The effect of seed priming with zinc sulphate on germination characteristics and seedling growth of chickpea (*Cicer arietinum* L.) under salinity stress

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Abstract :

A laboratory experiment was carried out to determine the effects of seed priming (NP: non prime and P: prime with zinc sulphate) 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 amount of these characteristics in primed seeds were less than non-primed. 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 is 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 (*Cicer arietinum* 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).

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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 imbibitions. 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 osmo priming by znic sulphate 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: non prime and P: prime with zinc sulphate) 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 25ºC. 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 form short, thick and spiral hypocotyl be 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:

Germination rate $= \frac{\sum ni}{\sum ni\ di}$ (ni = number of seeds germinated, di = days of germination)

seed vigor index $= \frac{(\text{Shoot length} + \text{Root length}) \times \%\text{Germination}}{100}$ (goodi and sharifzadeh,2006)

Data were analysed 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.

ISSN 2072-3875

Results and discussion :

According to the analysis of variance, there was a significant difference at $p \geq 0.01$ between treatments and all properties. Increasing salinity, in all traits a significant reduction was seen (except abnormal germination percentage). The amount of reduction at prime levels was less than control seeds. Also, abnormal seedlings increased. The amount of reduction at hydroprimed seeds was less than the reduction in other ones. This issue shows the positive influence of prime on reduction of negative effects of stress. At the highest amount of stress, reduction germination percentage and germination rate, seed vigor index, shoot and root length as well as seedling fresh weight and seedling dry weight at primed seeds were 50, 20, 75, 51, 79, 45 and 10 percentage lesser respectively. The findings of present study accompany with harris et al (2008) on chickpea and wheat plants.

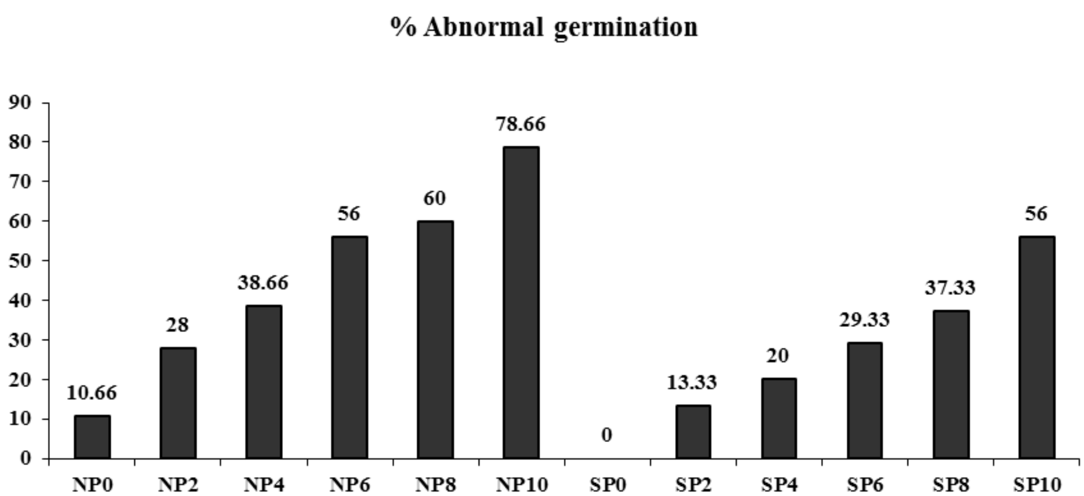

Fig2- The means of interaction between prime and stress on abnormal germination percentage (LSD = 3.37)

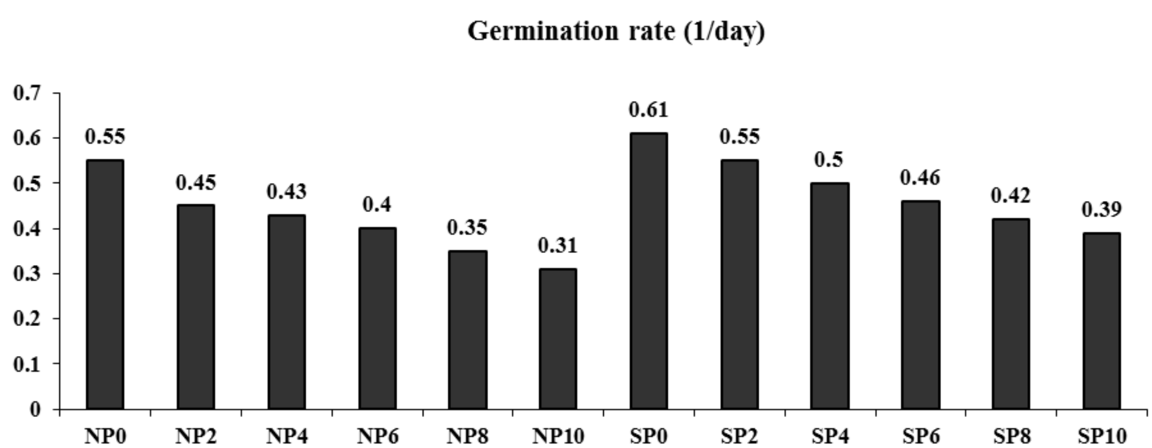

Fig3- The means of interaction between prime and stress on germinationrate (LSD = 0.01)

