

## EFFECT OF SALINE WATER ON GERMINATION AND GROWTH OF *ZIZIPHUS* SPECIES

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### ABSTRACT

*Ziziphus rotundifolia* Lamk., *Z. mauritiana* Lamk cv Tikadi, *Z. numularia* (Burm. f.) Wight & Arn. and *Z. spinachristi* (L.) Willd. were screened for tolerance to saline irrigation water (EC 0.5 to 6.5 mmhos) at germination and seedling growth stages. *Z. rotundifolia*, commonly used as rootstock for ber, was tolerant to irrigation water salinity upto 4.5 and 6.5 mmhos EC at germination and seedling growth stages, respectively. *Ziziphus spinachristi* and *Z. mauritiana* cv Tikadi were moderately tolerant upto 2.5 mmhos EC, *Z. nummularia* was sensitive to salinity

### INTRODUCTION

Commercial cultivars of ber (*Ziziphus mauritiana*) are raised by the budding on root stocks. Irrigation water of good quality is required for better germination and growth of rootstock seedlings. However, in arid and semi-arid regions irrigation waters are usually saline and, therefore, root stocks must have reasonable tolerance for such waters.

Wide variations in salt tolerance of rootstocks of citrus (Joolka and Singh 1979) sweet orange (Joolka et al., 1980) and pomegranate (Jain and Dass, 1988) have been reported. However, information about salinity tolerance of *Ziziphus* root stocks is not available and, therefore, these studies were undertaken.

### MATERIAL AND METHODS

Germination studies on *Ziziphus rotundifolia* Lamk., *Z. mauritiana* Lamk. cv Tikadi and *Z. nummularia* (Burm. f.) Wight & Arn. were conducted in September, 1985 at the Regional Station of the Central Arid Zone Research Institute, Pali, Rajasthan. Polythene bags (10 cm X 25 cm) were filled with a mixture of tank silt, fine sand and organic manure in equal proportions. Three seeds were placed in each bag, at 1 cm depth. Every treatment comprised four replications of 6 bags each. Besides, 6-month old seedlings of each species i.e. *Z. rotundifolia*, *Z. mauritiana* (Tikadi), *Z. spinachristi* (L.) Willd. and *Z. nummularia* were planted at 30 cm X 30 cm spacing in December,

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1985 for growth studies. Irrigation waters having electrical conductivity 0.5, 2.5, 4.5, and 6.5 mmhos were used for irrigation in both the lots. One cm of water was applied during the period September, 1985 to February, 1986 on every third day and during March, 1986 to June, 1986 on every alternate day. Soil of nursery beds was sandy clay-loam with pH 8.0, EC 0.6 mmhos, CEC 21 m eq./100g and organic carbon 0.4%.

Germination, survival and growth of *Ziziphus* seedlings was monitored for 6 to 7 months. Salt tolerance was evaluated by following parameters.

$$1. \text{ Mean survival} = \frac{Y_{ECw_1} + Y_{ECw_2} + \dots + Y_{ECw_n}}{n}$$

2. Per cent Mean Salinity

$$\text{Index (MSI)} = \frac{Y_{ECw_2} + Y_{ECw_3} + \dots + Y_{ECw_n}}{n \cdot Y_{ECw_1}} \times 100$$

3. Percent Reduction in growth at highest level

$$\text{of salinity} = \frac{Y_{ECw_n} - Y_{ECw_1}}{Y_{ECw_1}} \times 100$$

Where Y is the survival and growth parameters at the specified level of salinity of irrigation waters and  $ECw_1, ECw_2, ECw_3, \dots, ECw_n$  are the increasing levels of salinity of irrigation waters and n is the number of waters.

Soil of polythene bags and nursery beds ( upto 30 cm depth ) was analysed for salinity characteristics by standard procedures (Richards 1954).

## RESULTS AND DISCUSSION

Irrigation with saline waters lowered the pH and increased the electrical conductivity and exchangeable sodium of soil (Table 1 both in polythene bags and in nursery beds. However, salinity effects of irrigation waters were higher in nursery beds as compared to polythene bags. This variation was probably due to a higher proportion of organic matter and sand in polythene bags as compared to nursery beds.

