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Salt Tolerances of Some Mainland Tree Species Select as Through Nursery Screening

Md. Abdul Quddus Miah
Bangladesh Forest Research Institute, Plantation Trial Unit Division,
Rupatali, Barisal, 8200, Bangladesh

Abstract: A study of salt tolerance was carried out on germination, survival and height growth performance of important mesophytic species such as *Acacia auriculiformis*, *Acacia hybrid*, *Artocarpus heterophyllus*, *Albizia procera*, *Albizia lebbeck*, *Acacia nilotica*, *Achras sapota*, *Casuarina equisetifolaia*, *Emblica officinalis*, *Leucaena leucocephala*, *Samania saman*, *Swetenia macrophylla*, *Terminalia arjuna*, *Tamarindus indica*, *Terminalia bellirica* and *Thespesia populnea* in nursery stage using fresh water and salt (NaCl) solutions of 10, 15 and 20 ppm. Effect of salt on germination, survival performance and height growth performance were examined in this condition. Based on the observation, salt tolerance of these species has been determined *Acacia auriculiformis*, *Acacia hybrid*, *Achras sapota*, *Casuarina equisetifolia*, *Leucaena leucocephala* and *Tamarindus indica* has showed the best capacity to perform in different salinity conditions. *Acacia nilotica*, *Emblica officinalis*, *Thespesia populnea* has performed better. *Albizia procera*, *Samania saman* and *Terminalia bellirica*, germination and height performance showed good but when salinity increases survivability were decreases.

Key words: Salt tolerance, mesophytic species, growth performance, coastal belt

INTRODUCTION

The salinity generates adverse effect on livelihood and agricultural activities in the subtropical countries like Bangladesh, India, Thailand, Philippines and Indonesia (Khan *et al*., 1996). The salinity intrusion in coastal areas of Bangladesh has increased over the last decades (SRDI, 2003). In Bangladesh the coastal zone covers 32% of the country of which 8,142 sqkm (5.5% of the country) is salt affected with an increase of 146 sq km per year (SRDI, 2001). The level of salinity varies widely with location and season, depending on availability of fresh water, intensity of tidal flooding and nature of movement of saline ground water According to salinity survey, about 1.02 million hectares areas of Bangladesh (i.e., 70% of total cultivated land in the southern coastal areas) is affected by various degrees of salinity (SRDI, 2003). Soil salinity is a worldwide problem. Bangladesh is now facing serious problem to produce crops due to increases salinity in the coastal areas.

The effect of salinity on the bio-environment is severe and there is a significant reduction in vegetation in the salt affected areas (Dutta, 2001). This is only 0.02 hectare per person forested land in Bangladesh (BBS, 2002) and poor supply of forest product against national demands (Iftekhar, 2001). These two problems of inadequate tree coverage and salinity intrusion have attracted the attention of the Bangladesh Forest Department and it is trying to introduce agroforestry practice in the salt affected areas with salt tolerant multipurpose species (Canonizado, 1999; Islam, 2000a, b). The coastal areas ground water is saline and present at a shallow depth. Keeping lands leads to high salinity in soils due to evaporation of excessive soil moisture. Haque (2006) recommended that avoid fallowing of lands and introduce salt tolerant crops and trees which will kept lower the salinity.

The coastal area of Bangladesh is subjected to regular cyclone hits and tidal surges. It is well established that trees can minimize the loss of human life and property from coastal stormed and tidal surges. At certain minimal levels of inundation mangroves can not grow and non-mangroves species occupy this type land and vacant lands that are further raised by sedimentation and only inundated as spring tides during the monsoon can be brought under plantation with non-mangrove species like *Acacia nilotica*, *Casuarina equisetifolia*, *Pithecellobium dulce*, *Samania saman*, *Albizia lebbeck* and *Albizia procera* (Siddiqi, 2001). The mesophytic species planted on the raised foreshore and embankments are *Acacia nilotica*, *Acacia auriculiformis*, *Casuarina equisetifolia*, *Pithecellobium dulce*, *Samania saman*, *Albizia procera, Albizia lebbeck*, *Terminalia aurjuna*, *Tamarindus indica*, *Thespesia populnea* etc. (Majumder, 2001). The mesophytic species namely Rain tree (*Samania saman)*, Jhau (*Casuarina equisetifoli*), Sada koroi (*Albizia procer*), Kala koroi (*Albizia lebbeck*), Sissoo

(*Dalbergia sissoo*), Pyara (*Pithecellobium dulce*), Karanja (*Pongamia pinnata*), Babla (*Acacia nilotica*), Mehogony (*Swietenia macrophylla*) and Jarul (*Lagerstromia speciosa*) were considered in the elimination trial in two location. These species generally grows in the low lying areas of the coastal village (Serajuddoula *et al*., 2001).

