SALT TOLERANCE OF THREE *LEUCAENA LEUCOCEPHALA* VARIETIES

M. Yaseen, Anwar-ul-Hassan & R.H. Qureshi
Department of Soil Science,
University of Agriculture, Faisalabad

Effect of salinity on three *Leucaena leucocephala* varieties was studied in hydroponic culture. Differences in seed germination, plant growth and ionic composition were considered to determine relative salt tolerance of these varieties. All the varieties gave 100% germination in control and at 5 dS m^{-1} EC. Per cent germination of K-67, K-743 and K-28 decreased with increase in salinity beyond 5 dS m^{-1}. However, the variety K-28 gave maximum germination at all the salinity levels. Its germination was 73% compared to 40% and 7% by K-67 and K-743, respectively at 20 dS m^{-1}. This variety also produced maximum dry shoot and root weights and hence showed least reduction in growth in response to salinity. It was also observed that salinity affected shoot more than root. The K:Na ratios in leaves, shoot and root also revealed the salt tolerance of K-28 which maintained high K:Na ratio in leaves and low in stem, indicating less of absorbed Na^+ being translocated to leaves. Overall, results revealed that K-28 was relatively more salt tolerant than K-67 and K-743.

INTRODUCTION

Salinity inhibits plant growth in many ways. Possible causes for reduction in growth may be water stress, specific ion stress or ion toxicity and induced nutrient deficiency (Wyn Jones, 1981). Plant species and even the varieties of species vary in their salt tolerance at various growth stages. It is, therefore, necessary to identify the differences in salt tolerance among the varieties for a better utilization of salt-affected soils that cover 6.3 m ha^{-1} of the Pakistan's land.

Leucaena leucocephala (ipil ipil) has adaptability to various ecological conditions (Gupta *et al.* , 1986) and salinity (Hansen and Munns, 1988; Gorham *et al.*, 1988 and Niazi *et al.*, 1985). It provides pulp for the production of printing, writing and wrapping papers, rayon, cellophane and dyes and its leaves can also be used as a mixed fodder due to higher contents of protein (20-27%), carotene, vitamin K and other nutrients (Brewbaker *et al.*, 1985). The present study was undertaken to assess the relative salt tolerance of different *Leucaena* varieties in nutrient culture.

MATERIALS AND METHODS

Germination studies: Hot water (80°C) treated seeds of K-67, K-743 and K-28 were placed between the two filter paper sheets in triplicate. Half-strength Hoagland's solution (Hoagland and Arnon, 1950) having NaCl developed EC 2 (control), 5, 10 and 20 dS m^{-1} were added in the respective treatments to keep the seed wet. Washings with respective EC solutions were done daily to maintain the desired salt concentration. Germination was counted upto fifteen days.

Plant-growth studies: Twenty-days old seedlings raised in silica sand were transplanted to foam plugged holes in thermopol sheets floating over the nutrient solution. Known amounts of nutrient solutions were added according to modified phostrogen solution to each tub containing 100 l canal water. Each variety was replicated thrice following the Completely Randomised Design (CRD). Three days after transplanting plants were subjected to incremental salt stress of 2.5 dS m^{-1} per day by adding NaCl and $CaCl_2$ in the millimolar ratio of 10:1 till the final salinity levels of 5, 10 and 20 dS m^{-1} were achieved in the respective tubs. One tub was kept as control with an average EC of 2 dS m^{-1}. Nutrient solution was regularly aerated gently with air compressor continuously for 24 hours. EC and pH (6.0-6.5) of the solution were checked and maintained daily. Nutrient solution was changed after every ten days. Crop was harvested one month after the final salinity levels were achieved. Plant samples were taken for fresh and dry weights. Leaf, stem and root samples were extracted with nitric acid for Na^+, K^+ and Cl^- analysis.

RESULTS AND DISCUSSION

Seed germination: Data presented in Table 1 show decrease in percent germination of K-67, K-743 and K-28 varieties with increase in salinity. All the varieties gave 100% germination in control and 5 dS m^{-1} EC. However, at higher salinity levels i.e. EC 10 and 20 dS m^{-1}, varieties clearly showed variable response to the increasing salinity levels. Decrease in seed germination of *Leucaena leucocephala* at higher salinity was also reported by Sial (1982) and Niazi *et al.* (1985). Overall, K-28 gave the maximum germination at all salinity levels. At EC 20 dS m^{-1} its per cent germination was 73% compared to 40% and only 7% by K-67 and K-743, respectively. Results clearly indicate that K-28 is relatively tolerant, K-67 moderately tolerant and K-743 sensitive to high salinity (20 dS m^{-1}) at germination stage.

