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SALT TOLERANCE STUDIES ON IPIL IPIL (*LEUCAENA LEUCOCEPHELA* L.) CV. K-8

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Abstract

Ipil Ipil (*Leucaena leucocephela* L.) CV K-8 has been studied for its salt tolerance in pots containing gravel soaked in nutrient solution maintained at electrical conductivity (EC) of 3, 5, 10, 15 and 20 $mScm^{-1}$. Increase in salt contents adversely affected germination and plant growth. Fifty percent reduction in plant growth occurred at EC of 12.4 $mScm^{-1}$.

Introduction

Leucaena leucocephela L. locally known as ipil ipil has recently been introduced in Pakistan as a fast growing tree with its potential use as forage, fire wood, timber etc. (Brewbaker, 1975). Since a large area of arable land in Pakistan is saline-sodic, one of the approaches of utilizing such soil is for production of biomass which could then be converted to usable energy and in the process also improves the soil (Sandhu & Malik, 1975; Malik, 1978; Naqvi, 1983). Of the various plants screened for salt tolerance (Anon, 1982), ipil ipil (*L. leucocephela*) a legume has been tested for salt tolerance so that its potential for colonizing saline lands could be ascertained.

Materials and Methods

Gravel culture technique (Qureshi *et al.*, 1977) was used for studying the effect of salinity on germination of ipil ipil Cv. K-8. Coarse gravel (2-5 mm dia) was filled in 500 ml plastic beakers into which 250 ml half strength Hoagland solution maintained at salinity levels of 3, 5, 10, 15 and 20 $mScm^{-1}$ was added. Proper scarification of the seeds was carried out before sowing (Jones *et al.*, 1976). Ten such pretreated seeds were sown in each beaker at a salinity level. Number of seedlings that emerged or died after emergence was recorded daily over a period of 4 weeks.

The scarified seeds were sown in a fertile garden soil in 10 x 18 cm polythene bags, one seed per bag. When the seedlings were 15 cm high, these were then transplanted to glazed pots (26 cm dia., 28 cm deep) containing gravel saturated with Hoagland nutrient solution. After a week, the plants were subjected to salinity levels of 5, 10, 15 and 20 $mScm^{-1}$ by stepwise increase of 2.5 $mScm^{-1}$ every 2 days. The salinity level was subsequently maintained. Three plants pot^{-1} were grown for 66 days when plant height and dry matter content of aerial parts and roots were determined. The dried and powdered plant material was used for the determination of Na, K and Ca by flame photometry. Total ash content (Jackson, 1962) and Cl content was estimated following the procedure of Chapman & Pratt (1961).

Results and Discussion

Maximum germination of 83% was obtained at salinity of 3 $mScm^{-1}$ (control) and 5 $mScm^{-1}$ whereas no germination was recorded at 20 $mScm^{-1}$ (Table 1). Ipil Ipil seedlings were relatively more sensitive to salinity as nearly half of the germinated seeds at EC 10 and 15 $mScm^{-1}$ could not reach the seedling stage and died. A negative significant correlation was noticed between the seedling survival and the level of root zone salinity.

Table 1. Effect of salinity levels on growth parameters and ash content of Ipil-Ipil.

Root zone salinity $mScm^{-1}$	Germination %	Survival %	Plant height (cm)	Dry weight of leayes + stem $plant^{-1}$ (g)	Dry weight of root $plant^{-1}$ (g)
3 (Control)	83 a	92 a	93.48 a	14.33 a	10.12 a
5	83 a	73 a	87.25 ab (6.63)	13.90 b (3.00)	8.42 b (16.80)
10	67 ab	31 c	66.10 b (29.3)	10.36 c (27.70)	6.79 c (32.91)
15	43 b	25 c	37.28 c (60.32)	4.45 d (68.11)	2.44 d (76.58)
20	0.0 c	0.0 d	36.60 c (60.75)	3.03 c (78.86)	1.95 e (89.13)

Figures in parenthesis are % reduction over control.
abcd: Values sharing the same letter are not significantly different (P = 0.05).

