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EFFECTS OF SEED PRIMING ON GROWTH AND YIELD OF CHICKPEA UNDER SALINE SOIL

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Abstract

The present study was performed in order to assess influence of priming types and times on growth and development of Chickpea (*Cicer arietinum* L) in a saline soil. The seeds of Landrace Cultivar soaked by three treatment, NaCl (halopriming), Water (hydropriming), and Mannitol (osmopriming) for 8, 16, and 24 hours. Treated seeds had sown in agricultural research station (with salinity of 2.68 ds/m) of University of Mohaghegh Ardabili, Ardabil, Iran in 2007. Total dry matter accumulation between halo and hydro priming treatments had no differences until 80 days after sowing and the highest dry matter obtained from halo priming (increased with 37.9% and 16.7%, respectively relative to osmo and hydro priming). A similar Trend was observed for Leaf dry matter. Maximum leaf area (1489.7 cm^2) obtained from halo priming at 94 days after sowing. Results showed an increase of 63.6% and 44.7% in yield of halo priming compared to osmo priming and hydro priming, respectively.

Key Words: Priming; Plant Growth; Chickpea; Salinity.

Introduction

The general purpose of seed priming is to partially hydrate the seed to appoint where germination processes are begun but not completed. Treated seeds whit soaking in water (Hydropriming), Soaking in inorganic salt solutions (Halo priming) and different organic osmotic (Osmopriming) are usually redried before use, but they would exhibit rapid germination when re-imbibed under normal or stress conditions. Each treatment may have varying effects depending upon plant species, stage of plant development, concentration/dose of priming agent, and incubation period (Ashraf et al., 2005). Salinity in the arid and semi-arid regions of the world is a serious threat to agriculture and salinity is a worldwide problem in irrigated areas. In the Mediterranean area, the percentage of irrigated soils affected by salinity amounts to about 20%, varying from country to country between 7 and 40 % (Hamdy et al., 1995). Soil salinity adversely affects plant growth and development worldwide, about one-third of irrigated arable land is already affected and that level is still rising (Lazof and Bernstein, 1999). An excess of soluble salts in the soil leads to osmotic stress which results in specific ion toxicity and ionic imbalances (Munns, 2003), and the consequences of these can be plant demise (Rout and Shaw, 2001). Soil salinity, as a biotic hazards induces disorders in seeds and propagates of both halophytic and glycophytic plants, leading to a reduction and delay in germination (Katembe et al., 1998; Ashraf and wahid, 2000; Ismaill, 2003; Zapata et al., 2003). Chickpea (*Cicer arietinum* L.) is one of the most important grain legumes traditionally cultivated in deprived areas and saline soils (Rao et al., 2002). It is contain a high protein concentration 25.3-28.9 % (Hulse, 1991) for the human and animal diet. The number of seeds and seed yield per plant were higher in chickpea crops raised from water and mannitol (4%) primed seeds in comparison with the control non-primed crops (Kaur et al., 2005). It was also observed that osmo- and hydro priming of chickpea seeds whit monnitol and water alleviated the adverse effects of water deficit and salt stress on seeding growth (Kaur et al., 2002a, 2003).

Studies with primed chickpea seeds were conducted in the field and it was observed that priming increased plant biomass, numbers of branches, flowers, Pods and seeds per plant leading to higher seed yield (Kaur et al., 2002b). Seed priming has been reported to increase the yield of chickpea, maize, rice and wheat due to faster emergence of crop, early flowering, better drought tolerance and higher grain yield under semiarid

