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The Effect of Salinity on Seed Germination and Seedling Growth of *Chick Pea*

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ABSTRACT

Salinity is one of the environmental factors that has a critical influence on the germination of halophyte seeds and plant establishment. Salinity affects imbibition, germination and root elongation. However, the way in which NaCl exerts its influence on these vital processes, whether it is through an osmotic effect or a specific ion toxicity, is still not resolved. The purpose of this investigation was to determine the effect of salinity on germination and seedling growth of Chick Pea collected from different populations. Germination studies with Chick Pea indicated that each increase in salinity up to 1.5% NaCl caused a reduction in germination in both scarification and stratification + light treatments, with no seeds germinating at 2% NaCl. Stratified seeds without light did not germinate in any of the treatments. Seeds originating from parents growing at low, medium, and high salinity field sites differed in their response to salinity stress. At 2% NaCl, seeds originating from all three seed sources failed to germinate. Each increment in salinity caused a decline in seedling height, but the decrease was 61% at 1.5% NaCl for the low salt population, 77% for the medium salt population and only 38% for the high salt population.

Keywords:

Effect of Salinity, Seed Germination, Seedling Growth, Chick Pea

INTRODUCTION

Salinity is one of the major environmental stresses that can limit the growth and development of salt sensitive plant. Salinity is an important problem for crop production in many parts of the world, especially in irrigated fields of arid and semiarid regions (Schleiff, 2008). In such areas, the high level of NaCl affect the plant development by altering its functional state. The plant ability to acclimate salt stress includes alterations at leaf level, associated with morphological, physiological and biochemical characteristic whereby many plants adjust to high salinity and low soil water availability. (Cicek and Cakirlar, 2008). The success of bio-saline agricultural is dependent on the germination response of seeds of un-conventional halophytic crops (Khan, 2003). The soils where halophytes normally grow becomes more saline due to rapid evaporation of water particularly during summer, therefore, surface of the soil tent to have higher soil salinity (Khan, 2003). The germination of halophytes are inhibited by salinity for the following reasons: a) causing a complete inhibition of germination process at salinities beyond the tolerance limit of species, b) delaying the germination of seeds at salinities that cause some stress to seeds but do not prevent germination, c) causing the loss of viability of seeds due to high salinity and temperature and d) upsetting growth regulator balance in the embryo to prevent successful initiation of germination process. There is a great deal of variability in the response of halophytes to increasing salinity, moisture, light, and temperature stresses and their interaction (Khan & Ungar, 2001). Seeds of halophytes often germinate best under non-saline conditions and their germination decreases in salinity (Khan, 2003; Ungar, 1995).

Halophytic species that dominate the region have shown variable response to NaCl tolerance during germination (Khan & Gulzar, 2003). Halopyrum mucronatum failed to germinate at or above 300 mM NaCl (Khan & Ungar, 1995) while Aeluropus lagopoids (Linn.) Trin. Ex Thw., Sparobolus ioclados (Nees ex Trin.) Nees and Urochondra setulosa (Trin.) C.E. Hubbard could germinate in up to 500 mM NaCl approaching seawater salinity (khan & Gulzar, 2003). Stem succulent halophyte like A. macrostachyum could germinate in up to 800 mM NaCl (Khan & Gul, 1998).Halophytes have evolved characteristics to adjust the stress conditions in their native habitats by means of a number of different adaptive responses at the germination stage of development. The level of expression of salt tolerance by plant at germination stages cannot always be correlated with tolerance at later stages of development. Halophytes survive salt concentration equal to or greater than that of seawater and possess physiological mechanism that maintains a lower water potential than that in the soil. (Ungar, 1991). Salt tolerance is brought about by the development of succulence, transportation of salts to bladders or hair, secretion through salt glands and accumulation if a variety of organic compounds such as proline, glutamic and aspartic acid in their tissues, all of which mitigate the

salt stress in saline habitats. It is suggested that compartmentation of ions in

vacuoles and accumulation of compatible solute in their cytoplasm, as well as presence of genes for salt tolerance, confer salt resistance to halophytes (Gorham, 1995).

