cuminum Cyminum* L.) By Seed Priming

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Abstract

Drought is one of the abiotic stresses that limit agricultural productions. In this study the effects of various seed priming treatments on germination and seedling growth of cumin under different levels of drought were investigated. Seeds were treated with KNO3 and KH2PO4 solutions having -1.2 MPa (osmopriming) and water (hydropriming) for 18h. Drought levels -0.3, -0.6 and -0.9 MPa were created by PEG6000. Control seeds were not treated. Results showed that seed priming significantly improved germination and seedling growth of cumin under drought stress conditions. Primed seeds with KNO3 and KH2PO4 were more suitable to hydropriming compared to untreated ones.

Keywords: Drought, cumin, osmoriming, hydropriming, germination, seedling growth

INTRODUCTION

Cultivation of medicinal plants is very important from different aspects. Cumin is one of the most important medicinal plants and the second most popular spice in the world after black pepper. This plant is grown in the Mediterranean countries, Iran, China and some other countries as a medicinal and spice plant [13].

Cumin is an annual plant and its growth period is relatively short. This plant is highly sensitive to environmental factors. Unfavorable environmental condition during germination, vegetative and reproductive phases have a significant effect on its production and biological reactions [13,15].

One of the most critical stages in the cultivation of cumin is its establishment. Cumin is a relatively short plant and its germination and establishment is also longer than other plants. Therefore, if this plant's germination and establishment is not performed well, it is possible that weed dominance on the cumin to occur and cultivation of this medicinal plant to be disturbed. Thus, achieving good germination and uniform green field is the key to success of cultivation of cumin. As a result, understanding the factors that improve germination of cumin especially under stress condition is very important[13,4,8,9].

Seed treatment before sowing is one of the ways to improve germination and seedling establishment [12]. Different methods of seed treatment before planting or seed priming are Osmopriming, hydropriming, hardening etc [1, 5]. In these methods, metabolic activities in primed seeds are started before planting and then stopped before the radical is appeared [11]. Based on this, seed priming improve the biological activities and the seed vigor during germination in the soil [14, 16, 3]. Many researchers have reported that using seed priming can be created drought tolerance in different plants such as: maize, barley, wheat, canola, etc[2,7,10].

This study aimed to assess the impact of pre-sowing seed treatment on germination and seedling growth of cumin under drought stress.

MATERIAL and METHODS

This study was conducted in the Department of Agronomy, Faculty of Agriculture, Urmia University during 2011.

Seeds were prepared from Seed and Plant Improvement Institute of Iran. Initial seed germination percentage and moisture content were 93% and 11% respectively. Before applying the treatments, seeds were surface sterilized with sodium hypochlorite. The sterilized seeds were rinsed with water through three stages.

Seeds were treated with KNO_3 and KH_2PO_4 solutions having -1.2 MPa (osmopriming) and water (hydropriming) for 18h. Primed seeds were washed three times with distilled water, to reach the initial moisture were re-dried in the shade. Treated seeds in each treatment were planted in standard petri dishes for germination testes. Three replications were considered for testing, and 100 seeds were placed in each replication. Experimenters preformed according to ISTA's standard procedures. Seed samples were watered daily to four levels of drought (0 as control, -0.3, -0.6and -0.9 MPa) created by PEG6000. In order to assess the seedling growth, thirty germinated seeds the in evaluated treatments were selected immediately after germination. Seeds were considered as germinated when the radical length was at least 2 mm. selected seeds transferred to plastic containers with a cap and were grown to the filter paper for 10 days. Seedlings were irrigated by PEG solutions exactly the same as petri dishes. At the end of the test, seedling traits were measured and recorded according ISTA's standards laws.

Petri dishes and container of seedling were placed in growth chamber during the experiments. The experimental design used in both assays was completely randomized design (CRD) with three replications, based on factorial experiments. All data were analyzed with MSTAT-C software.

RESULTS and DISCUSION

Statistical analysis showed that the type of material used in the seeds treatment, drought levels and also interaction of these factors on the studied traits were significant ($p \leq 0.05$).