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conditions (Harris et al., 1999, 2001; Musa et al., 1999, 2001). Different priming conditions($CaCl_2$, KCl and NaCl) caused an increase in grain yield, fresh and dry shoot biomass of spring wheat (*Triticum aestivum* L.) and had significantly different effects on free IBA concentration and had a adverse effect on free ABA concentrations (Iqbal et al., 2006). Tejera et al (2006) show that the chickpea cultivars displayed differences in growth and N_2 fixation, such as the higher NaCl tolerance of the ILC1919 cultivar is supported by the less N_2 fixation inhibition, a higher root- to- shoot ratio, normalized nodule weight and shoot K/Na ratio; and a reduced foliar accumulation of Na^+. pessarakli and Zhou (1990) earlier reported this variability. Halo priming of broad bean (*Vicia faba*) seed resulted in significant increases in growth parameters (Sallam, 1999) and in soybean seed increased seed number and reduced number of seedless pods, but did not affect 100-seed weight (Eleiwa, 1989). Hydro priming improved salt tolerance of maize (Ashraf and Rauf, 2001) and pigeon pea seeds (jyotsna and srivastava, 1998). Some of the field experiments, displayed that the hydro priming of seed has growth-promoting effects at later developmental stages of plant due to alteration in various metabolic phenomena responsible for enhanced yield in safflower (Earthamus tinctorius) (Bastia et al., 1999), maize, rice, chickpea (Harris et al., 1999) and pearl millet(Kumar et al., 2002) grown under dry land conditions. In a greenhouse pot experiment, sallam(1999) demonstrated that plants of vicia faba raised from hydro priming seed exhibited significantly higher growth than those raised from untreated seed under saline conditions, hydro priming also eliminated the adverse effect of salinity on total and reducing sugar, lactose, maltose and proline du to some biochemical's in later plant growth stage. Enhanced invertase activities in growing parts of primed plants might result in an increased supply of hexose's to them resulting in increased source of energy and growth of the plant (kaur et al., 2005). The aim of this study was investigating the effects of priming treatments on growth and yield of chickpea plants on saline condition on filed.

Materials and Methods

Seeds of commune landrace cultivar chickpea were washed with water, dipped in 0.1% mercuric chloride for 5 min and then washed thoroughly with sterilized water. The washed seeds were divided into three lots. One was fully immersed in NaCl(-0.67 MPa) solution for halopriming another in mannitol (-0.67 MPa) for osmopriming and the thread in distilled water for hydropriming each in 8, 16, and 24 hours treatments and then kept in an incubator at 25± 1°C for 24 h. The seeds were then washed with distilled water and completely dried on filter papers at room temperature (27°C). The seeds inoculated with *(R. Leguminosarum),* and sown in six rows (35 and 20 cm inter and intra row spacing, respectively) with 4 cm row length in May under agronomic practices. the soil condition was: EC=2.68 m mhos/cm, PH= 7.09, O.C% (organic carbon)=1.17, O.M% (organic matter)= 2.01, S.P% (saturation percent) = 47.98%, $CaCo_3$ (T.N.V) = 13.75, N% (nitrogen percent = 0.056. The experiment was factorial based on completely randomized block design in three repeat. The first factor priming treatment had three levels, halo, hydro, and osmopriming and the second factor time for priming had three levels, 8, 16, and 24 hours. Five times and in each time the leaf area, leaf, and stem dry matter on five plant in each plot were determined, the leaf area measured with a leaf area meter. At harvest, the yield of seed and yield components (seed number, 1000-seed weight, seed yield, biomass per plant, and harvest index) were measured.

Dates were analyzed by using of SAS 6.12 and Microsoft Excel software's.

Results

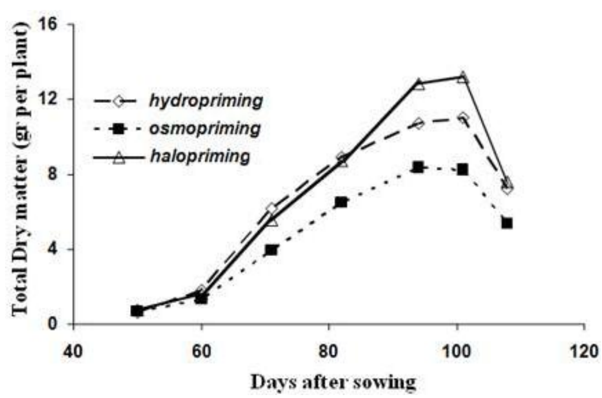
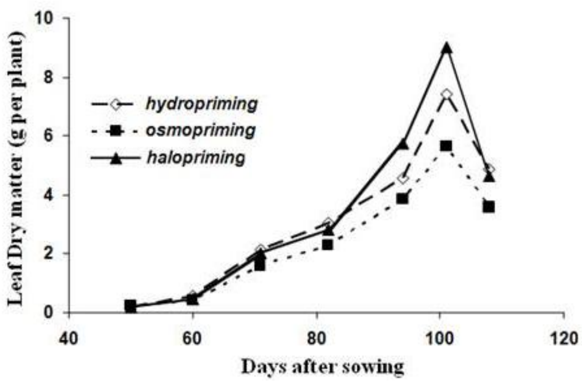


