EFFECT OF SALINITY AND WATER LEVELS ON ROOT/SHOOT DEVELOPMENT OF *ACACIA AMPLICEPS* (MASLIN)

*Zahoor Hussain Khan, M. Safeer, Amer H. Shah, Rashid Ahmed Khan and Shahid Yaqoob,**

ABSTRACT

These studies were conducted in the Department of Forestry, Range Management and Livestock, University of Agriculture, Faisalabad, Pakistan during 2006. Maximum root length (31.318cm) of *Acacia ampliceps* (Maslin) was recorded in normal soil irrigated with maximum water level of 125 percent of field capacity (FC) while minimum (zero cm) in highly saline soil (ECe 36.10 dS/m) irrigated with 50 percent water level of FC. Maximum shoot length (31.114 cm) was recorded in saline soil having ECe 11.33 dS/m against minimum (zero cm) in highly saline soil (ECe 36.10 dS/m). Low shoot growth was observed in all irrigation regimes of 50 percent in all salinity levels. Maximum and minimum root and shoot weight of *Acacia ampliceps* was found in saline soil having ECe 11.33 dS/m and highly saline soil having ECe 36.1 dS/m, respectively. More effect of 125 percent water level of FC was observed on fresh shoot weight in normal soil. Maximum dry root and shoot weight was found in saline soil having ECe 11.33 dS/m while minimum was noted in highly saline soil (ECe 36.1 dS/m). Water level of 125percent of FC showed maximum fresh shoot weight in normal soil as well as in saline soils as compared to other water levels.

KEYWORDS: Acacia ampliceps; saline soil; stems; roots; Pakistan.

INTRODUCTION

Soil salinity is a world wide problem that limits crop production in arid and semi arid regions (15). Flower *et al.* (8) reported that salinity affected 7 percent of the world total land area whereas Pessarakli and Szobolcs (16) pointed out that percentage of cultivated land affected by salts was even greater and comprised 19 percent of 20.8 billion hectares of arable land on earth. Furthermore, Saboora *et al.* (22) warned that there was a dangerous trend of a 10 percent per year increase in saline area throughout the world.

***Department of Forestry, Range Management and Wildlife, University of Agriculture, Faisalabad, Pakistan.**

Salinity and sodicity are most talked soil ailments in Pakistan (4, 11, 19, 20). Khan (11) stated that saline soils cover 5.3 million hectares in Pakistan. Out of 20 million hectares of agriculture land 6.67 m hectares are salt affected (2). Quraishi and Rana (18) stated that 8.1 percent of total geographical area of Pakistan is suffering from salinity. They further added that salinity covers 15.2, 24.3 and 2.7 percent areas of Punjab, Sindh and Baluchistan provinces, respectively. Detmann (7) estimated that 40,000 hectare land suffers from salinity and water logging every year whereas one acre of farm land becomes useless for crop production in every 5 minutes. Aslam (4) pointed out that tree planting is the cheapest and simple natural biological approach to control salinity and water logging and is preferred to engineering approach which is very expensive and complicated. Amjad *et al*., (1) and Quraishi *et al.* (17) state that there is acute shortage of wood in the country to meet its ever growing demand. In view of salinity and water logging menace one should test woody halophyte which may grow well in saline and drought conditions and contribute significantly in wood production. *Acacia ampliceps* (Maslin) having high economic potential has been reported as salt and drought resistant tree in Australia (6). Ansari *et al.* (2) and Aswathapa (5) have offered similar observation. However, no novel attempt was made to test it under saline and drought conditions in Pakistan. Present study was conducted to find out salinity and water levels effect on root and shoot development of *Acacia ampliceps* (Maslin).

MATERIALS AND METHODS

This study was carried out in green house of the Department of Forestry, Range Management and Wildlife, University of Agriculture, Faisalabad, Pakistan during 2006. Four levels of salinity (ECe 3.61, 11.33, 21.70 and 36.10 dS/m) and four levels of water (50,75, 100 and 125% water of field capacity) were tested against *Acacia ampliceps* (Maslin) and growth of root and shoot was recorded. Soil of pre-determined exact salinity level (3.61 dS/m ECe) was collected from nursery of Department whereas soils having exact 11.33, 21.70 and 36.10 dS/m ECe salinity levels were collected form Pakkanna, Faisalabad. Chemical analysis of soils (Table.1) was carried out at Nuclear Institute of Agriculture and Biology (NIAB), Faisalabad, following Jackson (10).

