

Effect of Soil Sodicity on Seed Germination of Different Tree Species

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Abstract: A nursery experiment was conducted in order to screen the suitable tree species under different soil pH levels during the year 2013-14 at Forest College and Research Institute- Mettupalayam. The impact of pH treatments (9.0, 9.5 and 10.0) on the germination was studied in thirteen multipurpose tree species viz., *Acacia auriculiformis*, *Acacia nilotica*, *Albizia lebbek*, *Albizia procera*, *Azadirachta indica*, *Casuarina equisetifolia*, *Ceiba pentandra*, *Dalbergia sissoo*, *Eucalyptus tereticornis*, *Leucaena leucocephala*, *Pongamia pinnata*, *Prosopis juliflora* and *Tamarindus indica*. A preliminary germination study indicated that, four species viz., *Acacia nilotica*, *Azadirachta indica*, *Prosopis juliflora* and *Tamarindus indica* are highly tolerant species to sodicity because of their ability to germinate well in all the three soil pH levels. Further, Seven species viz., *Albizia lebbek*, *Casuarina equisetifolia*, *Ceiba pentandra*, *Dalbergia sissoo*, *Eucalyptus tereticornis*, *Leucaena leucocephala* and *Pongamia pinnata* which were able to germinate at least in two levels of soil pH (9.0 and 9.5) are registered as medium tolerant species to sodicity. Finally, two species viz., *Acacia auriculiformis* and *Albizia procera* which were unable to record germination both at pH 9.5 and 10.0 were categorised as the least tolerant species to sodicity.

Keywords: Germination, Sodicity, Salt affected soil, Soil pH

1. Introduction

In India, the forest cover is 21.23 per cent [6] against requirement of 33 per cent of total geographical area for maintaining optimum ecological balance. As such, the only way to increase forest cover is through afforestation of unproductive and problematic wastelands. About 8.6 million hectares (9.1 per cent) area of 93.6 m ha wastelands are constituted by salt-affected soils that exists in the different parts of India [10] and enrichment of salts is a serious impediment for establishment and growth of tree species.

There are two major types of salt affected soils, namely saline and alkali soils. Soil salinity (high levels of water-soluble salt) and Sodicity (high levels of exchangeable sodium), called collectively salt-affected soils, affect approximately 932 million ha of land globally [14]. Saline soils include solonchak/white alkali and sodic soils also called solonetz/black alkali. Alkali soils, also termed sodic, due to the presence of excessive exchangeable Na⁺. Such soils possess bad physical conditions. Soil particles are dispersed and as a consequence, the movement of water and air is restricted. Their undesirable physical, chemical and biological conditions place them in the category of problem soils which require special remedial measures and intensive management practices to put them under biological land use.

A good amount of research work has been done on reclamation of salt-affected soils for agricultural purposes [11,12]. However, research on plantation of tree species on salt affected soils remained scanty and incomplete [4,7,13]. To overcome the sodic problem, a nursery level germination experiment was conducted and illustrated here.

2. Materials and Methods

The nursery experiment was conducted at Forest College and Research Institute, Mettupalayam, located at 11°19'N latitude and 77°56'E longitudes with an altitude of 300 m above MSL. The experiment was carried out in order to investigate the effect of sodic soil on the germination of seed propagated tree species during the year 2013-14. The tree species which are conceived to be ubiquitous in all type of climate and soil were selected for the screening of best species under different pH levels. The pH levels for the germination study are 9.0, 9.5 and 10.0. The 13 tree species chosen for germination study was *Acacia auriculiformis*, *Acacia nilotica*, *Albizia lebbek*, *Albizia procera*, *Azadirachta indica*, *Casuarina equisetifolia*, *Ceiba pentandra*, *Dalbergia sissoo*, *Eucalyptus tereticornis*, *Leucaena leucocephala*, *Pongamia pinnata*, *Prosopis juliflora* and *Tamarindus indica*. The nursery bed was irrigated daily and germination percent was studied.

3. Result and Discussion

The germination per cent of thirteen test tree species recorded at three different level of salinity viz., 9.0, 9.5 and 10.0. At pH 9.0 six tree species recorded 100 per cent germination viz., *Acacia nilotica*, *Azadirachta indica*, *Leucaena leucocephala*, *Pongamia pinnata*, *Prosopis juliflora* and *Tamarindus indica* followed by *Ceiba pentandra* which recorded 90 per cent. *Eucalyptus tereticornis* recorded 85 per cent whereas, *Dalbergia sissoo* and *Casuarina equisetifolia* registered with 80 per cent germination respectively. There were two species recording upto 55 per cent germination viz., *Albizia lebbek* and *Albizia procera*. The least germination percent was recorded in *Acacia auriculiformis* (52 %). The above finding combines with the fact that *Prosopis juliflora* grows faster

compared to other species in nursery under high pH (9-10) and the response to vegetative growth was studied [8].