The Sundarban raised land, coastal raised land vacant coastal land, raised keora forest, raised char land, coastal homesteads and coastal embankment trial with salt tolerant mesophytic species have been carried out to find suitable species for raising plantation. Against this backdrop the study was undertaken to determine the effect of salt (NaCl) on the germination, survivability and growth performance in nursery stage of 16 major species with the intention of facilitating the on-going initiative of finding suitable species for plantation in the salt affected areas.

MATERIALS AND METHODS

The species *Acacia auriculiformis*, *Acacia hybrid*, *Artocarpus heterophyllus*, *Albizia procera*, *Albizia lebbeck*, *Acacia nilotica*, *Achras sapota*, *Casuarina equisetifolia*, *Emblica officinalis*, *Leucaena leucocephala*, *Samania saman*, *Swetenia macrophylla*, *Terminalia arjuna*, *Tamarindus indica*, *Terminalia bellirica* and *Thespesia populnea* these 16 species have been chosen for study due to their multipurpose value, wide use in plantation, homestead plantation and proven salt tolerance at different growth stages in various environment. The determine salt tolerance of these species the effect of different concentration of salt on germination, survivability and height performance have been tested in nursery stages up to 9 month. In presence of salt during the germination period make the seeds susceptible to altered germination capacity and if they can tolerate salinity at the germination stage it is possible that will be able to survive later on (Arya *et al*., 1997).

The study was conducted at Plantation Trial Unit Division Head Quarter nursery of Barisal district of Bangladesh. The experiment was conducted during the period of 2006-2007. A total 16 mesophytic species were tried. Sixteen nursery beds were prepared with brick soling and brick wall. Each bed was divided in four plots. A total 480 number seedlings were tried each species and 2 number seeds were sown in each 4´´x 6´´ poly bag. Before seed sowing Poly bags were filling with 3:1 ratio loamy soil and cow dung. Accept *Casuarina equisetifolia* species were raised in tray. The dosages of salinity with NaCl solution in water like 10, 15 and 20 ppm and control dose only water and checked using a salinity refract meter. In the time of seed sowing artificial salinization were apply and continue to after 10 days and rest of days continuous watering with fresh water. Data were collected from experimental plots after 5 days only germination time and after one month for survival and height performance were recorded up to nine month.

RESULTS

The germination percentage of *Acacia hybrid*, *Artocarpus heterophyllus*, *Albizia procera*, *Achras sapota*, *Emblica officinalis*, *Leucaena leucocephala*, *Tamarindas indica*, *Terminalia bellirica* and, observed no variation control to 10, 15 and 20 ppm concentrations. Other hand *Acacia auriculiformes, Albizia lebbeck*, *Acacia nilotica*, *Samania saman*, *Sweitenia macrophylla*, *Terminalia aurjuna* and *Thespesia populnea* germination were showed difference in control to treatments. *Albizia lebbeck*, *Acacia nilotica, Sweitenia macrophylla* and *Thespesia populnea* germination were reduced when increasing salinity. Among the 16 species 8 species germination performance were showed in insignificant at 5% level and 7 species are significantly difference from control to treatments (Table 1). The survival performance of these 16 species observed that *Artocarpus heterophyllas* species were reduced when increasing salinity level. The results showed 82.68, 74.04, 22.22% and nil in control, 10, 15 and 20 ppm, respectively. The result showed that this species can not survive up to 15 ppm salinity condition.

Among the 16 species *Acacia auriculiformes*, *Acacia hybrid*, *Acacia nilotica*, *Achras sapota*, *Casuarina equisetifolia*, *Emblica officinalis*, *Leucaena leucocephala*, *Terminalia aurjuna*, *Tamarindus indica* and *Thespesia populne* were shown no significantly differences from control to 10, 15 and 20ppm salinity level. The survival performance was showed significantly differences from control to treatments in *Albizia lebbeck*, *Albizia procera*, *Samania saman*, *Swietenia macrophylla* and *Terminalia bellirica*. The survival performance in these 6 species shown after nine month were 76.66, 59.39, 54.84, 67.22; 100, 100, 80.55, 72.22; 97.91, 92.52, 70.55, 70.70; 79.83, 75.63, 62.91, 64.32 and 93.01, 87.90, 73.91, 67.36 control, 10,15 and 20 ppm, respectively (Table 2).