Fig. 1. Effects of seed priming dry matter chickpea

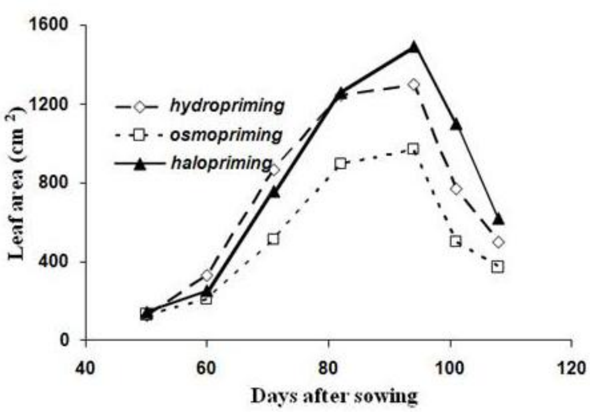
A trend of total dry matter is presented in Fig.1. There were no differences between dry matter of halo and hydropriming treatments until 80 DAS (days after sowing). The maximum levels of plant development showed between 95- 105 days after sowing and a highest dry matter production obtained from halopriming (increased with 37.9% and 16.7%, respectively against osmopriming and hydropriming).

Fig. 2. Effects of seed priming on leaf dry matter of chickpea



A trend of total dry matter is presented in Fig. 2. Leaf dry matter between halo and hydropriming treatments did not show a difference until 80 days after sowing. The maximum levels of development showed in the around 95-105 days after sowing and the highest leaf dry matter obtained from halopriming (increased with 37.8% and 17.8% respectively against osmopriming and hydropriming).

Fig. 3. Effects of priming treatments on leaf area of chickpea.



A similar Trend was observed for the Leaf area (LA) in chickpea plant (Fig. 3). No differences observed In Leaf area between halo and hydropriming treatments until 80 days after sowing. The halo priming treatment achieved maximum LA at the end of the flowering stage around 90-100 DAS. Maximum LA decreased significantly in osmopriming compared to halo and hydro priming (34.9% and 25.4% respectably). Maximum leaf area (1489.7), obtained at 94 days after sowing of halopriming.

The seed number components (Pod+ Seed per plant) showed a significant ($p < 0.01$) response to priming (Table 1). The highest seed number (54.44) belongs to halopriming had and the osmopriming had the lowest (24.94) seed number (difference between this two treatments was 54.2%). In both priming (i.e. hydro and halo priming) 1000- seed weight showed no difference but they have a significant difference with osmopriming. The average seed yield in osmopriming, hydro priming and halo priming were 3.07, 4.67 and 8.44 g per plant, respectively (Table 1). Resulted showed an increase of 63.6% and 44.7% in yield on halopriming compared with osmo and hydropriming, respectively). Plants of halopriming treatment attained maximum aboveground biomass per plant (without seed). There were slightly differences between halo and hydropriming, but biomass of plants decreased under osmopriming compared to hydro and halopriming (22.3% and 63.4%, respectively)

Table 1: Effect of priming on yield and yield compounds of chickpea in saline soils.

Priming Treatment	Seed no. (Pod + Seed /pod)	1000 Seed weight	Seed yield per plant	Biomass per plant without Seed	Harvest index
Osmopriming	24.94 ^{c}	120.00 ^{b}	3.07 ^{c}	4.28 ^{a}	0.42 ^{c}
Hydropriming	30.33 ^{b}	150.33 ^{a}	4.67 ^{b}	3.50 ^{b}	0.57 ^{b}
Halopriming	54.44 ^{a}	150.44 ^{a}	8.44 ^{a}	5.75 ^{a}	0.68 ^{a}

Fig. 4. Interactive between priming treatments and time (a) above ground biomass (without seed) gr/plant), and (b) (seed yield gr/plant).