ISSN 2072-3875

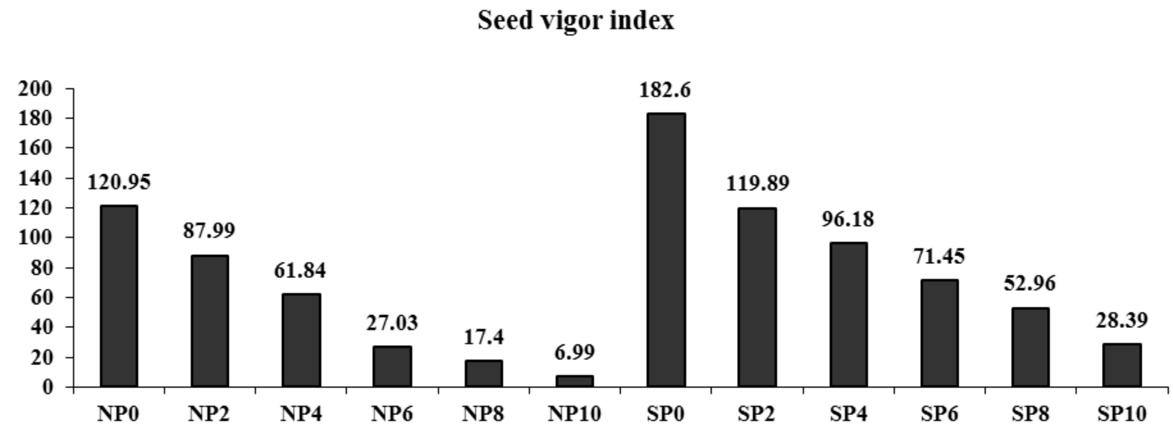

Fig4- The means of interaction between prime and stress onseed vigor index (LSD = 4.87)

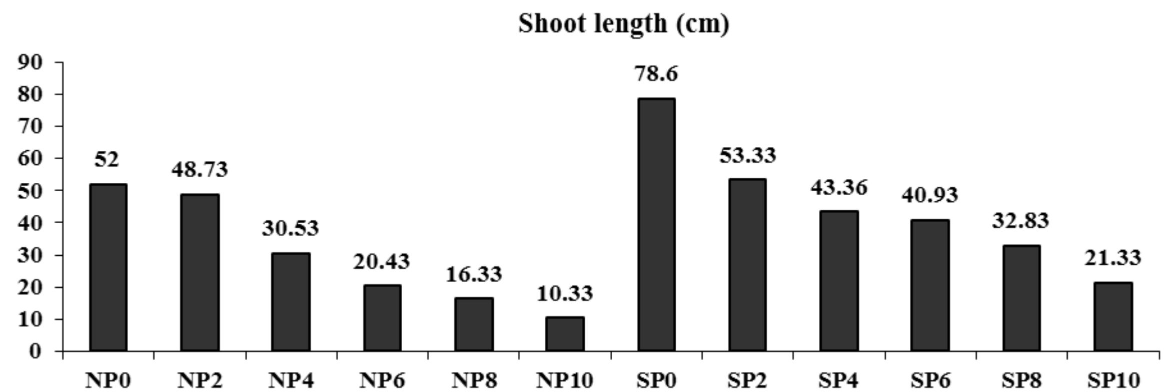

Fig5- The means of interaction between prime and stress onshoot length (LSD = 2.30)