Average plant height progressively decreased from 93.5 cm to 66.10 cm when the root zone salinity increased from 3 $mScm^{-1}$ to 10 $mScm^{-1}$ (Table 1); at 20 $mScm^{-1}$ the average plant height was only 36.6 cm corresponding to 60.75% reduction in height. Some of the plants died at an EC level of 20 $mScm^{-1}$. A significant negative correlation was observed between the plant height and the level of root zone salinity.

An increase in the root zone salinity decreased the dry matter yield from 14.33 g $plant^{-1}$ of aerial parts to 3.03 g $plant^{-1}$ (78.86% reduction) and from 10.12 g $plant^{-1}$ of roots to 1.95 g $plant^{-1}$ corresponding to 89.13% reduction when the EC level increased from 3 $mScm^{-1}$ to 20 $mScm^{-1}$. A significant negative correlation was found between the root zone salinity and dry matter yield. Similar results have been reported by Attaullah *et al.* (1981) in case of lucerne (*Medicago sativa*). Based on these results, the salt tolerance limit of reduction in green matter yield by 50% has been calculated to be at an EC of 12.4 $mScm^{-1}$

Ash content of plant tissue is an index of total ion retention in the plant body under test. With an increase in root zone salinity the ash content of plant showed an increase (Table 2) and even roots showed higher percentage of salts compared with aerial parts. Presumably the absorbed ions were retained by the roots and the aerial parts performed their normal physiological functions which may in part account for its tolerance to salts. A significant positive correlation was observed between the level of root zone salinity and the ash content of all parts of the plant.

The absorption of Na was accompanied by a substantial decrease of K in all parts of the plants. Similar observations have been made in barley (Greenway, 1962) and lucerne (Attaullah *et al.*, 1981). Epstein (1961) reported that the basic cause of K deficiency in case of salinization is a competitive inter-relationship between Na and K. A significant positive correlation was confirmed between the level of root zone salinity and Na content of all parts of the plants and a significant negative correlation was observed for K. Ca and Mg levels of aerial parts and roots decreased with increase in salinity. The uptake of Ca decreased from 120 me^{-100g} to 65 me^{-100g} in aerial parts and from 125 m^{-100g} to 73 me^{-100g} in roots when the EC levels of root zone salinity increased from 3 to 20 $mScm^{-1}$. Similar trend was noticed in case of Mg contents of both aerial parts and roots. Chloride contents (Table 2) of aerial parts increased from 40.625 to 109.375 me^{-100g}, but in case of roots the chloride contents decreased from 65.625 me^{-100g} to 18.75 me^{-100g} when the EC level of the root zone salinity increased from 3 $mScm^{-1}$ to 20 $mScm^{-1}$.

The results obtained from this investigation have shown that *L. leucocephela* cv. K-8 is marginally salt tolerant (12.4 $mScm^{-1}$) when compared to Kallar grass (*Diplachne fuscea*) which has a salt tolerance limit of 22.0 $mScm^{-1}$ (Sandhu *et al.*, 1981). As such Ipil Ipil can only be introduced in saline sodic areas as a secondary colonizer. Further work on its nodulation and inoculation by *Rhizobium* strain is in progress.

Table 2. Effect of salinity levels on the chemical composition of Ipil-Ipil.

Root zone salinity $mScm^{-1}$	me^{-100g} dry weight of plant material											
	Na		K		Ca		Mg		Cl		Ash content (% age)	
	Leaves + stem	Roots	Leaves + stem	Roots	Leaves + stem	Roots	Leaves + stem	Roots	Leaves + stem	Roots	Leaves + stem	Roots
3	15.20e	32.55e	76.0a	68.0a	120.0a	125.0a	75.0a	85.0	40.625a	65.625a	7.73e	10.80d
5	32.55d	59.10d	71.50a	60.0b	110.75b	115.0a	74.25a	80.0	53.125b	45.305b	8.52d	10.93d
10	91.90c	98.70c	64.50b	53.0c	90.0c	102.5b	45.0b	67.5	65.625c	40.625b	9.01c	12.50c
15	119.48b	160.96b	60.375bc	48.0d	75.18d	83.125c	32.31b	55.625	78.125d	25.0c	9.62b	13.06b
20	160.60a	192.60a	55.50c	45.0d	65.0e	75.0c	30.0b	35.0	109.375e	18.75c	13.38a	15.49a

abc: Values sharing the same letter are not significantly different (P = 0.05).

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