EFFECT OF SEED PRIMING WITH ZINC SULFATE ON GERMINATION CHARACTERISTICS AND SEEDLING GROWTH OF CHICKPEA (*Cicerarietinum* L.) UNDER SALINITY STRESS

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ABSTRACT: A laboratory experiment was carried out to determine the effects of seed priming (NP: nonprime and P: prime with zinc sulfate) on seed germination characteristics and seedling growth of Chickpea under different levels of salinity stress (0, -2, -4, -6, -8 and -10 bar). Therefore, a factorial experiment was used based on completely randomized design (CRD) with three replications. Results indicated that, with increasing salinity stress germination characteristics such as germination percentage, germination rate and seedling fresh weight decreased, but decreasing amounts of these characteristics in primed seeds were less than nonprime. In comparison with control (NP treatment) at all salinity levels, P treatment showed more germination rate and seedling fresh weight. Also, germination percentage in P treatment was more than control. In general, it is concluded that seed priming improved germination characteristics of Chickpea under salinity stress conditions and increased the resistance of Chickpea to salinity stress at germination phase.

Keywords: Priming, Chickpea, Germination, Salinity, Zinc.

INTRODUCTION

Grain legumes are a major source of proteins in human and animal nutrition and plays a key role in crop rotations in most parts of the world. When grown in rotation with other crops they can improve soil fertility and reduce the incidence of weeds, diseases and pests (Mwanamwenge et al., 1998). Chickpea (*Cicerarietinum* L.) is an annual grain legume crop grown mainly for human consumption. It plays an important role in human nutrition as a source of protein, energy, fiber, vitamins and minerals for large population sectors in the developing world and is considered a healthy food in many developed countries (Abbo et al., 2003). This crop is widely distributed being grown in over 33 countries in the world in South Asia, West Asia, North and East Africa, Southern Europe, North and South America, and Australia (Maiti, 2001). Chickpea is the major legume crops in the Iran. Yield of this crop is low and this low yield is attributed to factors of low rainfall and poor cultural practices. Also, the increasing frequency of dry periods in many regions and the problems associated with salinity in irrigated areas frequently result in the consecutive occurrence of drought and salinity on cultivated land (Majnoun Hosseini, 2008).

Salinization of soil is a problem in many parts of the world. Saline soils often occur in irrigated land in semi-arid or arid zones of the world. About 50% of irrigated areas of the world are either salinized or have the potential to be so in future, underlining the extent of the problem. Generally, salinity affects crop yield and beneficial soil biota, leading to economic losses. It affects the growth and survival of microorganisms (Yuan et al., 2007), plants (Kadukova and Kalogerakis, 2007) and soil animals. It is also well known that the distribution and abundance of earthworms are influenced by soil salinity in various ecosystems (Owojori et al., 2009).

Zinc deficiency is common throughout the developed and developing world and lack of Zn can limit the growth and productivity of a wide range of crops, including wheat and other crops (Harris et al., 2008).

Rapid and uniform field emergence is essential to achieve high yield with respect to both quantity and quality in annual crops (Subedi and Ma, 2005). Seed priming is now a widely used commercial process that accelerates the germination rate and improves seedling uniformity in many crops (Halmer, 2003). In
priming, seeds are exposed to restricted water availability under controlled conditions which allows some of the physiological processes of germination to occur and then, before germination is completed, the seeds are usually re-dried for short term storage before sowing (Halmer, 2003). At least three technologies exist to achieve priming including hydropriming, osmopriming and solid-matrix priming (Halmer, 2003; Ashraf and Foolad, 2005). Osmotic priming is widely used to improve seed quality. Priming decreases solute leakage during seed imbibition. The composition and quantity of membrane phospholipids may also change during priming. However, it is uncertain whether the reduction in electrolyte leakage is caused by changes in membrane structure or simply by washing electrolytes from seeds during priming (Moeinzadeh et al., 2010). This study was conducted to evaluate the effect of seeds osmopriming by zinc sulfate on germination of chickpea seeds under salinity stress conditions.