In all treatments the percentage of germination decreased with increasing levels of drought. However, the reduction in the treated seeds was significantly slower (Fig 1).

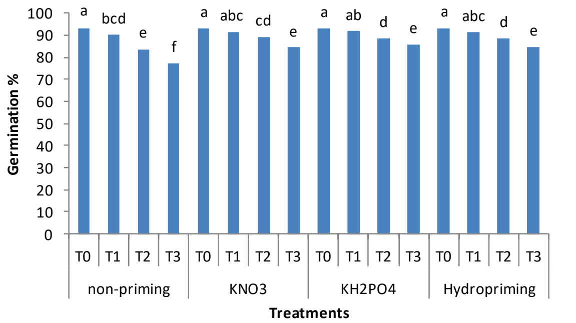

Figure 1. Effect of different priming treatments and drought levels on germination of cumin seeds. The bars with different alphabets are statically different at P= 0.05. T1= 0 MPa , T2= -0.3 MPa, T3= -0.6 MPa and T4= -0.9 MPa

Most of the germination index (GI) recorded from seeds treated with KNO_3 and KH_2PO_4 in 0 MPa drought levels were statically significant. This indicates that seed treated with these materials can improve germination, and it can be clearly observed comparing the control and hydropriming treatments. The lowest germination index (GI) was achieved at -0.9 MPa drought level in control (non-priming) treatment, and it was also statically significant (Fig 2 GI).

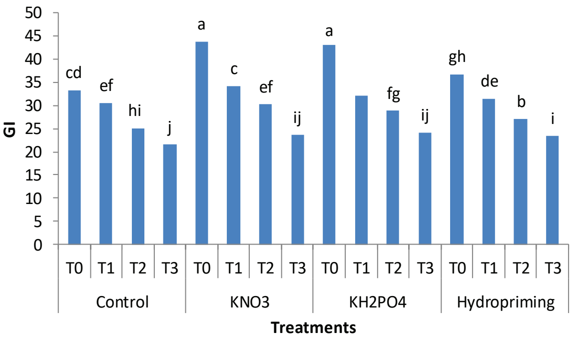

Figure 2. Effect of different priming treatments and drought levels on germination index (GI) of cumin seeds. The bars with different alphabets are statically different at P= 0.05.T1= 0 MPa , T2= -0.3 MPa, T3= -0.6 MPa and T4= -0.9 MPa

The shortest time to reach 50% germination (T_{50}) was obtained in seeds treated with KNO3, KH_2PO_4 and hydropriming in 0 MPa dry levels. Speed of germination in seed treatments with KNO3 and KH2PO4 was increased more than hydropriming seeds. Thus, T_{50} and mean germination time (MGT) of these treatments were shorter. The results that these treatments have improved the vigor of primed seeds the most (Fig 3 and Fig 4).

The highest root length was recorded from seed treated with KNO_3 in first level of drought (0MPa) it was statically significant and with the other treatment. The minimum value for this test was recorded from non-priming treatment in fourth level of drought (-0.9 MPa). The root and shoot length in all these treatments compared than non-priming at the same levels of drought were longer (Fig 5 and Fig 6). In addition to, in seed priming treatments (KNO_3, KH_2PO_4 and Hydropriming) with increased drought level root and shoot length reduction was lower (Fig 5 and Fig 6).

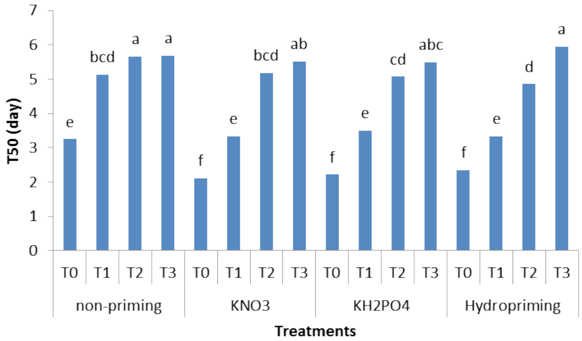

Figure 3. Effect of different priming treatments and drought levels on time to reach 50 % germination (T50) of cumin seeds. The bars with different alphabets are statically different at P= 0.05. T1= 0 MPa , T2= -0.3 MPa, T3= -0.6 MPa and T4= -0.9 MPa