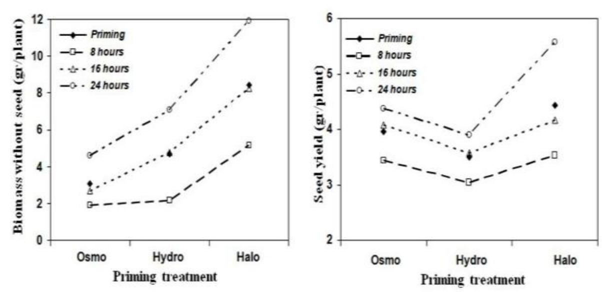


Table 2: Effect of priming times of yield and yield compounds of chickpea.

Time for Priming	Seed no. (Pod + Seed /pod)	1000 Seed weight	Seed yield per plant	Biomass per plant without Seed	Harvest index
8 Hours	28.30 ^{c}	107.22 ^{c}	6.04 ^{c}	3.33 ^{b}	0.46 ^{c}
16 Hours	35.76 ^{b}	144.22 ^{b}	7.77 ^{b}	3.93 ^{a}	0.55 ^{b}
24 Hours	45.67 ^{a}	169.33 ^{a}	9.34 ^{a}	4.28 ^{a}	0.63 ^{a}

The seed number (Pod+ Seed per plant) showed a significant ($p < 0.01$) response to priming time (Table 2). Soaking of seeds for 24 hours had the highest seed number (45.67) and the 8 hours had the lowest (28.30) one (Difference between these treatments was 38.01%). In all treatments (i.e. 8, 16 and 24 hours priming times) 1000- seed weight showed a significant difference. The average seed yields/plant in 8, 16 and 24 priming time were 6.04, 7.77 and 9.34 g respectively (Table 2). Results showed an increase of 35.3% and 16.8% in yield of 24 hours priming time compared to 8 and 16 hours, respectively). Plants at 24 hours priming time attained maximum total aboveground biomass per plant (without seed). There were slightly difference between 24 and 16 hours timing for priming treatments, but biomass of plants decreased in 8 hours compared to 16 and 24 hours treatments (22.3% and 63.4% respectively).

The Interactive between priming treatments and its time was significantly in seed yield and biomass per plant showed in Fig.4.

Discussion

The highest leaf and total dry matter accumulation obtained from halopriming, so a similar Trend was observed for the Leaf area (LA). The Maximum leaf area (1489.7cm^2 per plant) obtained at 94 days after sowing for halopriming. Increasing in grain yield, fresh and dry shoot biomass of spring wheat in different priming conditions ($Cacl_2$, KCl and NaCl) reported previously (Iqbal et al., 2006). Halopriming of broad bean (*Vicia faba*) seeds resulted significantly increases in growth parameters (Sallam, 1999). The seed number per plant showed a significant ($p< 0.01$) response to priming. The highest seed number (54.44) belongs to halopriming and the osmopriming had the lowest one (24.94).

The maximum aboveground biomass per plant (not including seed) attained by halopriming treatment. Although there were slightly differences between halo and hydropriming, but biomass of osmopriming decreased compared to hydro and halopriming (22.3% and 63.4%, respectively). The harvest index of priming treatments was 0.68, 0.57., and 0.42 for halo, hydro, and osmopriming, respectively. It seems that halopriming may cause high partition of photo assimilates to reproductive organs. The effect of seed priming on chickpea yield increase that resulted from number of seeds, 1000-seed weight and or number of pods per plant also reported earlier by kaur et al (2002b, 2005). Also it is reported that seed priming increase the yield of chickpea, maize, rice and wheat by faster emergence of seedlings, early flowering, better drought tolerance and higher grain yield under semiarid conditions (Harris et al., 1999, 2001; Musa et al., 1999, 2001).

Conclusion

Based on this results there was significantly differences between priming treatments and times. Halopriming of seeds for 24 hours increased yield of chickpea by increase of leaf area, above ground biomass, seed number per plant, 1000-seed weight and harvest index. These results can be useful for crop production in soils subjected to salinity.

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