MATERIALS AND METHODS

A laboratory experiment was carried out to determine the effects of seed priming (NP: nonprime and P: prime with zinc sulphate- ZnSO4-) on seed germination characteristics and seedling growth of chickpea under different levels of salinity stress (0, -2, -4, -6, -8 and -10 bar). Therefore, a factorial experiment was used based on completely randomized design (CRD) with three replications.

The experiment was carried out in Hamedan Bu-Ali Sina University, Faculty of Agriculture. Salinity levels were prepared with NaCl. Seeds of chickpea were soaked for 8 hours in distilled water at a temperature of 25°C. For experiment was used of Hashem cultivar.

The different potential levels were used with Coons et al. (1990) formula, and using NaCl prepared and for levels salinity control used the distilled water. For priming was used of method Harris et al. (2008). In each replication of each treatment 25 seeds were placed in Petri dishes that had previously been disinfected and Petri grown to 25±1°C were transferred. Visit daily for 7 days after seeds were germinated seeds (leave root of 2 mm) counted. The seedlings with short, thick and spiral hypocotyl are considered in abnormal germination. Properties were assessed inclusive germination percentage, germination rate, seed vigor index, the percentage of abnormal germination, shoot and root length and seedling fresh and dry weight.

Germination rate and seed vigor index were assessed based on below:

\[
\text{Germination rate} = \frac{\sum_{i=1}^{n} n_i}{\sum_{i=1}^{n} d_i} \quad (n_i = \text{number of seeds germinated, } d_i = \text{days of germination})
\]

\[
\text{Seed vigor index} = \left( \frac{\text{Shoot length} + \text{Root length}}{\% \text{Germination}} \right) \times 100
\]

(Goodi and Sharifzadeh, 2006)

Data were analyzed using SAS statistical software. Wherever, the F-test showed significant differences among means, the differences among treatments were compared by least significant differences (LSD) test at the 0.05 level of probability.

RESULTS AND DISCUSSION

Chickpea illustrated respond positively, to priming seeds with ZnSO4. The results of this research shows with the increase assembly stress reduce traits of percentage and rate germination, seed vigor index, shoot and root length, Also, seedling fresh and dry weight. Amount of this decrease in the prime levels with zinc sulfate was lesser than control seeds. The abnormal seedlings likewise rose with stress increasing; however, this increasing in prime seeds with zinc sulfate was lesser than nonprime seeds (Figs 1-8).

Normal germination and abnormal germination percentage:

The effects of prime and stress and both reaction were significantly in traits of normal germination and abnormal germination percentage in \( p \geq 0.01 \) (Table 1). In spite, normal germination percentage increasing in -10 bar stress level in prime seeds was 50% more than control seeds (Fig 1). With increasing in normal germination in prime seeds with zinc sulfate, abnormal germination was reduced, normally. this results was confirmed the findings of Demir et al (2006) research's. In this research was seen by increasing in the stress normal germination in control seeds shows reduction more than prime seeds. Also, in their research's abnormal germination in control seeds was more than prime seeds. Edulatpishe et al (2009) confirmed these results in the maize, too.

Germination rate:

The effects of prime and stress were significantly in germination rate in \( p \geq 0.01 \). Also, the effect of reaction between prime and stress was significantly in \( p \geq 0.05 \) (Table 1).
Germination rate is one of important traits in the suitable establishment of seeds, that due to better yield in crop. Therefore, increasing this property is a well way to successful of farmers. Germination rate in research of Edalatpishe et al (2009) likewise as this present in prime seeds levels was more than nonprime seeds. Soltani et al (2008) in the cotton crop reported that, Prime cause of improve in germination rate. Also, the results of Behpouri et al (2009) study’s showed coordination with the results of this research.

**Seed vigor index:**

The effects of prime and stress and both reaction were significantly in seed vigor index, too (p<0.01). Seed vigor index reduction in –10 bar stress level in control seed was 75% more than prime seeds with zinc sulfate levels (Fig 4). Sung and Chiu (1995) in themselves research on watermelon stated that seedlings of prime seeds are stronger.

