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SEEDLING GERMINATION CHANGES BY SODIUM CHLORIDE ON CERIOPS ROXBURGHIANA, ARNOTT. HALOPHYTE

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ABSTRACT

The term "mangrove" is being applied to the specific ecosystem of the intertidal world in the tropics and subtropics and the plant community of this ecosystem is termed as "mangrove vegetation". Halophytes as a group have one or more of several physiological adaptations that allow for the survival in the saline environment. A halophyte is a plant which is capable of surviving in a highly salty environment. In the present research an attempt has been made to study the effect of Sodium Chloride on seedling germination constituents of *Ceriops roxburghiana*. Seedlings were collected from mangrove forest in pichavaram, Tamilnadu, India. Polytene bags sizes with 12×18 cm were filled with sand, humus and red sand in 1:2:1 ratio. Various concentration of Sodium Chloride solution (0,100,200,300,400,500,600 and 700mM) were prepared by using distilled water. Plantation were separated into 8 groups, each group containing 50 number of plants. Each group of plants treated uniformly by different concentration of Sodium Chloride solution. In addition to this, plants were irrigated with distilled water and maintained as control (0). The effects of Sodium Chloride on seedling germination of the halophyte Ceriops roxburghiana were studied. Germination activity was maintained up to 300 mM NaCl. The NaCl inhibited germination only at concentrations higher than 300 mM.The results indicated that the NaCl salinity stimulated the seedling germination upto the optimal level of salinity (i.e., 100mM and 300mM) and decreased significantly with increased salinity (400 to 700mM). The inhibition of seed germination was proportional to the concentrations of NaCl increased.

Keywords: Ceriops, Concentrations, Germination, Increase, Treatment.

INTRODUCTION

Mangrove plants live in hostile environmental conditions such as high salinity, hypoxic (oxygen deficient) waterlogged soil strata, tidal pressures, strong winds and sea waves. The plants that can be naturally established in saline soils called halophytes (Tabaee Oghdaee, R, 1999). Mangroves are found extensively in the estuarine regions where mud-flats are wide and gently sloping. Besides estuaries, they also inhabit the intertidal regions of shallow bays and creeks where the environment is conducive for the growth of mangroves. Growing in the intertidal areas and estuary mouths between land and sea, mangroves provide critical habitat for a diverse marine and terrestrial flora and fauna. Healthy mangrove forests are key to healthy marine ecology. Salt stress in soil or water is one of the major stresses especially in arid and semi-arid regions and can severely limit plant growth and productivity. The floral diversity of mangroves in India is great. The Indian mangroves are represented by approximately 59 species (inclusive of some mangrove associates) from 29

families. Of the 59 species, 34 species belonging to 21 families are present along the west coast. Soil salinity limits the plant growth and crop yield in many parts of the world, particularly in the arid and semi arid areas. Halophytes will not only offer great potential as novel crops but also important models for understanding salt tolerance in plants. A wide range of environmental stresses (such as high and low temperature, drought, alkalinity, salinity, are potentially harmful to the plants.

Halophytes actually have increased germination at low salt concentrations (compared to no salt), with decreased germination at much higher concentrations. Plant germination, growth and productivity is severely affected by high salinity. Internal osmotic and water potential generally become increasingly negative with increases in salinity (Khan *et al*., 1998).Salinity stress affects plant growth, as well as development processes such as seed germination and seedling growth (Sairam and Tyagi 2004).Halophytes are plants of salty environments, capable of thriving and growing under high concentrations of NaCl (Hellebust 1976; Flowers *et al*. 1986). Salinity tolerance of halophytes at germination varies among species (Yokoishi & Tanimoto, 1994; Liu *et al*. 2006). Salinity stress is a major limiting factor for plants germination and growth in coastal habitats as it is one of the most critical periods in life cycle of halophytes (Gilles et al., 2001; Rubio Casal et al., 2003). *Ceriops roxburghiana, Arn*. These species are typical woody mangrove shrubs with opposite leaves belonging to the family Rhizophoraceae. *Ceriops roxburghiana* the adaxial side, extensive formation of ribbons and occasional (Fujiwara., 2002). In the present investigation an attempt has been made to study the effect of Sodium Chloride on germination constituents of *Ceriops roxburghiana* belongs under Rhizophoraceae family.

