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# Effects of Salinity Levels on Visual Symptoms of Agroforestry Tree Species

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## ABSTRACT

Tolerance of eight agroforestry tree species (*Acacia nilotica* Linn. willd, *Azadirachta indica* A. Juss, *Dalbergia sissoo* Roxb, *Dalbergia latifolia* Roxb., *Gmelina arborea* Linn., *Leucaena leucocephala* (Lam)de Wit., *Prosopis cineraria* Druce and *Prosopis juliflora* DC.) to soil salinity was evaluated under pot culture conditions on clayey soil. Four different salt levels viz., 0, 2.5, 3.5 and 6.5 ds/m were created by employing NaCl, $CaCl_2$ and $MgSo_4$ in the ratio of 5:3:2. An examination of visual symptoms on the seedlings grown in S2 salinity level (3.5 ds/m) indicated that *Dalbergia sissoo* Roxb, *Dalbergia latifolia* Roxb. showed leaf chlorosis along with stunted root growth and in *Gmelina arborea* linn., severe leaf necrosis along with stunted root growth was observed. In S3 salinity level (6.5 ds/m) complete destruction of shoot and root system occurred in *Dalbergia sissoo* Roxb, *Dalbergia latifolia* Roxb. and *Gmelina arborea* linn., while other tree species namely *A. nilotica, A. indica, L. leucocephala, P. cineraria* and *P. juliflora* showed normal growth with slight reduction in number of leaves, shoot and root length.

**Key words:** *Leaf necrosis, salinity tolerance, visual symptoms.*

It is both axiomatic and true that millions of hectares of land throughout the world is deteriorating day by day due to salinity. About 952 million hectares of area falls under moderate to severely salt affected in world (Szabolcs, 1977), whereas in India it spread over 8.11 million hectares of land (Singh, 1992). The most suitable land-use system for such soils is agroforestry which would not only provide fuel, fodder, timber, rural employment and improve the environment but would also biologically reclaim the soil through multiple ameliorative process by favorably affecting physical, chemical and biological properties of soil.

Determination of salt tolerance of various tree species is of immense value for deciding their suitability for plantation on such sites, especially during establishment and early stages of growth when the plants are too tender to bear unhospitable soil conditions. The information on the visual symptoms of various species in salinity conditions and also on the critical limits of salts-tolerance is scanty. Keeping these facts in view, the present investigation was designed to find out the relative salt tolerance of *Acacia nilotica* (Linn.) willd, *Azadirachta indica* A. Juss, *Dalbergia sissoo* Roxb, *Dalbergia latifolia* Roxb., *Gmelina arborea* linn., *Leucaena leucocephala* (Lam)de Wit., *Prosopis cineraria* Druce and *Prosopis juliflora* DC. tree species.

A pot culture experiment was conducted during the rainy season during the year 1995 in the net-house with overhead polythene sheet to protect the direct impact of rainwater. The trial was conducted at the farm of N.M. College of Agriculture, Gujarat Agricultural University, Navasari, Gujarat.

Surface soil from a depth of 0-15 cm was collected in bulk from 5 random spots and thereafter it was composited by mixing soils from all the spots. The soil was then pounded and sieved through a 2 mm sieve. One kilogram of soil sample was retained for the basic soil analysis, while the remaining lot of soil was taken for creating different salinity levels for the pot culture experiment.

The amount of salts needed to bring the soil to a given salinity level (i.e EC) was worked out using Jackson (1967) formula. The soil was artificially salinized to desired salinity levels by the addition of the calculated amounts of sodium chloride, calcium chloride and magnesium sulphate in the ratio of 5:3:2. After the addition of the salts, the soil was subjected to the wetting and drying cycles for a period of two days to attain proper equilibrium.

Seeds were collected in the month of May and June 1995 and sown in the second week of June 1995. Two factors completely randomized design was employed with five replications. In all eight tree species and four salinity levels were tried and thus 32 treatments were analyzed.

When nutrient elements are in short supply or its availability is adversely affected changes in the cellular metabolism takes place and may lead to the development of the visual symptoms. *Gmelina arborea* showed severe leaf necrosis in the S3 salinity level and resulted in

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Table 1. Observations on visual symptoms of Agroforestry trees at different salinity levels

