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RESEARCH ARTICLE

EFFECT OF NaCl ON SHOOT AND ROOT LENGTH OF *Bruguiera cylindrica* HALOPHYTE

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ABSTRACT

Mangroves have evolved characteristics to adjust to the stress conditions in their native habitats to by means of a number of different adaptive responses at the germination stage of development. Salt tolerance in halophytes is brought about by a variety of structural biochemical and physiological adaptations. A variety of mechanism contributes to the salt tolerance of halophytes. It suggested that compartmentation of ions in the vacuole and accumulation of compatible solutes in the cytoplasm as well as presence of gene for salt tolerance (Gorham, 1995). Salinity is the environmental stresses that can limit the growth and development of Salt – sensitive plants. In the present investigation, the effect of different concentrations of NaCl on shoot and root length of the mangrove plant *Bruguiera cylindrica* were collected in the tidal forest mangrove belt of Pichavaram on the north east coast of Tamilnadu, India. One month old healthy seedlings of *Bruguiera cylindrica* of uniform size were collected and planted in polytene sleeves. Various concentrations of NaCl solutions were prepared and treated. The shoot and root length were maximum at 400mM than control. Upto 400mM the shoot and root length were decreased gradually (500,600 and 700 mM) NaCl concentrated salt solution treated seedlings. The increased concentrations of NaCl proportional to the decreased shoot and root length in the halophyte *Bruguiere cylindrica*.

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INTRODUCTION

Plants which grow and complete their life cycle in habitats with a high salt content are known as salt plant or halophytes. Halophytes arethe plant of saline environments was recognized in the early Sixteenth century. The effect of salinity of halophytes has been the subject of study by several researchers. Saline and sodic soils cover about 10% of the total arable lands and exist in over 100 countries. The coastal salt marshes of tropical region are usually characterised by woody plants of saline or brackish water and which are called mangroves. The mangroves occupy the salt lands between high and low tidal levels forming a labyrinthine interface between the land, the river and the sea (Seshan, 1987). Salinity tolerance of halophytes at germination various among species (Liu *et al*., 2000). *Bruguiera cylindrica* is a mangrove occurs along the coastal Indian Ocean islands. Leaves are decussately opposite, simple and entire. Saline soil is characterized by the presence of toxic levels of sodium and its chlorides and sulphates. Halophytes as a group has one or more of several physiological adaptations that allow for the survival in the saline environment. Halophytes will not only offer great potential as novel crops but also important models for understanding salt tolerance in plants. Mangroves form unique communities in tropical coastal region and tidal low lands. They are considered as an ecologically essential component in protecting adjuscent l and from wave and storm erosion while preventing terrigenous nutrient from affecting nearby reefs (Dubinsky, 1996). Growth and development of mangroves occurring in saline habitats may be determined by combination of edaphic and biotic interference (Shonway and Bertness, 1992). When the growth of crop species is inhibited by salinity, the growth and development of halophytes are either unaffected or stimulated (Pollak, 1967). In the present investigation, *Bruguiera cylindrica* was found to survive NaCl concentrations upto 700mM and the shoot and root length were determined.

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MATERIALS AND METHODS

For the present investigation the seedlings of *Bruguiera cylindrica* was used. *Bruguiera cylindrica* is a halophyte plant

