CURRENT BOTANY

Curr. Bot. 1 (1):10-12, 2010

REGULAR ARTICLE

The effect of NaCl salinity on seed germination of *Excoecaria agallocha* L.

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KEYWORDS

Tissue Culture, secondary metabolites, alliin, artimisnin, podophyllotoxin, taxol

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EDITOR

CB Volume 1, Year 2010, Pages xx-xx

ABSTRACT

The present work is based on the observation of seed germination in *Excoecaria agallocha* in different concentrations of NaCl. The seeds of Excoecaria agallocha were germinated in 0, 50, 100, 150 and 200 mM NaCl concentrations. The germinating seedlings were observed after 15th and 30th day of NaCl treatment. It was observed that the germination percentage were decreased with increasing NaCl salinity. The maximum percentage (100%) of seed germination was recorded in fresh water and the minimum percentage (36%) of germination was observed in 200 mM NaCl concentration.

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 Method

The seeds were collected from the dehisced fruits when fall on the ground from Pitchavaram mangrove area during monsoon period. The seeds were sterilized with 0.5% sodium hypochloride solution for 2 minutes and then washed several times with distilled water. Seeds of same size and weight were selected and germination was carried out in 90 x 90mm sterile petridishes lined with Whatmann No.1 filter paper. Each petriplate were allowed for 25 seeds and treated with 0, 50, 100, 150 and 200 mM NaCl concentrations. The petridishes were placed in wooden trays giving a 12 hours photoperiod with 30^0 C day temperature and 22^0 C night temperature. Germination studies were recorded on the 15th day and 30th day of treatment.

Result and Discussion

The data shows that the maximum percentage (100%) of germination was recorded in fresh water (control) and the minimum percentage (36%) of germination was observed at 200 mM NaCl (Table 1). (Misra and Dwivedi, 2004) consequently induces a reduction in germination rate and delay in the initiation of the germination and seedling establishment (Almansouri *et al.*, 2001). A wide range of different environmental condition can induces stresses, which significantly alter plant metabolism, growth development and at their extremes ultimately lead to plant death (Dat *et al.*, 2005). The data also shows that there is a depressed growth at high salinities. A stimulation of growth in response to moderate levels of NaCl salinity has been reported for several halophytes such as *Atriplex griffithii* which produce high yield in the presence of 360mM NaCl and *Atriplex halimus* tolerates upto 600mM NaCl (Gul et al., 2000). Most halophytic species are inhibited by high salt concentration, with none of show optimal growth at seawater concentration (Ungar, 1991). Increased competition caused a progressive reduction in growth of *Allendrolfea occidentalis*. Higher planting density decreases growth even at low salinity. At higher planting densities, there is no significant difference in growth among various salinity treatments. Intraspecific competition may affect biomass production, reproduction , survival and growth of halophytes in saline habitats (Keiffer and Ungar, 1997). NaCl salinity stimulated the shoot and root length upto 200 mM and at higher concentration the growth was decreased gradually (Table 2). The fresh weight and dry weight increased with increasing salinity upto 200 mM and gradually decreased at higher concentration. In relation to seedling growth, the cotyledons and the embryonic axis are suppressed by NaCl. They are smaller than in distilled water because of reduced fresh weight resulting from reduced water absorption, cell vacuolation and turgor- driven wax expansion

(Ayala and O' Leary 1995). Even at extreme salinity of 300 mM, though the dry weight is less than that of optimal concentration, it higher than that of control plants. The dry weight increase may be attributed to the accumulation of organic and inorganic constituents in plant tissues. In the dicotyledonous halophytes, Na^+ and Cl^- ions are 30 to 50% of the dry weight (Flowers *et at.*, 1986). The results of the present study reveal the obligate requirement of 200 mM NaCl for the optimal growth and maximum increase in dry weight. The accumulation of salt may have positive functions. Similar observations have been observed in certain other halophyte such as *Heliocola setulosa* (Joshi et al., 2002), *Chenopodium quinoa* (Prado *et al.*, 2000), *Kandelia candel* (Hwang and Chen, 2001), *Aegiceras corniculatum* (Manikandan and Venkatesan, 2004) and *Chenopodium quinoa* (Schabes and Elizabeth Sigstad, 2005). The effect of NaCl on the leaf number per plant on the 30th days after the salt treatment were represented in Table 2. Sodium chloride treatment had favourably affected the leaf production upto 200 mM. Leaf number was reduced at high salinity level.Finally it was concluded that NaCl stimulate the growth parameters upto the optimal concentration.

Table 1 :- Effect of NaCl on germination of *Excoecaria agallocha* on 15 th and 30 th days after salt treatment

Concentration of NaCl (mM)	Total number of Seeds	Total number of seeds germinated	% Germination	Total number of seeds	Total number of seeds germinated	% Germination
Control	25	20	80	25	25	100
50	25	15	60	25	18	72
100	25	12	48	25	16	64
150	25	10	40	25	12	48
200	25	6	24	25	9	36

Table 2. Effect of NaCl on growth parameters of Excoecaria *agallocha* on 30th day after treatment