The height performance was reduced when increasing salinity in *Emblica officinalis*, *Terminalia aurjuna* and *Thespesia populnea* but the species of *Acacia auriculiformes*, *Sweitenia macrophylla* and *Tamarindus indica* were significantly increased in height from control to treatments 10, 15 and 20 ppm

Table 1: Effect of different degrees of salinity on seedlings germination (%) of various species

	Concentration (PPM)				
Name of species	Control	10 ppm	15 ppm	20 ppm	LSD at 5%
Acacia auriculiformis	49.30	45.30	50.70	61.30	7.32
Acacia hybrid	16.50	16.41	14.73	15.81	-
Artocarpus heterophyllus	18.70	26.70	28.00	24.00	-
Albizia lebbeck	78.70	53.30	58.70	64.00	8.43
Albizia procera	17.30	12.00	16.00	14.70	-
Acacia nilotica	65.75	60.50	55.00	18.00	7.55
Achras sapota	45.44	43.19	46.28	44.11	-
Casuarina equisetifolia	-	-	-	-	In tray
Emblica officinalis	25.00	25.00	24.00	20.83	-
Leucaena leucocephala	20.30	24.00	21.30	26.70	-
Samauia saman	65.30	81.30	82.70	78.70	4.73
Swetenia macrophylla	61.30	58.70	54.70	50.70	7.57
Terminalia arjuna	68.48	50.00	55.00	20.00	14.44
Tamarindus indica	70.10	72.00	68.00	67.85	-
Terminalia bellirica	75.00	74.00	74.00	77.00	-
Thespesia populnea	69.30	64.00	48.00	50.70	10.13

Table 2: Effect of different degrees of salinity on seedlings survival (%) of various species after 9 months

	Concentrations				
Name of species	Control	10 ppm	15 ppm	20 ppm	LSD at 5%
Acacia auriculiformis	73.03	70.00	65.47	65.32	-
Acacia hybrid	93.26	95.83	82.43	82.44	-
Artocarpus heterophyllus	82.68	74.04	22.22	00.00	n.c
Albizia lebbeck	76.66	59.39	54.84	67.22	11.27
Albizia procera	100.00	100.00	80.55	72.22	14.63
Acacia nilotica	96.29	82.59	81.84	89.92	-
Achras sapota	84.72	89.64	82.32	94.82	-
Casuarina equisetifolia	71.05	73.33	83.33	91.66	-
Emblica officinalis	93.33	84.41	86.11	87.83	-
Leucaena leucocephala	95.23	78.88	94.44	89.25	-
Samauia saman	97.91	92.52	70.55	70.70	6.15
Swetenia macrophylla	79.83	75.63	62.91	64.32	12.30
Terminalia arjuna	100.00	100.00	100.00	100.00	-
Tamarindus indica	100.00	100.00	100.00	100.00	-
Terminalia bellirica	93.01	87.90	73.91	67.36	14.18
Thespesia populnea	92.00	88.67	84.22	96.06	-

salinity. The result showed 48.04, 43, 55, 67; 54, 53, 59, 71 and 36, 40, 44 and 50 cm. in control , 10, 15 and 20ppm respectively. Another 9 species such as *Acacia hybrid*, *Albizia lebbeck*, *Albizia procera*, *Acacia nilotica*, *Achras sapota*, *Casuarina equisetifolia*, *Leucaena leucocephala*, *Samania saman* and *Terminalia bellirica* height performance showed no difference from control to treatments (Table 3).

When we compare germination %, survival % and height performance of 16 species in LSD at 5% level we saw *Acacia hybrid*, *Achras sapota*, *Casuarina equisetifolia*, *Leucaena leucocephala* and *Tamarindus indica* are very good performance. These species performance in germination, survival and height growth are not significantly differences control to treatments. *Acacia auriculiformis* were very good performance in germination, survival and height performance. There is no significantly difference in survival performance but in germination and height performance were increases when salinity increases. Other hand *Albizia procera*, *Samania saman* and *Terminalia bellirica* in these three species showed in germination and height performance is good and have no variation from control to treatments but in survival when salinity increases survivability were decreases (Table 4).