belonging to the family Rhizophoraceae. This was growing in the tidal forest of Pichavaram on the North East coasts of Tamilnadu, India. In India there are 7,00,000 ha of area covered by mangroves along the esturies and major deltas. Indian mangroves composed of more than 60 species belonging to 41 genera and 29 different families. Pichavaram mangrove forest is located at about 225 km south of Chennai and 5 km north east of Chidambaram, Cuddalore District, about 10 km away from Annamalai University 9°11' N and 79° 44' E). Mangrove is present in the higher land of Vellar – Coleroon esturien complex. The mangrove extends to an area of 1,100 hc, representing a heterogenous mixture of mangrove elements. The mangrove comprises of about 51 small and large islands. Two major rivers viz. Vellare and Coleroon drain into the Bay of Bengal in this area. The area between the two rivers has brackish water with mangrove vegetation. The seedlings of one month old *Bruguiera cylindrica* of uniform size were collected from mangrove soil without damaging. Polyteen sleeves were filled with homogenous mixture of garden soil comprising of red earth, sand and farm – yard manure in the ratio of 1:2:1.Collected healthy seedlings were planted in polytene sleeves. The plants had an approximate 12 h photoperiod. seedlings were kept in 8 plots, each consisting of 40 plants for salt treatments. Various millimolar concentrations of Sodium Chloride solution were prepared using distilled water. The treatment constituent of millimolars 100,200,300, 400,500,600 and 700 mM. The control plants were maintained without addition of NaCl, using distilled water as control. Samples were collected periodically at bimonthly intervals for different analysis. Samples were collected periodically at one month intervals upto four months after salt treatment and they were utilized for the study of shoot and root length analysis. The shoot length and root length were measured before and after the treatment of sodium chloride. Five plants were collected from each concentration and used for studying the morphological parameters.

RESULTS

The results obtained from the experiment were recorded from after 30^{th} day, 60^{th} day, 90^{th} day and 120^{th} days various concentrations of NaCl treatment to the seedlings. The results were tabulated for calculations. The values of shoot and root length were higher in 100mM concentration than control. In the 30^{th} day shoot length (±0.560), 60^{th} day (±0.790), 90^{th} day (±0.975) and 120^{th} day (±1.175) were observed after treatment. This values increased to 200mM and 300mM concentrated treatment. In the treatment of 400mM concentration the shoot and root length were higher in 30^{th} day (±0.675), 60^{th} day (±1.015), 90^{th} day (±1.280) and 120^{th} day (±1.425) recorded. This values were become decreased in 500mM and 600mM concentrations of treated seedlings. In 700 mM very low values of shoot length in 30^{th} day (±0.545), 60^{th} day (±0.720), 90^{th} day (±1.075) and very lower shoot length (±1.130) were observed in 120^{th} day afer treatment. Similarly, root length of seedlings were higher in 30^{th} day (±0.245), 60^{th} day (±0.360), 90^{th} day (±0.440) and 120^{th} day (±0.475) were recorded. This values were increased in other concentrations 200mM and 300mM NaCl solutions. Very high values were obtained in 30^{th} day (±0.325), 60^{th} day (±0.590) in the concentration 400mM NaCl solution treatment. This increased values were gradually decreased in 500mM and 600mM concentration treated seedlings. This decreased values shows very low root lengths in 700mM on 30^{th} day (±0.250), 60^{th} day (± 0.350), 90^{th} day (±0.490) and 120^{th} day (±0.500) were recorded.

DISCUSSION

Mangroves survive high concentration of electrolytes in their environment. A productive approaches to the salinity tolerance of plants to study the mechanism by which naturally occurring mangroves flora survive. Such knowledge seems fundamental to any attempt to develop further crops combining both aquatic tolerance and yield characteristics. Most naturally occurring salinity problems are caused by excessive level of sodium salt especially NaCl. The objective of the present study was to understand the effect of different concentration of NaCl on shoot and root length activities of *Bruguiera cylindrica* under controlled experimental conditions. In the present investigation *Bruguiera cylindrica* was found to survive NaCl concentrations upto 700mM. However, from the results the favourable effect for maximum shoot and root length were

Table 1. Effect of NaCl on Shoot a and Root length (Cm plant-^{l}) of *Bruguiera cylindrica* at 30,60,90 and 120 days of Treatment