Table 1. Chemical analysis of soils used in experiment soil type.

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S.No.	Chemical characteristics	Soil types			
		1	2	3	4
1.	EC (dS/m)	3.61	11.33	21.70	36.10
2.	TSS (m mol/L)	36.10	113.30	217.00	361.00
3.	pH	8.29	8.16	8.29	8.45
4.	CO_3^{2-} (m mol/L)	2.00	0.00	1.00	2.00
5.	HCO_3^-(m mol/L)	8.00	7.00	9.00	7.50
6.	Cl^- (m mol/L)	15.66	37.26	211.90	261.89
7.	SO_4^{2-} (m mol/L)	10.44	69.04	73.08	89.91
8.	$Ca^{2+} + Mg^{2+}$ (m mol/L)	3.55	40.77	15.60	44.31
9.	Na^+ (m mol/L)	13.94	20.08	23.11	54.42
10.	K^+ (m mol/L)	3.73	2.87	22.28	40.25
11.	S.A.R	10.48	4.45	8.28	11.56
12.	Saturation percentage	38.68	27.094	28.816	32.61
13.	Field capacity (FC) (%)	19.34	13.547	14.408	16.30
14.	50% water level of FC (m1/7 kg soil)	67.69	47.41	50.42	57.05
15.	75% water level of FC (ml/7 kg soil)	101.53	71.12	75.64	85.57
16.	100% water level of FC (ml/7 kg soil)	135.38	94.82	100.85	114.1
17.	125% water level of FC (ml/7 kg soil)	169.22	118.53	126.07	142.62

Soil type No. 1: Normal soil collected from the nursery of Department which had exact ECe 3.61 dS/m.
Soil type No. 2: Slight saline soil collected from Pakkanaa, Faisalabad which had exact 11.33 ECe dS/m.
Soil type No. 3: Moderate saline soil collected from Pakkanna, Faisalabad which had exact 21.70 ECe dS/m.
Soil type No. 4: High saline soil collected from Pakkanna, Faisalabad which had exact 36.10 ECe dS/m.

Soils were air dried, ground and passed through 2 mm sieve before filling 7 kg in each plastic pot of uniform size (upper diameter 10", lower diameter 7.5" and depth 10"). Seeds of *Acacia ampliceps* (Maslin) were treated with boiling hot water for five minutes and then soaked in fresh water for whole night before sowing in earthen pots having pure sand to obtain seedlings. Distilled water free from salts was used to raise seedlings. After some weeks, these seedlings were transplanted to aforementioned plastic pots having soils of 3.61, 11.33, 21.70 and 36.10 dS/m salinity separately. Four water levels (50, 75, 100 and 125% water of FC) were applied to each salinity level of each soil type making a total of 16 treatments . There were 80 pots which were arranged in five rows. Each row consisted of 16 pots and presented one replicate while each pot of each row represented one treatment.

Water levels were prepared by employing method as described by Hussain and Jabbar (9). Seedlings were grown till phyllod stage to study root and

shoot development. The data collected were statistically analyzed following procedures as described by Steel *et al*. (23).

RESULTS AND DISCUSSION

Analysis of variance showed that salinity and water levels had significant effect on the length and oven- dried weight of root and shoot (Table 2).

Table 2. Effect of salinity and water levels on the growth of root and shoot of *Acacia ampliceps*.