| ***Acacia nilotica* (Linn.) willd** | | | |
|---|---|---|---|
| **S0= Natural soil** | **S1= 2.5 ds/m** | **S2= 3.5 ds/m** | **S3= 6.5 ds/m** |
| New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 35, 83.40 and 40.03. Plant maintains normal shoot and root growth during the entire course of study. Shoot development and leaf number was maximum as compared to all other levels | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 23.6, 57 and 36.5. Overall reduction in shoot and root growth with lowered number of leaves was observed as compared to S0 salinity level plant. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 23, 46.8 and 32.4. Length of root and shoot and number of leaves reduced as compared with S0 and S1 salinity level plant. | New leaves emerged within 7 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 19.6,40.63 and 27.06. Reduction in shoot and root length and number of leaves was highest among all the levels (S0, S1 and S2). |
| ***Azadirachta indica* A. Juss** | | | |
| New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 19.6, 63.4 and 33.06. Plant maintains normal growth. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 17.6, 61.53 and 24.26. Minimum reduction in shoot and root growth and number of leaves was observed. | New leaves emerged within 6 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 17, 56.6 and 23.96. Length of shoot and no. of leaves reduced as compared to S0 and S1 level. Few leaves turned yellow. | New leaves emerged within 6 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 9.2, 23.68 and 15.92. Minimum reduction in soot length and no. of leaves was observed as compared to all the levels (S0, S1 and S2). Few leaves turned yellow and dropped. |
| ***Dalbergia sissoo* Roxb** | | | |
| New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 21, 66 and 35. Plant maintained normal growth during the entire course of study. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 16, 43.2 and 19.72. Slight marginal leaf chlorosis was observed and moderate leaf drop of older leaves in few plants was observed. Root hair growth suppressed. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 5.4, 19.27 and 10.4. Reduction in shoot and root growth as compared to S0 and S1 level was observed. Leaves turned white and fall. | New leaves emerged within 6 days after sowing. The leaves turned white and permanent wilting of plants. Very few leaves emerged after 30 days. Plants remained very weak and died after 75 days after sowing. |
| ***Dalbergia latifolia* Roxb.** | | | |
| New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 9.2, 38 and 30.67. Plant remained healthy during the entire course of study. Shoot and root growth was normal. | New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 8, 20.45 and 25.65. Moderate leaf chlorosis and drop of older leaves was observed. Shoot and root growth was stunted. Root hairs network was reduced to minimum. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 1.8, 7.34 and 7.3. Extreme leaf chlorosis and severe drop of older leaves was observed. Root growth was stunted, with lack of root hairs network. Few plants died after 75 days after sowing. | New leaves emerged within 5 days after sowing. Browning of stem with complete defoliation of leaves was observed. Root system completely collapsed. All plants remained very weak and died after 65 days after sowing. |

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| ***Gmelina arborea* linn.** | | | |
| New leaves emerged within 6 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was respectively 18, 56.6 and 27.37. Normal shoot and root growth was observed during the course of study. | New leaves emerged within 6 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 16, 40.83 and 26.97 respectively. Slight marginal leaf necrosis was observed. Root growth was normal. | New leaves emerged within 7 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 1.2, 3.65 and 4.31 respectively. Severe leaf necrosis followed by heavy leaf drop was observed. Root growth was stunted and root hair growth was reduced to minimum. Few plants died after 70 days after sowing. | New leaves emerged within 7 days after sowing. Extreme leaf necrosis with complete defoliation of leaf was observed. Browning of stem was observed. All plants died after 60 days after sowing. |
| ***Leucaena leucocephala* (Lam)de wit.** | | | |
| New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 16, 106.1 and 23.73 respectively. Plants remained healthy throughout the course of study. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 14, 76.97 and 22.5 respectively. Reduction in shoot length was observed. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 14, 65.6 and 21.7 respectively. Reduction in shoot length was observed. Growth of root hairs was adversely affected with reduction in root length as compared with S0 plants. | New leaves emerged within 6 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 12, 46.5 and 20 respectively. Reduction in shoot length and leaf no. was observed. Root growth was suppressed as compared to S0, S1 and S2 levels plants. |
| ***Prosopis cineraria* Druce** | | | |
| New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 29, 76 and 33.5 respectively. Plant growth was normal with greater extension of shoot growth. | New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 16, 44.9 and 24.4 respectively. Shoot length reduced to a great extent. Root length was found equal in comparison to S0, whereas root hairs growth was suppressed. Reduction in leaf number was also observed. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 14, 31.87 and 22.6 respectively. Similar response was observed as that in the case of S1 level. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 11.4, 29.65 and 17.25 respectively. Maximum reduction in shoot length was observed as compared to the S0 level. |
| ***Prosopis juliflora* DC** | | | |
| New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 35.4, 67.8 and 37.05 respectively. Plant growth was normal and remained healthy throughout the course of study. | New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 34, 62.8 and 29.67 respectively. Plants remained healthy and shoot and root growth was normal. | New leaves emerged within 4 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 29.2, 53.4 and 29.27 respectively. Plants remained healthy with slight reduction in shoot growth and no. of leaves. | New leaves emerged within 5 days after sowing. Average no. of leaves/plant, shoot and root length (cm) was 26, 44.4 and 16.9 respectively. Overall reduction in shoot and root growth with lowered no. of leaves as compared to S0, S1 and S2 levels plant. |

complete defoliation of leaves. Even under S2 salinity level, prominent leaf necrosis and browning of stem was observed. In S1 salinity level, marginal leaf necrosis was observed. In *Dalbergia sissoo* and *Dalbergia latifolia*, complete defoliation of leaves was observed with browning of shoot under S3 salinity level. Under S2 salinity level, leaf chlorosis and severe drop of older leaves with stunted root growth was observed. Under S1 salinity level, moderate leaf chlorosis and drop of older leaves was observed. Similar visual symptoms were also reported by Awwathappa et al. (1987), Francois (1982) and Sharma et al. (1991). The probable explanation for this may be due to transportation of higher levels of salts causing injury to the plants. After prolonged periods, transpiration may brings large amounts of salts into the shoots, and in plants unable to regulate this uptake, salt concentration may built up to toxic levels. This occurs first in the older leaves, causing them to die prematurely. Other tree species namely *Acacia nilotica*, *Azadirachta indica*, *Leucaena leucocephala*, *Prosopis cineraria* and *Prosopis juliflora* showed normal growth with slight reduction in number of leaves and shoot and root length. This reduction in number of leaves, shoot and root length may be due to osmotic pressure created by salts in the root zone.

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