Acacia nilotica germination success was decreases when salinity increases but in survival and height growth have no significantly difference from control to treatments. The species of *Emblica officinalis* was good performance in survival and germination success but height performance decreased when salinity increases. The species of *Thespesia populnea* it is significantly differences in germination, survival and height performance but its performance was remarkable to select as a salt tolerant in this conditions. *Terminalia aurjuna* germination and height performance showed significantly differences from treatments to control but survivability was same in all condition. When we saw the result of *Swetenia macrophylla* species performance in this condition the result shown that significantly differences

Table 3: Effect of different degree of salinity on seedlings height (cm) performance of various species

	Concentrations				
Name of species	Control	10 ppm	15 ppm	20 ppm	LSD at 5%
Acacia auriculiformis	48.04	42.90	55.13	64.79	4.95
Acacia hybrid	53.32	56.94	63.38	60.80	-
Artocarpus heterophyllus	65.66	43.34	53.00	-	n.c.
Albizia lebbeck	90.05	96.16	103.43	101.25	-
Albizia procera	86.22	74.27	95.88	70.77	-
Acacia nilotica	117.01	129.20	127.36	132.24	-
Achras sapota	10.70	11.47	12.19	13.45	-
Casuarina equisetifolia	52.91	56.71	57.04	63.76	-
Emblica officinalis	74.61	72.05	61.35	50.58	12.86
Leucaena leucocephala	202.95	194.41	181.62	159.41	-
Samaula saman	88.97	82.90	78.92	83.11	-
Swetenia macrophylla	54.11	53.71	59.25	71.00	9.31
Terminalia arjuna	121.00	103.04	102.03	89.43	7.16
Tamarindus indica	36.36	39.76	43.85	49.45	4.00
Terminalia bellirica	69.42	75.98	70.01	63.76	-
Thespesia populnea	94.66	94.22	83.40	76.07	8.41

Table 4: LSD value at 5% level of different degree of salinity on germination %, survival % and seedlings height (cm) of various species

	LSD at 5%		
Name of species	Germination (%)	Survival (%)	Height performance (m)
Acacia auriculiformis	-	-	4.95 (+)
Acacia hybrid	-	-	-
Artocarpus heterophyllus	-	nc	nc
Albizia lebbeck	12.57	11.27	-
Albizia procera	-	14.63	-
Acacia nilotica	8.14	-	-
Achras sapota	-	-	-
Casuarina equisetifolia	-	-	-
Emblica officinalis	-	-	12.86
Leucaena leucocephala	-	-	-
Samaula saman	-	6.15	-
Swetenia macrophylla	5.74	12.34	9.31 (+)
Terminalia arjuna	11.84	-	7.16
Tamarindus indica	-	-	4.00 (+)
Terminalia bellirica	-	14.18	-
Thespesia populnea	7.43	-	8.41

+ = Height increases when salinity increases

in all parameters but height performance increased when salinity level increased and other species *Albizia lebbeck* which is significantly differences in germination and survival but height performance is same from control to treatments (Table 4).

DISCUSSION

Concentration of salinity shows no effect on the germination, survival and height performance in some species and some species showed a marked effect in present study. Germination initiation of *S. saman*, *D. sissoo*, *L. leucocephala*, *S. macrophylla*, *A. lebbeck* and *A. auriculiformis* concentration of NaCl shows a marked effect when increasing level of salinity (Rashid *et al*., 2004). A total of 19 mesophytic tree species were planted in three salinity areas of the Sundarbans such as less, moderate and strongly saline zones. Among them four mesophytic like *Albizia procera*, *Samania saman*, *Lagerstomia speciosa* and *Acacia nilotica* were found suitable only in the raised lands of the less saline zone (Ahiul, 2004).

From this result we can say *Acacia auriculiformis*, *Acacia hybrid*, *Achras sapota*, *Casuarina equisetifolia*, *Leucaena leucocephala* and *Tamarindus indica* species are best salt tolerant in this conditions and *Albizia procera*, *Samania saman*, *Terminalia bellirica*, *Acacia nilotica*, *Thespesia populnea* also salt tolerant species and *Terminalia aurjuna*, *Swetenia macrophylla*, *Albizia lebbeck* species are less salt tolerant. The result should be considered with caution, as in the field condition the result might be different. So long term study on the salt tolerant in these species in the field condition is recommended.

CONCLUSION

The present study recommended that *Acacia auriculiformis*, *Acacia hybrid*, *Achras sapota*, *Casuarina equisetifolia*, *Leucaena leucocephala* and

Tamarindus indica species are considered to planting in salt affected areas and also *Albizia procera*, *Samania saman*, *Terminalia bellirica*, *Acacia nilotica* and *Thespesia populnea* also salt tolerant species and planting in coastal areas and *Terminalia aurjuna*, *Swetenia macrophylla*, *Albizia lebbeck* species are planting in less saline zone.

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