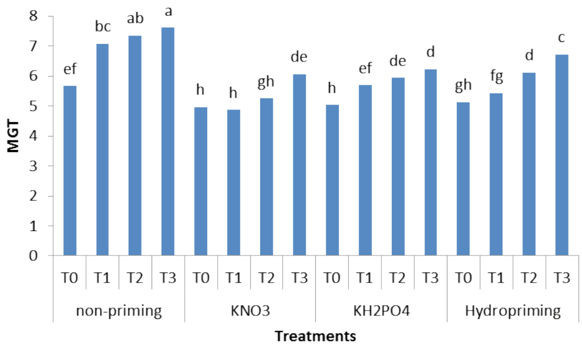

Figure 4. Effect of different priming treatments and drought levels on mean germination time (MGT) of cumin seeds. The bars with different alphabets are statically different at P= 0.05.T1= 0 MPa , T2= -0.3 MPa, T3= -0.6 MPa and T4= -0.9 MPa

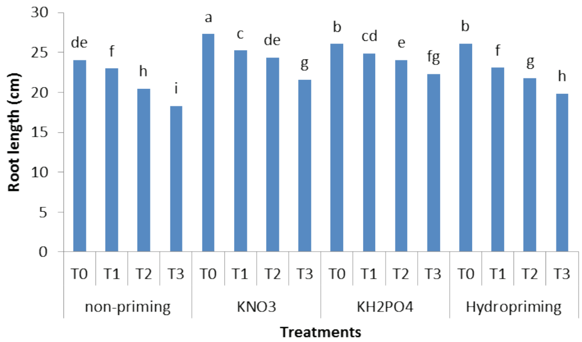

Figure 5. Effect of different priming treatments and drought levels on root length of cumin seeds. The bars with different alphabets are statically different at P= 0.05.T1= 0 MPa , T2= -0.3 MPa, T3= -0.6 MPa and T4= -0.9 MPa

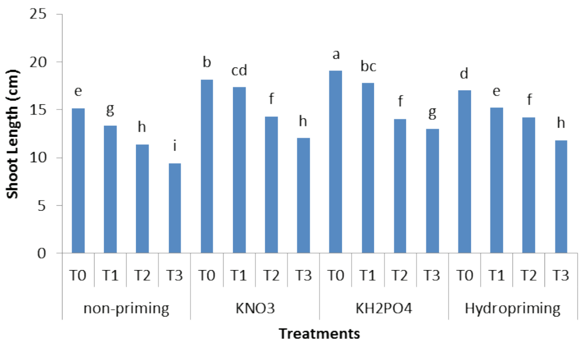

Figure 6. Effect of different priming treatments and drought levels on germination of cumin seeds. The bars with different alphabets are statically different at P= 0.05. T1= 0 MPa , T2= -0.3 MPa, T3= -0.6 MPa and T4= -0.9 MPa

According to our results comparing treated and non-treated seeds it is clear that seed priming could enhance seed germination and seedling growth under drought stress condition and by the way seed treated with KNO_3 and KH_2PO_4 are more suitable to hydropriming.

The results of this research showed that the seed priming improved germination and seedling growth of cumin under drought stress condition. Germination is a physiological process is largely depended on environmental condition. Seed priming treatments are done in laboratory and controlled conditions. Thus, began the germination process is done under optimal condition. It is the physiological advantage in the treated seeds. Under this condition germination and vigor are improved, and the treated seeds will germinate better after planting.

Results of this study were consistent with previous reports about the seed priming. Ghiyasi et al., (2008 b) reported that seed priming improve germination and seedling growth, especially under unfavorable conditions such as salinity, drought, infertility, etc. This method effective was proven in many pervious reports on wheat, soybean, clover, alfalfa, fennel, millet, etc [6,7,8,13,14,16].

CONCLUSION

Results showed that seed priming was improved germination and seedling growth of cumin seeds under drought stress. However, treated seeds with KH_2PO_4 and KNO_3 (osmopriming) to the hydropriming indicated greater performance.