Concentration of NaCl (mM)	Shoot length (cm plant-1)	Root length (cm plant-1)	Number of leaves	Fresh weight (g plant -1)	Dry weight (g plant -1)
Control	12.0	10.5	5	9.26	2.84
100	13.5 (+ 12.5)	12.6 (+ 20)	7	10.54 (+ 13.82)	3.9 (+37.32)
150	14.5 (+20.83)	13.2 (+ 25.71)	8	11.55 (+ 24.73)	4.26 (+ 50.00)
200	15.0 (+ 25)	15.5 (+ 47.61)	11	13.98 (+ 50.97)	5.06 (+78.16)
250	14.5 (+ 20.83)	12.5 (+ 19.04)	8	10.26 (+10.79)	3.85 (+ 35.56)
300	12.5 (+ 4.16)	11.0 (+ 4.76)	5	9.47 (+2.26)	3.56 (+ 25.35)

(+/-) Percent of increase or decrease over control are in parentheses

References

Almanseuri,M., Kinet. J.M and Lutts, S.,(2001). Effect of salt and osmotic stresses on germination in durum wheat (*Triticum durum* Dest). *Plant Soil.* 231 – 254.

Ayala, F. and J.W. O'Leary, 1995. Growth and physiology of *Salicornia begelovii* Tour. at suboptimal salinity. *Ind. J. Plant Sci.*, **156**:197 – 205.

Cicek, N and Cakirlar, H., (2008). Effects of salt stress on some physiological and photosynthetic parameters at three different temperatures in six soya bean (*Glycine max* L.Merr.) Cultivars, *J. Agron. Crop. Sci.* **194**; 34- 46.

Dat.J., Vandenabeole, S., Vranova, E., Van monta g u, n. Inze, D. and van Breusegem, F. *Cell Mol life Sci.* 2005; **57**. 779- 95.

Flowers, T. J., S.A. Flower and H.Greenway, 1986. Effects of sodium chloride on tobacco plants. *Plant Cell and Environment*, **9**: 645-651.

Gorham, J., 1995. Mechanisms of salt tolerance of halophytes. In: Halophytes and biosaline agriculture (R. Choukr Allah, C.V. Malcolm and A. Hmaby, Eds.), 207 – 223.

Gul, B., Weber and M. Ajmalkhan, 2000. Effect of salinity and planting density on physiological responses of *Allenrolfea occidentalis. Western North American Naturalist*, 188 – 197.

Hwang, Y.H. and S.C. Chen, 2001. Effects of ammonium phosphate and salinity on growth gas exchange characteristics and ionic contents of seedlings of mangrove *Kandelia candel* (L.) Druce. *Bot. Bull. Acad. Sci.*, **42**: 131 – 139.

Joshi, A.J., A. Sagar Kumar and H. Heriglajia, 2002. Effects of seawater on germination, growth, accumulation of organic components and inorganic ions in halophytic grass *Heleochaloa setulosa* (TRIN), Balatt et. McCann. *Indian J. Plant Physiol.*, **7**(1): 26- 30.

Keiffeer, C.H. and I.a. Ungar, 1997. The effect of density and salinity on shoot biomass and ion accumulation in five inland halophytic species. Can. *J. Bot.*, **75**: 76-107.

ISSN: 2220-4822

Khan, M.A. & Gul, B. 1998. High salt tolerance in the germinating dimorphic seeds of *Arthrocnemum macrostachyum*. *International Journal of Plant Science* **159**: 826-832.

Khan, M.A. & Ungar, I.A. 2001. Alleviation of salinity stress and the response to temperature in two seed morphs of *Halopyrum mucronatum* (Poaceae). *Australian Journal Botany* **49**: 777-783.

Khan, M.A. 2003. Halophyte seed germination: Success and Pitfalls. In: A.M. Hegazi, H.M El-Shaer, S. El-Demerdashe, R.A. Guirgis. A. Abdel Salam Metwally, F.A. Hasan, & H.E. Khashaba(Eds.). International symposium on optimum resource utilization in salt affected ecosystems in arid and semi arid regions. Cairo, Egypt: *Desert Research Centre*. 346-358 pp.

Khan, M.A. and I.A. Ungar. 2000. Alleviation of salinity-enforced dormancy in *Atriplex griffithii* Moq. Var. stocksii Boiss. *Seed Science & Technology*. **28**: 29-37.

Manikandan, T. and A. Venkatesan, 2004. Influence of NaCl on growth, organic constituents and certain antioxidant enzymes of *Aegeceras corniculatum* Blanco. *Geobios*, **31**: 30-33.

N. Misra, U.N. Dwivedi. Genobypic difference in salinity tolerance of green gram cultivars. *Plant Sci*. **166** (2004) 1135 – 1142.

Prado, F.E., C. Bocern, M. Gallardo and J.A Gonzalez, 2000. Effect of NaCl on germination growth and soluble sugar content in *Chenopodium quinoa* Willd, Seeds. *Bot. Acad*. **41**: 27- 34.

Schabes, F.I. and E. Elizabeth, 2005. Calometric studies of quinoa (*Chenopodium quinoa* Willd.) seed germination under saline stress conditions. *Thermochim. Acta*, **428**: 71-75.

Schleiff, V (2008). Analysis in water supply of plants under saline soil conditions and conclusions for research on Crop salt tolerance. *J. Agron crop Sci*. **194**; 1 – 8.

Ungar, I.A., 1991. Ecophysiology of vascular halophytes. CRC Press, Boca Raton, IL.

Ungar, I.A., 1995. Seed germination and seed- bank ecology in halophytes. In: Kigel, J. & Galili, G. (Eds.), Seed development and germination. New York: Marcel Dekker. 599 -628 pp.

ISSN: 2220-4822