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GROWTH OF *AZADIRACHTA INDICA* AND *MELIA AZEDARACH* AT COASTAL SAND USING HIGHLY SALINE WATER FOR IRRIGATION

RAFIQ AHMAD, D. KHAN AND SHOAIB ISMAIL

Department of Botany,
University of Karachi, Karachi-32, Pakistan

Abstract

Azadirachta indica and *Melia azedarach* were grown at coastal sand using 10-30% dilutions of saline water; (EC_{iw}: 4.5-14.0 $dS.m.^{-1}$) for irrigation. Height and diameter of the plants decreased as compared to control plants which were irrigated with non-saline water. Plants irrigated with saline water showed an increase in moisture content and decrease in chlorophyll, sugar and protein content associated with an increase in proline. Under saline water irrigation *M. azedarach* showed rapid growth than *A. indica*. These plants could, therefore, be grown for afforestation at sandy deserts using underground saline water for irrigation where normal non-saline water is not available.

Introduction

Azadirachta indica (L) A. Juss, and *Melia azedarach* L. commonly known as *Neem* (Indian Lilac) and *Bakain* (Persian Lilac) respectively, native of Mid-south West Asia are naturalized in Tropical Africa and Middle East. Being grown as road side trees providing fuel wood, they are widely used in pharmaceutical industry, as efficient soil ameliorant, provide medium quality timber for house building and furniture. Considering their good growth under semi-arid environment and demand for afforestation at coastal sandy deserts of Middle East countries, the possibilities of growing these plants through brackish water irrigation at coastal sand was explored.

Material and Methods

Freshly collected seeds of *A. indica* and *M. azedarach* were sown in 1 Kg sand in polyethylene bags with a basal perforation allowing leaching of irrigation water without standing in root zone for long. The sand was first saturated with half strength Hoagland solution followed by tap water irrigation at suitable intervals. Seedlings at five leaf stage were irrigated with different concentrations of sea water from 10-100% with a difference of 10% concentration between subsequent irrigation. Control plants were irrigated with half strength Hoagland solution. In order to reduce Na^+ toxicity and provide essential mineral elements for plant growth, dilution of sea water were amended with chemicals (Ahmad & Abdullah, 1979). Laboratory chemicals providing major ions were replaced by commercial fertilizer like Calcium Ammonium Nitrate (CAN), Single

Super Phosphate (SSP) and Sulphate of Potash (SOP) to reduce cost of amendments. Preliminary experiments conducted for 20 days showed that plants did not survive beyond 30% sea water irrigation.

The experiment was repeated in which 20 day old seedling irrigated with half strength, Hoagland solution, 10%, (EC: 4.5 $dS.m^{-1}$), 20% (EC: 9.5 $dS.m.^{-1}$) and 30% (EC:14.0 $dS.m.^{-1}$) dilutions of sea water supplemented with chemical amendments were transferred in 200 kg of coastal sand in 60 cm diam drum pot with a basal outlet so that irrigation water leached out after giving a quick bath to the root system (Boyko, 1966). The practice of over irrigation was maintained to leach out toxic Na^+ ions. Three replicates were kept for each treatments and the experiment was terminated after four months. Various physiological and biochemical parameters were studied. Water content was determined by the relative difference between fresh and dry weights. Chlorophyll (Maclachlam & Zalik, 1963) total sugars (Nelson, 1944), protein (Lowry *et al*, 1951) and proline (Bates, 1973) contents of leaf were analyzed.

Results and Discussion

A. indica and *M. azedarach* have been graded among salt tolerant plants (Tsing *et al.*, 1956; Yadav & Singh, 1970). With the use of highly saline water for irrigation at sandy strata it has been made possible to grow the test plants at sandy deserts (Table 1). Reduction in growth due to salinity as reported by Bernstein & Hayward (1958) and Pasternak *et al.*, (1979) is evident from the data presented in Fig. 1. It would appear that salt concentration in the irrigation medium as used in present study may reduce the yield in halophytic species (Jefferies & Pitman, 1984). Survival of these plants under the salinity stress, is primarily due to their salt tolerant character, growth at sandy strata and amendments with chemicals which minimises the toxicity of excessive Na^+ present in the

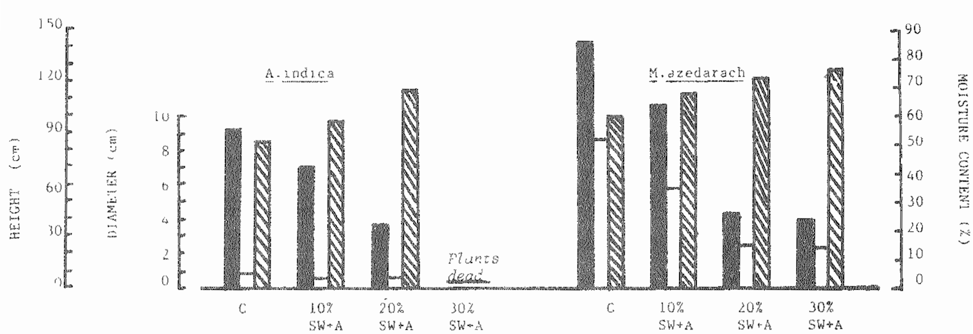

Fig. 1. Comparative rate of growth and moisture content between *Azadirachta indica* and *Melia azedarach* under different salinity regimes.
■ Height of shoot □ Diameter of shoot ▨ Moisture content
SW+A = Sea Water + Amendments