Table 1: Germination percentage of tree species under different levels of Sodicity

Sl.No	Tree Species	Germination %		
		pH 9.0	pH 9.5	pH 10.0
1	<i>Acacia auriculiformis</i>	52	Nil	Nil
2	<i>Acacia nilotica</i>	100	90	85
3	<i>Albizia lebbek</i>	65	45	Nil
4	<i>Albizia procera</i>	55	Nil	Nil
5	<i>Azadirachta indica</i>	100	90	80
6	<i>Casuarina equisetifolia</i>	80	70	60
7	<i>Ceiba pentandra</i>	90	55	Nil
8	<i>Dalbergia sissoo</i>	80	50	Nil
9	<i>Eucalyptus tereticornis</i>	85	70	65
10	<i>Leucaena leucocephala</i>	100	80	75
11	<i>Pongamia pinnata</i>	100	85	75
12	<i>Prosopis juliflora</i>	100	90	90
13	<i>Tamarindus indica</i>	100	90	85

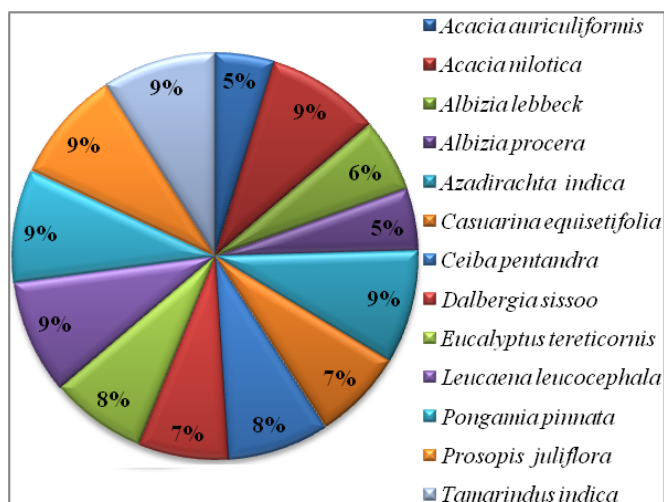


Figure. Seed Germination percentage of tree species at pH of 9.0

At pH 9.5, four tree species viz., *Acacia nilotica*, *Azadirachta indica*, *Prosopis juliflora* and *Tamarindus indica* recorded highest germination (90 %) compared to other test tree species followed by *Pongamia pinnata* (85 %), *Leucaena leucocephala* (80 %), *Casuarina equisetifolia* and *Eucalyptus tereticornis* 70 per cent respectively. Other tree species were in the range of 45-55 per cent germination viz., *Ceiba pentandra* (55 per cent), *Dalbergia sissoo* (50 %) and *Albizia lebbek* (45 %). The test species *Acacia auriculiformis* and *Albizia procera* have not germinated at pH 9.5.

Highest germination of 90 per cent was found in *Prosopis juliflora* followed by 85 per cent germination in *Acacia nilotica* and *Tamarindus indica*. *Azadirachta indica* recorded 80 per cent followed by *Leucaena leucocephala* and *Pongamia pinnata* 75 per cent respectively. *Eucalyptus tereticornis* registered 65 per cent and *Casuarina equisetifolia* 60 per cent. Many of the test tree species did not germinate at pH 10.0 viz., *Acacia auriculiformis*, *Albizia lebbek*, *Albizia procera*, *Ceiba pentandra*, *Dalbergia sissoo*. Increasing salinity concentration often causes osmotic or

specific toxicity which may reduce or cease seed germination [13]. Reduction in germination of plants by increasing salinity levels has been described by numerous authors [1,2,3,5].

Firstly, the test species which were able to germinate consistently with better germination percentage (>85 per cent) in all the levels of soil i.e., upto pH 10.0 can be placed under highly resistant species to sodicity viz., *Acacia nilotica*, *Azadirachta indica*, *Prosopis juliflora* and *Tamarindus indica*. On supporting the present result, low salinity levels increased seed germination of *Acacia leucophloea*, *Parkinsonia aculeate* and *Cassia auriculata*. But with increasing salinity a decreasing in germination was observed [9]. Secondly, the test species which were able to germinate (>50 %) at least in two levels of soil pH (9.0 and 9.5) can be posed as medium resistant species to sodicity viz., *Albizia lebbek*, *Casuarina equisetifolia*, *Ceiba pentandra*, *Dalbergia sissoo*, *Eucalyptus tereticornis*, *Leucaena leucocephala* and *Pongamia pinnata*. Finally, the test species which were unable to record germination both at pH 9.5 and 10.0, however, recorded germination upto 55 per cent at pH 9.0 can be categorised as the least resistant species to sodicity viz., *Acacia auriculiformis* and *Albizia procera*.

4. Conclusion

Among the thirteen test species, four species were found to be germinating (>85 per cent) well in all the three soil pH levels (9.0, 9.5 and 10.0) viz., *Acacia nilotica*, *Azadirachta indica*, *Prosopis juliflora* and *Tamarindus indica* which are considered to be highly tolerant species to Sodicity. Further, seven species viz., *Albizia lebbek*, *Casuarina equisetifolia*, *Ceiba pentandra*, *Dalbergia sissoo*, *Eucalyptus tereticornis*, *Leucaena leucocephala* and *Pongamia pinnata* which were able to germinate (>50 per cent) at least in two levels of soil pH (9.0 and 9.5) are registered as medium tolerant species. Finally, two species viz., *Acacia auriculiformis* and *Albizia procera* which were unable to record germination both at pH 9.5 and 10.0, however, it recorded germination upto 55 per cent at pH were categorised as the least tolerant species.

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