**Shoot and root length:**

In this present effects of prime and stress and both reaction were significantly in traits of shoot and root length in p≤0.01 (Table 1). Amount of shoot and root length reduction in –10 bar stress level in nonprime seeds were 51 and 79 percentage respectively, more than prime (Figs 5 and 6). Germination rate increasing was due to that, crop traits as shoot and root length had been a better growth. Shahsavand et al (2009) reported that Prime cause to increasing in seedling shoot and root length. The results of Demir et al (2006) and Edalatpishe et al (2009) were accordance with this present, too.

**Seedling fresh and dry weight:**

Primings and stress levels and reaction effect prime and stress in this properties had a significant different, and Seedling fresh and dry weight reduction in nonprime seeds was more than prime seeds. In research on onion were done by Khodadadi et al (2003), Seedling fresh weight affected by prime. Primings treatments could have increased Seedling fresh weight in prime seeds. Also, researches of Demir et al (2006) and Edalatpishe et al (2009) confirmed these findings.

Table 1. Analysis of variance (mean square) of Chickpea germination and early growth properties under Salt stress with prime and nonprime.

<table>
<thead>
<tr>
<th>Source</th>
<th>d.f.</th>
<th>% Normal germination</th>
<th>% Abnormal germination</th>
<th>Germination rate</th>
<th>Seed vigor index</th>
<th>Shoot length</th>
<th>Root length</th>
<th>Seedling fresh weight</th>
<th>Seedling dry weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priming 1</td>
<td>3364.00**</td>
<td>3364.00**</td>
<td>0.049**</td>
<td>13140.95**</td>
<td>2117.53**</td>
<td>2659.12**</td>
<td>2.02**</td>
<td>0.005**</td>
<td></td>
</tr>
<tr>
<td>Stress 5</td>
<td>2887.00**</td>
<td>2887.00**</td>
<td>0.042**</td>
<td>14703.61**</td>
<td>1966.77**</td>
<td>3508.40**</td>
<td>1.896**</td>
<td>0.003**</td>
<td></td>
</tr>
<tr>
<td>P × S 5</td>
<td>52.00**</td>
<td>52.00**</td>
<td>0.00003</td>
<td>729.637**</td>
<td>88.56**</td>
<td>68.12**</td>
<td>0.097**</td>
<td>0.0001**</td>
<td></td>
</tr>
<tr>
<td>Error 24</td>
<td>4.00</td>
<td>4.00</td>
<td>0.00009</td>
<td>8.38</td>
<td>1.86</td>
<td>3.34</td>
<td>0.0001</td>
<td>0.000004</td>
<td></td>
</tr>
<tr>
<td>CV (%)</td>
<td>5.10</td>
<td>7.60</td>
<td>4.17</td>
<td>5.97</td>
<td>5.65</td>
<td>4.97</td>
<td>3.01</td>
<td>3.09</td>
<td></td>
</tr>
</tbody>
</table>

Fig 1- The means of interaction between prime and stress on normal germination percentage (%).

NP0: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.
Fig 2: The means of interaction between prime and stress on abnormal germination percentage (%).
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.

Fig 3: The means of interaction between prime and stress on germination rate (1/day).
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.

Fig 4: The means of interaction between prime and stress on seed vigor index.
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.
Fig 5 - The means of interaction between prime and stress on shoot length (cm).
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.

Fig 6 - The means of interaction between prime and stress on root length (cm).
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.

Fig 7 - The means of interaction between prime and stress on seedling fresh weight (g).
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.
Fig 8- The means of interaction between prime and stress on seedling dry weight (g).
NPO: Nonprime, P: Prime, 0: without salinity stress, 2: -2 bar salinity stress, 4: -4 bar salinity stress, 6: -6 bar salinity stress, 8: -8 bar salinity stress and 10: -10 bar salinity stress.

REFERENCES