REFERENCES

[1] Abbasdokht, H., Edalatpishe, M. R. and Gholami, A. (2010). The effect of hydropriming and halopriming on germination and early growth stage of wheat (*Triticum aestivum* L.). World Academy of Science, Engineering and Technology. 68:974-978.

[2] Azooz, M. M. (2009). Salt stress mitigation by seed priming with salicylic acid in two faba bean genotypes differing in salt tolerance. Int. J. Agric. Biol., 11(4): 343-350.

[3] Debez, A., Ben, K., Grignon,. C. and Abdelly,C. (2004). Salinity effects on germination, growth and seed production of the halophyte *cakile maritime*. Plant Soil. 262:179-189.

[4] Dezfuli, P. M., Sharif-Zade, F. and Janmohammadi, M. (2008). Influence of priming techniques on seed germination behavior of maize inbred line (*zea mays* L.) ARPN., J. Agri. Biol. Sci. 3(3):22-25.

[5] Ghiyasi, M., Abbasi, A., Tajbakhsh, M., Amirnia, R. and Salehzadeh, H. (2008a). Effect of osmopriming with polyethylene glycol (8000) on germination and seedling growth of wheat (*Triticum aestivum* L.) seeds under salt stress. Res. J. Bio. Sci. 3(10): 1249-1251.

[6] Ghiyasi, M., Pouryousef, M., Tajbakhsh, M., Salehzade, H. and Meshkat, M. V. (2008b). Influence of different osmopriming treatments on emergency and yield of maize (*zea mays* L.). Res. J. Biol. Sci. 3(12):1452-1455.

[7] Ghiyasi, M., Zadoshty, M. R., Mogaddam, A. F., Tajbakhsh, M. and Amirnia, R. (2008 c). Effect of osmopriming on germination and seedling growth of corn (*zea mays* L.) seeds. Res. J. Biol. Sci. 3(7):779-782.

[8] Giri, G.S. and Schillinger, W.F. (2003). Seed priming winter wheat for germination, emergence and yield. Crop Sci., 43: 2135-2141.

[9] Janmohammadi, M., Moradi, P., Sharifzadeh, F. (2008). Seed invigoration techniques to improve germination and early growth of inbred line of maize under salinity and drought stress. Gen Apple. Plant Physiology. 34(3-4): 215-226.

[10] Kadkhodaie, A. and Bagheri, M. (2011). Seed treatment during germination in linseed to overcome salt and drought stresses (*Linum usitatimum* L.). World Academy of Science, Engineering and Technology. 73:373-377.

[11] Li, X., An, P., Inanaga, S., Eneji, A. E. and Tanabe, K. (2006). Salinity and defoliation effects on soybean growth. J. Plant Nutr. 29:1499-1508.

[12] Masoudi, P., Gazanchian, A., and Azizi, M. (2010). Improving emergence and early seedling growth of two cool season grasses affected by seed priming under saline conditions. Afr. J. Agric. Res. 5(11): 1288-1296.

[13] Neamatollahi, E., Bannayan, M., Souhani, A. and Ghanbari, A. (2009).Hydropriming and osmopriming effects on cumin (*cuminum cyminum* L.) seeds germination. World Academy of Science, Engineering and Technology. 57: 526-529.

[14] Salehzade, H., Izadkhah, M., Ghiyasi, M., Forouzin, F. and Abasi, A. (2009). Effect of seedpriming on germination and seedling growth of wheat (*Triticum aestivum* L.). Res. J. Biol. Sci. 4(5):629-931.

[15] Tavili, A., Zare, S., Moosavi, S. A. and Enayati, A. (2011). Effect of seed priming on germination characteristics of *Bromus* species under salt and drought conditions. Am-Euras. J. Agric. And Environ. Sci. 10(2):163-168.

[16] Triyaki, I., Kizilsimsek, M. and Kaplan, M. (2009). Rapid and enhanced germination at low tempreture of alfalfa and white clover seeds following osmotic priming. Tropical Grasslands. 43:171-177.