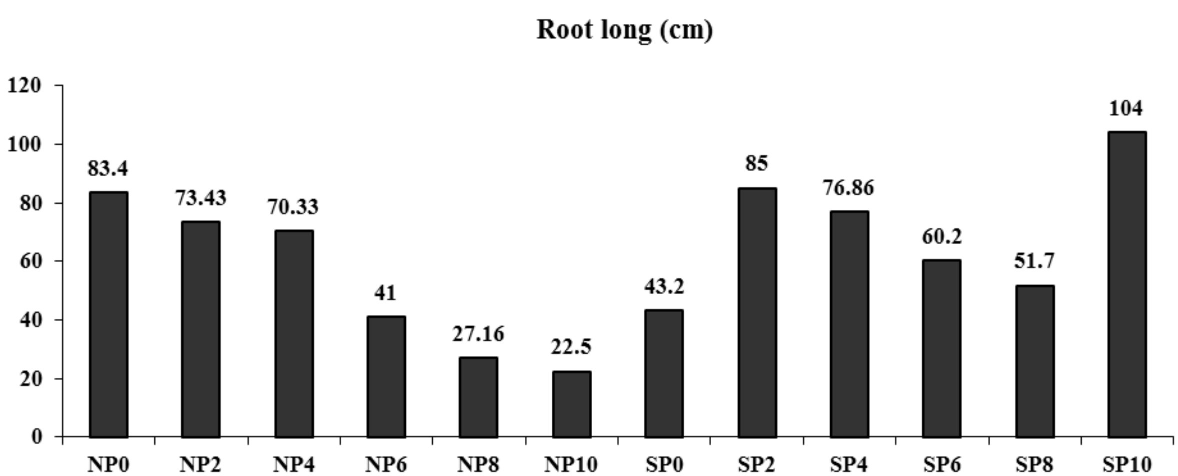

Fig6- The means of interaction between prime and stress on root length (LSD = 3.08)

ISSN 2072-3875

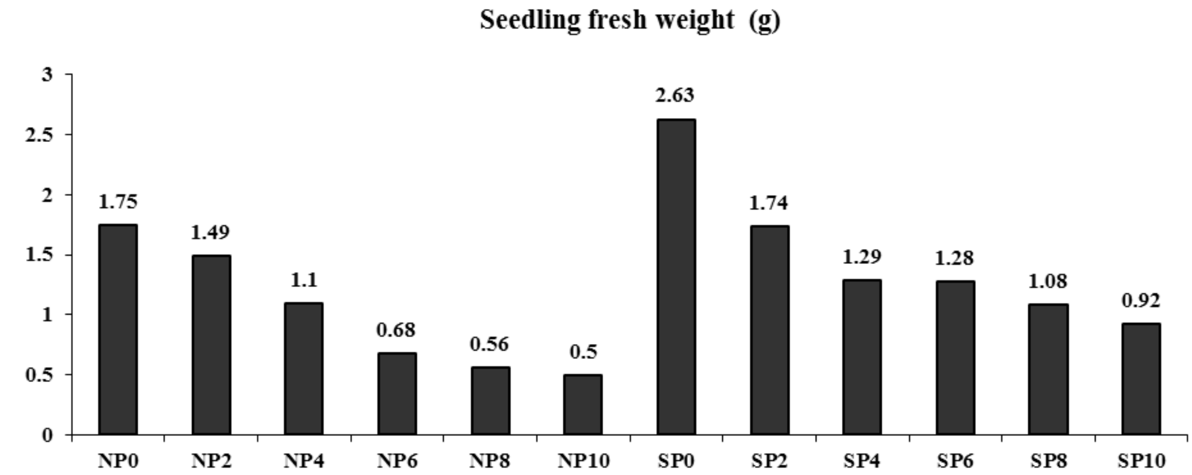

Fig7- The means of interaction between prime and stress on seedling fresh weight (LSD = 0.01)

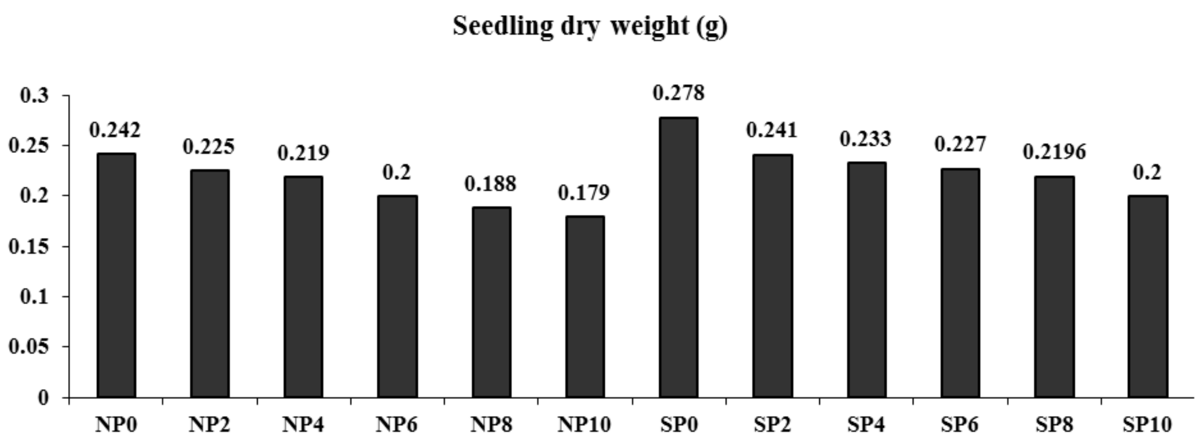

Fig8- The means of interaction between prime and stress on seedling dry weight (LSD = 0.003)

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ISSN 2072-3875

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ISSN 2072-3875