MATERIALS AND METHODS

To study the germination responses of the seeds of C*hick pea* to environmental factors, several laboratory treatments were performed. The treatments included wet –cold stratification, scarification with sand paper and salinity levels ranging from 0% to 2% NaCl. In stratification treatments the seeds of C*hick pea* were exposed to wet (distilled water)-cold conditions (5^0C) for 30 days and then placed in a growth chamber with 30/20^0C temperatures for 20h light/12h dark. In the wet (distilled water)-cold treatments, eight petridishes were kept in metal petridish holder and placed in a refrigerator at a temperature of 5^0C for 30 days. Subsequently, four petridishes were exposed to light during germination and other four were kept in a metal petridish holder to maintain the dark condition in a 12h-30/12h-20^0C growth chamber. In the scarification treatment, the caryopses' were rubbed with sandpaper, and the seeds were soaked in distilled water for three days and then placed at 20/30^0C in a lighted incubator to study germination responses at different salinities for this experiment, 25 seeds were placed in 5cm diameter sterile plastic petridishes containing two sheets of Whatman No. 2 filter paper. Filter paper was moistened with 5ml of solution containing 0%, 0.5%, 1.0%, 1.5%, 2.0% NaCl respectively. Four replicates were used for each salinity treatment. The number of seeds germinating daily was recorded for 20 days.

RESULTS

Seeds of chick Pea from both searification and stratification + light treatment responded similarly to salinity, treatment (table 1). Highest germination percentages were found in the distilled water controls in both the stratification + light and searification treatments. Germination decreased in the 1.5% Nacl concentration by 34.6% and 31.5% from controls for each treatment, respectively. No seeds germinated in the 2.0% Nacl treatments. Percentage seeds germination in both treatments decreased significantly ($P<0.5$) with increasing salt concentration from 0% to 1.5%. Stratified seeds incubated in darkness did not germinate in any of the treatment (Table 1).

Table: 1: The effect of salinity on germination percentages (means) of chick pea seeds after scarification and stratification + light treatments.

S.No.	Solution	Searification	Stratification + light	Stratification – light
1.	0.0% Nacl	85.1 ± 0.93	86.o ± 1.49	0
2.	0.5% Nacl	81.6 ± 1.09	75.3 ± 1.87	0
3.	1.0% Nacl	58.5 ± 1.08	55.9 ± 0.91	0
4.	1.5% Nacl	55.2 ± 0.92	54.6 ± 0.69	0
5.	2.0% Nacl	0	0	0

DISCUSSION

Horst and Taylor (1983) determined that the number of *Poa pratensis* seeds which germinated at the end of a 35-day test period was reduced by approximately one seed for every 0.1% increase in salt concentration. Francois *et al.,* (1984) found that soil salinity up to 0.5% did not significantly inhibit germination of *Sorgbum bicolor* seeds but salts level greater than 0.5% delayed germination. Francois ut al.(1986) reported that germination of *Triticum aestivum* was little affected by soil salinity up to 0.25%, but at 0.5% and above germination was significantly delayed and the final germination percentage was markedly reduced. The tolerance limits of *Chick pea* at the germination stage were higher than the glyeophyte *Triticum aestivum* and are closer to those of the moderately salt-tolerant halophyte *Hordeum jubatum* (Ungar, 1974).

Many annual weed species have a light requirement for the induction of seed germination (Harper 1977; Baskin and Baskin, 1977 and Mayer and Poljakoff-Mayer, 1975). A light requirement is of ecological significance to fugitive species and those plant species growing in rapidly changing, high-stress environments because it provides for a temporal distribution of seed germination, delayed germination until optimal conditions for seeding development occur (Ungar, 1974) Even though C*hick pea* seeds could germinate in NaCl solution with up to 1.5% NaCl, seedlings survived for only twenty days at salinities above 1% NaCl. These data indicate that at the seedling growth stage was more sensitive to the stress of the salinity than the germination stage. Similar results were reported by Francois *et al.*, (1984) for *Sorgum bicolor* and Ungar (1974) for *Hordeum jubatum*.

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