Table 1. Effect of saline water irrigation on soil salinity

Irrigation water		Polythene bags			Nursery beds		
EC (mmhos)	SAR	pH <sub>2</sub>	EC <sub>2</sub> (mmhos)	Exchangeable Na (m eq/100g)	pH <sub>2</sub>	EC <sub>2</sub> (mmhos)	Exchangeable Na (m eq/100g)
0.5	2.1	8.4	0.7	0.8	8.3	0.7	2.1
2.5	4.6	8.2	1.1	1.2	8.1	1.0	2.4
4.5	12.2	8.2	1.2	1.5	8.1	1.2	2.9
6.5	15.6	8.1	1.1	1.5	8.0	1.9	3.8

High salinity irrigation waters decreased the germination of *Z. nummularia* seeds (Table 2) but not of *Z. rotundifolia* and *Z. mauritiana*. From germination onwards, survival and growth of all the species was severely affected by irrigation waters of 6.5 mmhos EC. Waters upto 4.5 mmhos EC can be used for germination of *Z. rotundifolia* but of not more than 2.5 mmhos EC for *Z. mauritiana*. *Z. nummularia* was sensitive to salinity as both germination and survival were adversely affected at higher salinity levels (Table 2).

Table 2. Effect of saline water irrigation on germination, survival and growth of *Ziziphus* Seedlings

EC of Irrigation Water	Species		
	<i>Z. rotundifolia</i>	<i>Z. mauritiana</i>	<i>Z. nummularia</i>
	*Germination (%)		
0.5	47	69	42
2.5	56	48	25
4.5	61	50	19
6.5	58	58	26
Mean	55	57	28
Mean Salinity Index (%)	124	83	56
	Seedling survival (%) 7 months after seeding		
0.5	100	95	95
2.5	83	81	69
4.5	74	44	42
6.5	8	26	0
Mean	66	61	51
Mean Salinity Index (%)	58	53	42
	Seedling height (cm) 7 months after seeding		
0.5	16.7	14.2	14.2
2.5	16.1	17.3	13.8
4.5	13.2	15.3	16.6
6.5	2.1	11.7	2.7
Mean	12.0	14.6	11.7
Mean Salinity Index (%)	62.7	103.3	75.5

\*Significant at 5%, CD = 8

Irrigation with saline waters, in general, caused mortality of all *Ziziphus* species and lowered the growth rate of young seedlings in nursery (Table 3). Effects of salinity were, however, quite variable in different *Ziziphus* species. *Z. nummularia* was most sensitive to high salinity and even waters of 2.5 mmhos EC caused severe mortality. *Z. rotundifolia* showed high tolerance to salinity even with waters upto 6.5 mmhos EC. *Z. mauritiana* and *Z. spinachristi* were moderately tolerant to salinity and can be irrigated with waters upto 2.5 mmhos EC. Results of higher sensitivity of *Ziziphus* species to salinity at germination stage as compared to seedling growth stage are in conformity with the results of Dhankar et al. (1980).

Table 3. Effect of saline water irrigation on survival and height of different *Ziziphus* saplings, six months after planting

Irrigation water (EC, mmhos)	Species			
	<i>Z. rotundifolia</i>	<i>Z. nummularia</i>	<i>Z. mauritiana</i>	<i>Z. spinachristi</i>
	Survival (%)			
0.5	100	90	100	90
2.5	100	30	90	90
4.5	80	10	40	80
6.5	90	10	60	30
Mean	92	35	72	72
Mean Salinity Index (%)	90	18	63	74
% Reduction in growth at highest salinity	10	89	40	67
	Height (cm)			
0.5	20.2	14.7	27.4	28.6
2.5	18.9	10.3	17.7	24.9
4.5	15.9	14.0	15.0	20.5
6.5	17.0	6.0	9.7	20.0
Mean	18.0	11.2	17.4	23.3
Mean Salinity Index (%)	85.5	68.7	51.6	77.9
% Reduction in growth at highest salinity	15.8	59.2	64.6	28.6

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