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Influence of Soil Salinity on Relative Biomass and Critical Limits of Growth in Selected Tree Species

Growth suppression is initiated at some threshold value of salinity, which varies with crop tolerance (Anon., 1992). Very little work has been done on salt tolerance of perennial tree species. Biological amelioration of salt affected soils through afforestation has invited the attention of scientists and foresters since several years. Determination of salt tolerance of various tree species is of immense value before deciding their suitability for plantation on such sites, especially during establishment and early stage of growth when plants are too tender to bear soil salinity. The present study was conducted to find out the effect soil salinity on growth (biomass accumulation) and critical limits of salt tolerance of selected tree species.

Experiments were conducted in green house during 2000-01 and repeated in 2001-02 at Agriculture College, Shimoga, Six tree species-neem, jack, acacia, eucalyptus, pongamia and tamarind that are commonly grown in agro/social forestry were chosen for the study. Seeds were sown in small polybag (12 x 5) containing potting mixture (red earth, farmyard manure and mixed in a ratio of (3: 2: 1) and placed in a green house with regular watering to raise healthy and uniform seedling. Saline soils were prepared by adding sodium chloride and calcium chloride to the potting mixture in a ratio of 2 : 1 (Todd and Reed, 1998) to obtain EC of 4, 8, 12, 16 or 20 dsm^4. Artificially prepared saline soils were filed into a large polybag (40 x 15 cm) and four hundred and fifty-day-old seedling raised in potting mixture were transplanted into these large polybag. Field capacity of the soil was calculated and each time only measured amount of water was applied to each bag, once in three days. Periodically samples were collected and biomass was recorded. The critical limit of salt tolerance of tree species was worked out on the basis of data of biomass accumulation. The salinity level, which caused 50 percent reduction in biomass as compared to biomass content of control plant at a growth stage, has been considered as critical limit of growth. Also relative growth values were determined to compare the performance of tree species. Relative growth value is the percent variation in the growth of plant over a period of time in a saline situation as compared to the growth at the time of treatment or that would be obtained under non-saline conditions. Determination of relative growth values aids in nullifying initial growth variations as the initial growth in different plant species is considered as 100.

There were no considerable differences in biomass production before treatment imposition but later on variations were evident in all the six tree species. The relative biomass contents on 180 DAT were 67, 42 and 37 in pongamia, neem and tamarind, respectively but they were 120, 60 and 20 in these crops on 360 DAT. This indicated that effect of soil salinity has a prolonged effect on these plant species. The increased relative biomass from 180 to 360 DAT in case of pongamia and neem indicated that the plants were developing tolerance to salinity. The recovery was slow in case of tamarind but mortality of seedling was not observed. Evers *et al.* (1998) observed that, salt stress induced biometric and physiological, changes in *Solanum tuberosum.* In their experiment, potato grown *in vitro* showed decreased shoot and root length with increased salinity levels. In the present study, reduction in biomass could be attributed to reduction in leaf number due to early senescence, dropping of leaves, reduced leaf production and retarded plant height. Even though biomass reduction was evident due to salinity stress when compared to control, a marginal increase was noticed in surviving plants after a short period of gap. As a result, per gram increment in biomass was higher in treated plant, which further indicated that the plants were recovering from stress.

Critical limit is the salinity level below, which a reasonably satisfactory economic response should be expected and above which the probability of such response is low. Assessment of critical limits of salinity for various crops is essential for recommendation of plant species and for rational use of soil. According to the methodology proposed by FAO (*Anon.* 1992), 50% reduction in biomass could be considered for defining a critical limit for different crop species. In the present study, among the different species tested pongamia appeared to be relatively tolerant to different levels of soil salinities as it is evident from the fact that all the salinity levels tried (EC 4 to 20 dsm^{-1}) did not cause biomass reduction to a tune of 50% as compared to other tree species at all four stages of observation.

Table 1. Effect of soil salinity on relative biomass in tree species

DAT	Neem	Jack	Acacia	Eucalyptus	Pongamia	Tamarind
0	100	100	100	100	100	100
30	75	98	100	92	102	87
60	42	70	87	70	106	78
90	22	48	82	53	72	52
120	25	28	51	38	65	51
150	37	21	20	-	59	44
180	42	-	-	-	67	37
210	51	-	-	-	75	29
240	53	-	-	-	89	26
270	55	-	-	-	102	25
300	58	-	-	-	109	20
360	60		-	-	120	20

- Mortality of plants

Table 2. Effect of soil salinities on critical limits in tree species

Crop	Days after treatment			
	120	180	270	360
Neem	>8[a]	>12	-	-
Jack	>12	>8, M >16	>8, M >16	>8, M >16
Acacia	-	>8, M >16	M >12	>8, M >16
Eucalyptus	20	>8, M >16	M >12	>8, M >16
Pongamia	-	-	-	-
Tamarind	-	>8	>8	>8

[a] Soil salinities in EC M- Mortality of plant - Expected reduction was not evident

In case of neem, the effect of salinity treatment was only for the period of 180 days. On the contrary in tamarind 50% biomass reduction was noticed only after 120 days when the salinity was at and above EC 8 ds m^{-1}. Mortality of neem, pongamia and tamarind was not noticed during the experimental period. The jack, acacia and eucalyptus seedlings recorded 50% biomass reduction at the salinity of > 8 ds m^{-1}. And all the plants of these species completely died at the higher salinity > 12 ds m^{-1}. Further, Batra et al. (1993) also observed variations in biometric observations under saline stress in *Casuarina equisetifolia* and *C. glauca* when soil salinity increased upto 9.2 ds m^{-1}. While C. equisetifolia did not show significant difference in shoot yield, *C. glauca* showed significant increase shoot yield at EC 4,8 and 9.2 ds m^{-1}. On the basis of present study pongamia could be compared as relatively saline tolerant, while neem and tamarind are less tolerant types.

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