Plant growth and chemical composition: Shoot and root growth are the important indicators of plant biomass production particularly under stress conditions. Shoot and root dry weights of all the varieties decreased with increase in salinity (Table 2). Sial (1982) also reported reduction in dry matter yields of shoot and root of *Leucaena leucocephala* with salinity. Maximum dry matter yields of shoot and root were recorded in the case of K-28 followed by K-67 and K-743. Calculated EC values for 50% reduction in shoot dry weight were 10.7, 5.2 and 11.9 dS m^{-1} for K-67, K-743 and K-28, respectively. Shoot:root ratio also indicated that salinity affected shoot more than root. Except K-67 which showed increased shoot growth at 5 dS m^{-1} salinity, rest of the varieties showed decreasing trend in shoot:root ratios. From this it can be con-

Table 1. Effect of salinity on seed germination (% of control)

Variety	EC (dS m^{-1}) 5	10	20	Mean
K-67	100 a	80 c	40 f	73 B
K-743	100 a	67 e	7 g	58 C
K-28	100 a	93 b	73 d	89 A

Table 2. Effect of salinity on plant growth

Variety	EC ($dS\ m^{-1}$) 2	5	10	Mean
Shoot dry weight (g $plant^{-1}$)				
K-67	4.9 b	4.4 bc	2.5 d	3.9 A
K-743	4.1 c	2.5 d	0.0 e	2.2 B
K-28	5.1 a	4.6 ab	2.9 d	4.2 A
Mean	4.7 A	3.8 B	1.8 C	
Root dry weight (g $plant^{-1}$)				
K-67	1.4 a	1.1 b	0.8 c	1.1 A
K-743	1.2 b	0.8 a	0.0 d	0.7 B
K-28	1.4 a	1.2 b	0.9 c	1.2 A
Mean	1.3 A	1.0 B	0.6 C	
Shoot:Root ratio				
K-67	3.5	4.0	3.1	3.5
K-743	3.4	3.1	0.0	2.2
K-28	3.6	3.8	3.2	2.2
Mean	3.5	3.6	2.1	

Table 3. Effect of salinity on K:Na ratio

Variety	EC ($dS\ m^{-1}$) 2	5	10	Mean
Leaf				
K-67	2.9	1.5	1.1	1.8 B
K-28	3.5	1.8	1.2	2.2 A
Mean	3.2 A	1.7 B	1.2 C	
Stem				
K-67	1.9	0.8	0.6	1.1 A
K-28	2.4	0.9	0.7	1.3 A
Mean	2.2 A	0.9 B	0.7 C	
Root				
K-67	3.5	1.2	1.0	1.9 B
K-28	4.3	1.4	1.2	2.3 A
Mean	3.9 A	1.3 B	1.1 C	

Means in rows and columns with different letter(s) differ significantly at P = 0.05.

cluded that salinity had less effect on root growth than the above ground portion of plant i.e. shoot. K:Na ratio was higher in leaves than in stem, indicating that a small proportion of the absorbed Na^+ was translocated towards leaves (Table 3). This energy requiring phenomenon causes reduction in plant growth (Table 2). Yaseen *et al.* (1990) reported similar conclusion in *Sesbania aculeata* varieties. Since the variety K-28 preferentially retained more Na^+ (toxic for growth) in stem and more of K^+ (acts as compatible osmoticum, Wolf *et. al.*, 1991) in leaves, so this variety proved more tolerant to salinity compared to K-67. The K:Na ratio in leaf, stem and root of both the varieties decreased with the increase in salinity (Table 3). Overall, leaves of K-67 and K-28 maintained higher K:Na ratio which was almost equal to that of K:Na ratio in root but stem contained low K:Na ratio indicating that *Leucaena* plants retained more Na^+ in stem to set free leaves of Na^+ excess-a physiologically active part of the plant.

Note: Data about ionic composition at 20 dS m^{-1} EC and that of Variety K-743 were not discussed because all the varieties failed to maintain their growth at 20 dS m^{-1} EC level. This was probably due to high temperature (40-45°C) and dry climatic conditions during the experimental period. High temperature and low relative humidity decrease the salt tolerance of crops especially salt sensitive one's. That is why the variety K-743 did not grow longer at 10 dS m^{-1} salinity that reflects its sensitivity for NaCl salinity.

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