NaCl(mm)	Shoot length (days after treatment)				Shoot length (days after treatment)			
	30	60	90	120	30	60	90	120
0(control)	10.5	13.6	18.6	21.3	4.3	6.8	8.2	8.3
	±0.525	±0.680	±0.930	±1.065	±0.215	±0.340	±0.410	±0.415
100	11.2	15.8	19.5	23.5	4.9	7.2	8.8	9.5
	±0.560	±0.790	±0.975	±1.175	±0.245	±0.360	±0.440	±0.475
	(6.66)	(16.17)	(4.83)	(10.32)	(19.95)	(5.88)	(7.31)	(14.45)
200	12.6	17.3	21.7	24.7	5.4	7.9	9.5	10.0
	±0.630	±0.865	±1.085	±1.235	±0.270	±0.395	±0.475	±0.500
	(20.00)	(27.20)	(16.66)	(15.96)	(25.58)	(16.17)	(15.85)	(20.48)
300	12.9	18.6	22.8	26.8	5.8	8.5	10.2	10.5
	±0.645	±0.930	±1.140	±1.370	±0.290	±0.425	±0.510	±0.525
	(22.85)	(36.76)	(22.58)	(25.82)	(34.88)	(25.00)	(24.39)	(26.50)
400	13.5	20.3	25.6	28.5	6.5	9.5	11.5	11.8
	±0.675	±1.015	±1.280	±1.425	±0.325	±0.475	±0.575	±0.590
	(28.57)	(49.26)	(37.63)	(32.86)	(51.16)	(39.70)	(40.24)	(42.16)
500	12.8	18.5	23.2	26.5	5.9	8.6	10.9	11.2
	±0.640	±0.925	±1.160	±1.325	±0.295	±0.430	±0.545	±0.560
	(21.90)	(36.02)	(24.73)	(24.41)	(37.20)	(26.47)	(32.92)	(34.93)
600	11.6	16.3	22.6	24.3	4.5	8.0	10.0	10.5
	±0.580	±0.815	±1.130	±1.215	±0.275	±0.400	±0.505	±0.525
	(21.90)	(19.85)	(21.50)	(14.08)	(27.90)	(17.64)	(23.17)	(26.50)
700	10.9	14.5	21.5	22.6	5.0	7.0	9.8	10.0
	±0.55	±0.720	±1.075	±1.130	±0.250	±0.350	±0.490	±0.500
	(3.80)	(6.61)	(15.59)	(6.10)	(16.27)	(2.94)	(19.51)	(20.48)

noticed at 400mM NaCl treated solution. At this optimal NaCl concentrations, the percentage increase in the plant height was greater during the first 60 days after salt treatment when compared to those of later 60 days. This could be due to greater accumulation of salt in these tissues over prolonged period of salt treatment. The data also showed support that there was depressed growth at high salinities. A stimulation of shoot and root 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 360 mM NaCl and *Atriplex halimus* tolerates 480mM NaCl (Gale *et al*., 1970). Sodium Chloride increased the shoot and root length of plant upto the optimal concentration of 400mM NaCl solution. At higher NaCl concentration, the shoot and root length of seedlings were reduced. In relation to seedlings growth, the cotyledons and the embryonic axis were suppressed by NaCl. The results of the present study revealed that obligate requirement of 400mM NaCl for the optimal growth and maximum increase in shoot and root length. The shoot and root length were increased in 100,200 and 300mM treated seedlings. Very high shoot and root length were increased in 400mM concentration treated seedlings. This increased shoot and root length were gradually decreased upto 500mM and 600mM concentrations. Very low shoot and root growth were noticed in 700mM treatment. High concentrations of NaCl solution decreases the growth of *Bruguiera cylindrica* seedlings. The saline soils have the problems of high soluble salt creating a condition of physiological drought, which limit plant growth by inhibiting nutritients and water uptake by plants (Jhu *et al*., 1977). Most of the halophytes of the families Chenopodiaceae have the highest member of halophytic genera and show growth stimulation of moderate to higher level salinity their exist species to species difference in their capacity to tolerate salinity (Glenn *et al*., 1996). *Salicornia begelovii* is a succulent marine halophyte grows optimally in a broad range of Na^+ concentrations between 100,400mM NaCl (Ayala and O'Leary, 1995). The growth of several halophytes stimulated at some levels of salinity (Khan and Aziz, 1998). The chlorophyll content was sharply decreased at higher NaCl concentration in *Ceriops tagal* and *Rhizophora apiculata* (Das *et al*., 1995).

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