MATERIALS AND METHODS

Plant Material: For the present investigation *Ceriops roxburghiana* has been collected from the mangrove forest in Pichavaram in Tamilnadu. Pichavaram mangrove forest is located in the southeast coast of India, at about 225 km south of Chennai and 5 km north east of Chidambaram, Cuddalore district, Tamilnadu. Mangrove is present in the higher land of Vellar - Coleroon estuarine complex, extends to an area of 1,100 hectares, representing a heterogeneous mixture of mangrove elements. The area between the two rivers has brackishwater with mangrove vegetation. During 90s, M.S. Swaminathan Research Foundation (MSSRF), Chennai, India established a mangrove Genetic Resource Conservation Centre here by adopting 50 ha forest area. *Ceriops roxburghiana* leaf blade is elliptic, oblong without prominent veins. The apex is rounded. The adaxial side is dark green and glabrous while the abaxial side is yellow and non glabrous, margin is smooth. Seedlings were collected from mangrove forest in pichavaram. The polythene bags size with 12×18 cm filled with homogenous mixture of garden soil containing red earth, sand and farmyard manure (1:2:1). Seedlings with uniform size were selected during September month and each seedling planted in 400 polythene bags separately. Plantations were separated into 8 groups and each group containing 50 number of plants. Various concentration of Sodium Chloride solution (0,100,200,300,400,500,600,700mM) were prepared by using distilled water and it used for the present study. Each group of plants treated uniformly by different concentration of Sodium Chloride solution. In addition to this, plants were irrigated with distilled water and maintained as control (0).All the experiments were conducted in the PG and Research, Department of Plant Biology and Biotehnology, Arignar Anna Government Arts College, Villupuram, Tamilnadu.

Study of Germination: Germination was studied by the initial appearance of the radicle by visual observation in regular interval in every day. The effects of Sodium Chloride on germination percentage of the halophyte Ceriops roxburghiana were recorded regularly. The germination percentage of seedlings was calculated by using the following formula,

$$\text{Germination percentage} = \frac{\text{Percentage of seeds germinated}}{\text{Total number of seeds sown}}$$

RESULTS AND DISCUSSION

The results on the various concentrations of NaCl solution treatment on seedling germination of *Ceriops roxburghiana* presented in Table-1.From these observations both positive and negative effects are obtained on these *Ceriops roxburghiana* halophytic plant. The positive effects shows in low concentrations and negative effects on higher concentrations of NaCl solution. Some of the earlier reports describe largely it imposes a water deficit because of osmotic effects on a wide variety of metabolic activities (Green way and Munns, 1980; Cheesman et al.,1997). Salt induces osmotic stress by limiting absorption of water from soil, and ionic stress resulting from high concentrations of potentially toxic salt ions within plant cells. The germination of seedlings of *Ceriops roxburghiana* slowly increasing from 100mM upto 300mM concentrations of NaCl solution. From the results seedling germination of *C. roxburghiana* was maintained up to 300 mM NaCl. The 300mM concentration treatment germination was increased in 30 days (±2.26) ,but slightly low in control (± 1.59). According to Manimegalai et.al.,(2012) seedling Growth activity of *Bruguiera gyhmnorrhiza* was maintained up to 400 mM NaCl. NaCl had increased the number of seedling growth with increasing concentrations up to 300mM. NaCl inhibited seedling growth such as root, shoot and leaf area of seedlings only at concentrations higher than 400 mM. The decreasing germination (± 1.03) was observed in700mM of NaCl solution. Some of the researches strongly support these observations. Most of the plants cannot tolerate high salt concentrations of the soil and cannot be grown on a salt affected land (Glenn and Brown, 1999). Kelly *et al*.(1982), Daoud *et al*.(2001) and Harrouni *et al.* (2001) who reported that low NaCl concentrations stimulate growth of some halophytic species, but an excess of salt decreases growth and biomass production. Similarly, gradually increasing the germination perentage in 60^{th} and 90^{th} day NaCl treatment. Under 300mM increased (± 3.69) and low value (± 3.05) in 100mM than control (± 2.68) in 120^{th} day treatment. The rate of germination values recorded in 700mM(± 1.97) . The growth of *Sesuvium portulacastrum* showed positive effect to NaCl concentrations upto 600 mM and the upper limit for survival of this species was 900 mM (Ashraf, M., 1999.). Maas.,et al (1987) reported that in most halophytic species growth decreases gradually with the increase of salt rate in the culture medium above a critical threshold specific to each species.