irrigation medium. These amendments also provide mineral nutrients essential for growth. *M. azedarach* appears to be a fast growing plant as compared to *A. indica* and this character has been retained even under salt stress condition (Table 1). *A. indica* could not survive at EC: 14.0 $dS.m.^{-1}$ where as *M. azedarach* was able to grow with 73% reduction in growth. Though reduction in heights of *A. indica* and *M. azedarach* under EC: 4.5 and 9.5 $dS.m^{-1}$ at 10 and 20% sea water irrigations was 29 and 40% respectively over their controls, but the growth vigour of *M. azedardch* was four times more than *A. indica.*

With increase in salinity of irrigation medium succulence and accumulation of moisture in both the plants species was noted (Fig. 1). Development of this halophytic character helps them in salt tolerance (Strogonov, 1962; Walter, 1961). With exception of a slight increase at EC: 9.5 $dS.m^{-1}$ in case of *M. azedarach,* a decrease in chlorophyll

Table 1. Comparison between different biochemical parameters of *Azadirachta indica* and *Melia azedarach* under different salinity regimes

	Azadirachta indica			*Melia azedarach*		
	CHLOROPHYLL CONTENT ($mg.g^{-1}$ FW)					
	Chl 'a'	Chl 'b'	Chl 'a/b'	Chl 'a'	Chl 'b'	Chl 'a/b.
Control	0.234 ± 0.008	0.331 ± 0.007	0.707	0.349 ± 0.011	0.495 ± 0.012	0.760
10% S.W. + Amend.	0.233 ± 0.003	0.341 ± 0.009	0.683	0.378 ± 0.031	0.494 ± 0.027	0.765
20% S.W. + Amend.	0.182 ± 0.019	0.270 ± 0.010	0.674	0.280 ± 0.013	0.375 ± 0.014	0.746
30% S.W. + Amend.		–– Plants dead ––		0.241 ± 0.009	0.291 ± 0.022	0.828
	SUGAR CONTENT ($mg.g^{-1}$ DW)					
Control	6.856 ± 0.147				3.968 ± 0.492	
10% S.W. + Amend.	6.876 ± 0.307				4.740 ± 0.263	
20% S.W. + Amend.	6.050 ± 0.030				3.417 ± 0.305	
30% S.W. + Amend.	––– Plants dead				2.659 ± 1.283	
	PROLINE CONTENT ($mg.g^{-1}$ DW)					
Control	1.135 ± 0.245				0.693 ± 0.018	
10% S.W. + Amend.	1.930 ± 0.061				0.790 ± 0.021	
20% S.W. + Amend.	2.272 ± 0.162				1.566 ± 0.288	
30% S.W. + Amend.	––– Plants dead				2.526 ± 0.262	
	PROTEIN CONTENT ($mg.g^{-1}$ DW)					
Control	7.825 ± 0.373				1.965 ± 0.161	
10% S.W. + Amend.	7.664 ± 0.129				1.187 ± 0.203	
20% S.W. + Amend.	7.315 ± 0.074				0.800 ± 0.112	
30% S.W. + Amend.	–– Plants dead				0.759 ± 0.185	

S.W. + Amend. = Sea Water + Amendments.

content was evident in both the plants as the salinity level increased (Table 1). This decrease can be attributed to an increase in water content as suggested by Strogonov (1970). Furthermore reduction may be due to inhibition of iron containing enzymes which activates the bio-synthesis of chlorophyll (Rubin & Artikhovskaya, 1964). Besides number and size of chloroplast reduced under saline conditions, as a result synthesis of protein and chlorophyll was reduced (Galaktionov, 1963b). A decrease in sugar content was associated with the increase in salinities with slight exception at 10% dilution of sea water irrigation in both the plants. This is contradictory to the earlier reports where increase in sugar concentrations has been reported at lower salinities. It seems that translocation of sugars is more efficient in both the plant species, which eventually results in increased sugar glycolysis in root (Strogonov, 1962). The energy yielding products thus produced could control ion fluxes during mineral uptake (Chimiklis & Karlander, 1973; Ahmad & Abdullah 1982). Increase in the level of proline and a decrease in total protein content is apparent with the increase in salt concentration of irrigation medium (Table 1). Accumulation of proline has been reported under different stress conditions and its accumulation under saline condition as well is considered beneficial for plant growth. (Strogonov, 1962; Jaeger & Priebe, 1975; Ahmad & Abdullah, 1979; Rains *et al.*, 1982). Participation of proline in osmeregulation has been suggested for controling ion fluxes (Stewart & Lee, 1974), it may have some remedial and/or protective effects against stress damage as reported by Wyn Jones & Storey (1978).

Although the duration of our experiment was small, however, it is evident that both *M. azedarach* and A. *indica* are salt tolerant upto certain extent. *M. azedarach* being less salt tolerant has shown better growth at sandy soils using highly saline water for irrigation.

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