Treatments			Root length (cm)	Oven-dried weight of root (g)	Shoot length (cm)	Oven-dried weight of shoot (g)
T_1	=	Normal soil (ECe 3.61 dS/m) applied with 50% water of F.C.	22.22bcde	0.38cd	19.76de	1.25g
T_2	=	Normal soil (ECe 3.61 dS/m) applied with 75% water of F.C.	28.08ab	0.55abc	22.87bcd	2.21cd
T_3	=	Normal soil (ECe 3.61 dS/m) applied with 100% water of F.C.	28.67ab	0.63ab	26.84abc	2.59bc
T_4	=	Normal soil (ECe 3.61 dS/m) applied with 125% water of F.C.	31.31a	0.64a	27.84ab	3.20a
T_5	=	Saline soil (ECe 11.33 dS/m) applied with 50% water of F.C.	23.51abcd	0.44bcd	21.22cde	1.42f
T_6	=	Saline soil (ECe 11.33 dS/m) applied with 75% water of F.C.	29.61ab	0.49abcd	23.33bcd	1.17ef
T_7	=	Saline soil (ECe 11.33 dS/m) applied with 100% water of F.C.	28.56ab	0.56abc	21.82bcde	2.08de
T_8	=	Saline soil (ECe 11.33 dS/m) applied with 125% water of F.C.	26.17abc	0.62ab	31.11a	2.96ab
T_9	=	Saline soil (ECe 21.70 dS/m) applied with 50% water of F.C.	11.05fg	0.16e	9.00gh	0.41gh
T_{10}	=	Saline soil (ECe 21.70 dS/m) applied with 75% water of F.C.	13.97ef	0.14e	18.13def	0.66g
T_{11}	=	Saline soil (ECe 21.70 dS/m) applied with 100% water of F.C.	17.62cdef	0.15e	13.18fg	0.52g
T_{12}	=	Saline soil (ECe 21.70 dS/m) applied with 125% water of F.C.	16.28def	0.35d	15.71ef	0.39gh
T_{13}	=	Normal soil (ECe 36.10 dS/m) applied with 50% water of F.C.	0.00h	0.00e	0.00i	0.00h
T_{14}	=	Saline soil (ECe 36.10 dS/m) applied with 75% water of F.C.	5.32ghj	0.01e	3.42hi	0.04h
T_{15}	=	Saline soil (ECe 36.10 d/Sm) applied with 100% water of F.C.	0.00h	0.00e	0.00i	0.00h
T_{16}	=	Saline soil (ECe 36.10 dS/m) applied with 125% water of F.C.	0.00h	0.00e	0.00i	0.00h
		Coefficient variation:	38.90%	44.64%	30.52%	28.98%
		LSD value	4.35	0.09	3.04	0.22

Means with same letters denote non-significant differences at 5% level of probability.

Mutual mean differences of last four treatments i.e. T_{13} -T_{16} were found non-significant for all recorded parameters (length and oven- dried weight of root and shoot) except T_{14} for root and shoot length because seedlings of *Acacia ampliceps* could not survive in highly saline soil (ECe 36.10 dS/m) despite supply of high amount of water,. In addition, mutual mean differences of T_2,

T_3, T_6 and T_7 for root length; T_2 and T_6 for shoot length; T_2, T_3 T_7 ,T_3 ,T_8 ,T_9 and T_{10} for oven dried weight of root; T_1, T_5, T_9, T_{10}, T_{11} , T_{12}, for oven- dried weight of shoot were also found non- significant. All other treatment mean differences were observed as significant.

T_4 gave maximum values of root length (31.31cm), oven- dried weight of root (0.64g) and shoot (3.20g) whereas T_8 excelled in shoot length (31.11cm). On the other hand, $T_{13,}$ T_{15} and T_{16} gave the lowest values for all parameters where nothing was obtained. However, T_{14} gave 5.32cm and 3.42cm long root and shoot, respectively.

It is an established fact that salinity and drought have detrimental effect on plant growth. Like other trees, *Acacia ampliceps* is also affected by these stress factors. From these results, it was observed that as salinity levels increased, development of root and shoot of *Acacia ampliceps* decreased and eventually ceased at ECe 36.10 dS/m. Moreover, length and oven- dried weight of root and shoot gradually increased as water levels increased from 50 to 125 percent water of FC in all saline group of soils having ECe 3.61 to 21.70 dS/m except high saline soil having ECe 36.10 dS/m where plant could not survive and no result came out despite application of maximum water. This was due to adverse disturbance in physiological and metabolic process occurring in plant body due to salt accumulation and ion concentration as reported earlier (4, 13, 14, 15, 16, 17, 22, 25).

On the basis of results, it is suggested that *Acacia ampliceps* (Maslin) can be grown successfully on saline lands having salinity less than ECe 36.10 dS/m.

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