At higher concentrations, a gradual reduction in germination was noticed. NaCl inhibited germination only at concentrations higher than 300 mM. Gulzar and Khan reported that seeds of *A. lagopoides* showed 30% germination at 500mM NaCl under optimal temperature conditions. This indicates that this species is highly salt tolerant during germination. Halophytes actually have increased growth at low salt concentrations , with decreased growth at much higher concentrations The germination percentage was maximum in sixtieth day when the seedlings of *C. roxburghiana* was treated with

300mM NaCl solution and the percentage of germination gradually decreased as the concentration of the NaCl solution increased. A very low percentage of germination of seedling was observed in 700mM concentration of NaCl treatment. Some *Atriplex* species such as *A. nummularia, A. griffithii, and A. hortensis* are reported to grown at higher salinities, ranging to 100 to 200 mM NaCl (Ramos et al. 2004, Khan et al. 2000, Wilson et al. 2000). Among the different concentrations of NaCl treatment, the 300mM NaCl alone showed a promontory effect while the other concentrations exhibited inhibitory effect on the germination of *C. roxburghiana* seedlings. The intensity of inhibition was proportional to the concentration of the NaCl concentration increased.

CONCLUSION

There are more than 1500 known halophytic plant species throughout the world. They constitute the basis for the selection of plant material that combines economic utility with the ability to grow, produce and reproduce under high salinity (Aronson, 1989). A halophyte is a plant that grows in waters of high salinity, coming into contact with saline water through its roots or by salt spray, such as in saline, mangrove swamps, marshes and seashores. Present investigation shows the inhibition of seedling germination in *Ceriops roxburghiana* was casued by the NaCl solution .When increasing the concentration from 100 upto 300mM the seedling germination was influenced. When increasing the other concentrations 400,500,600,700mM inhibited and delayed seedling germination of *Ceriops roxburghiana* over control intensity of inhibition. Saline soil is characterized by the presence of toxic levels of sodium and its chlorides and sulphates. Increasing the concentration of NaCl with increasing the rate of germination of seedlings, while decreasing the concentrations of NaCl with decreasing the rate of seedling germination of *Ceriops roxburghiana.* Maximum germination rate shows in 300mM and very low germination obtained in 700mM of NaCl. The intensity of inhibition of germination was proportional to increasing the concentrations of NaCl solution employed.

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Figure: Effect of sodium chloride on seedling germination of the halophyte *Ceriops Roxburghiana, Arnott.*

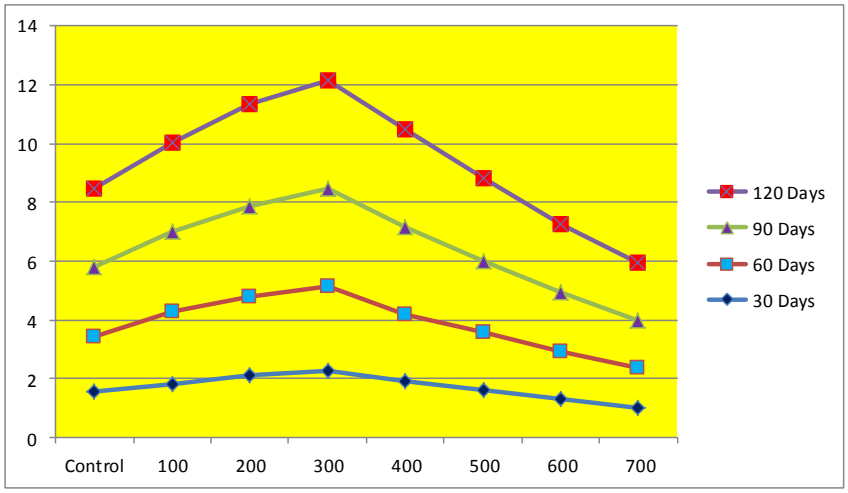

Table: Effect of various concentrations of NaCl solution on Seedling Germination percentage of halophyte *Ceriops roxburghiana* (The values are mean ± SE).

Concentrations of NaCl	Days after Treatment			
	30 Days	60 Days	90 Days	120 Days
Control	31.9 (±1.59)	36.8 (±1.84)	47.0 (±2.35)	53.8 (±2.69)
100mM	36.5 (±1.82)	49.0 (± 2.45)	54.5 (± 2.72)	61.0 (±3.05)
200mM	42.0 (±2.1)	54.2 (±2.71)	61.7 (± 3.08)	69.4 (±3.47)
300mM	45.3 (±2.26)	57.9 (±2.89)	66.1 (±3.30)	73.9 (±3.69)
400mM	38.2 (±1.91)	46.1 (±2.30)	58.8 (±2.94)	67.3 (±3.36)
500mM	32.3 (±1.61)	39.5 (±1.95)	49.3 (±2.46)	56.2 (±2.81)
600mM	26.7 (±1.33)	31.8 (± 1.59)	40.6 (±2.03)	45.8 (±2.29)
700mM	20.6 (±1.03)	27.2 (± 1.36)	32.2 (± 1.61)	39.5 (±1.97)