EFFECT OF IRRIGATION FREQUENCY ON GERMINATION, ROOT AND SHOOT YIELDS OF *LEUCAENA LEUCOCEPHALA*

J. Kayode and P. O. Tedela[1]

Abstract

Leucaena leucocephala planted in three different soil samples was subjected to three different watering treatments. Though the rates of growth of the seedlings, their root lengths and the number of lateral roots produced improved with the frequency of watering, Statistical analyses at 5% level revealed that the different watering treatments had no significant effects on these growth parameters in different soil samples. Both the soil type and the frequency of watering affected the number of nodules. The dry weight of nodules was affected by soil type but the soil type and the frequency of watering did not significantly affect the dry shoot and root weights.

Keywords: Irrigation frequency, Germination, Root and shoot yields, *Leucaena leucocephala*.

Introduction

Leucaena leucocephala (Lam) de Wit, Leguminosae, is a legume tree, which originated in Central America (Anon, 1984). The species is now widely used in afforestation and reclamation of degraded soil. In Nigeria, the species is commonly found growing along roadsides and waste lands (Nyawuame and Gill, 1990; Nyawuame, 1992). In a recent survey of farmlands in southwestern Nigeria, *L. leucocephala* was observed to be widely adopted for alley farming, a practice which is gaining wide spread adoption in the region. The species is equally valued as fodder in the study area.

Consequent on the above, a thorough understanding of the biology of this species is considered as highly desirable in the study area. Previous research efforts in Nigeria had concentrated mostly on the utilization of the species while a gross dearth of literature abounds on its eco-physiology. This aspect is considered as an important pre-requisite for its biology. This study was carried out to achieve this objective.

Materials and methods

Seeds of *L. leucocephala* were obtained from the New Forest Project, Washington, USA. Soil samples were collected at 10cm depth from three sites viz, a 2-year-old fallow land, a cultivated maize (corn) farmland and a degraded land from a construction site in Ado-Ekiti, Ekiti State, Nigeria. Ado-Ekiti ($7^{o}40'$N, $5^{o}15'$E) has a tropical and hot humid climate with a bimodal rainfall pattern. The rain season lasts from March to

[1] Department of Plant Science, University of Ado-Ekiti, Ado-Ekiti, Nigeria.

November with a short dry spell in August, and the hot dry season between November and February.

Each of the soil samples was fed into 30 pots. Five seeds of *L. leucocephala* were planted in each pot. The pots were watered daily for 3weeks either early in the morning or late in the evening. After germination the seedlings were thinned to one plant per pot. Weekly heights of seedlings were measured. After 3 weeks, the seedlings from each soil sample were divided into three sub-groups of 10 seedlings per sub-group and were subjected to three different watering treatments for 4 months. One group was watered daily, another every two days and the third, every four days. The relative growth rate (RGR) for height was calculated for seedlings in each soil sample using the relationship:

$$RGR=\ln H_2-\ln H_1/t_2-t_1$$

Where H_2 is the final height,

H_1 is the height before treatment

t_2-t_1 is the number of days between the two height measurements

The plants in each sub-group were harvested after 4 months and separated into shoots, roots and nodules. The fresh and dry weights of the component parts were determined. Nodulation index, which accounts for the effect of plant size on nodules mass, was determined after Hughes and Herridge (1989) as:

Nodulation Index = Nodules mass / Shoot mass x 100

Data obtained were subjected to statistical analysis (t-test and ANOVA, P= 5%).

Results and Discussion

Weekly increase in seedling height in three soil samples with water given daily revealed that though seedlings from the fallow soil appeared to have the highest increase in height while the least demonstrated by seedlings from degraded soil yet the RGR values were the same in all the soil samples (Table 1). Also the growth in height was not significantly different (P=0.05) in all the soil samples. Thus supporting the previous assertion of Cobbina *et al.* (1990) that height of *L. leucocephala* both in fertile and poor soils does not differ significantly.

Table 1. Weekly increase in seedling height of *L. leucocephala* after daily water treatment.

Soil Sample	Seedling Heights (cm)			RGR
	1	2	3	
Fallow soil	1.50	5.35	6.55	0.11
Cultivated soil	1.17	4.27	5.82	0.11
Degraded soil	1.06	3.71	4.97	0.11

The monthly growth in heights of *L. leucocephala* seedlings following different watering treatments in the three soil samples displayed that the rate of growth tended to increase with the increase in the frequency of watering in all the soil samples (Table 2). Seedlings watered on daily basis had the highest height though statistical analyses at 5% level revealed that the results from different watering treatments were not significantly different from one another on the same soil sample. Also the RGR values obtained from seedlings in the same soil samples were relatively the same. Thus *L. leucocephala,* as previously observed by Manidol (1984), may be said to be tolerant of low moisture, especially during its early growth (Ezenwa and Atta-Krah, 1990).

Table 2. Monthly increase in seedling height of *L..leucocephala* given different watering treatments

Soil Sample	Watering Treatment	Monthly Seedling Heights (cm)				RGR
		1	2	3	4	
Fallow	Everyday	22.20	58.31	102.53	125.39	0.08
	Every 2nd day	19.43	55.83	100.01	121.47	0.09
	Every 4th day	14.95	42.77	88.95	110.93	0.10
Cultivated	Everyday	12.88	31.23	70.89	101.05	0.10
	Every 2nd day	12.28	30.45	70.37	93.65	0.10
	Every 4th day	10.13	31.00	70.30	86.73	0.10
Degraded	Everyday	11.77	33.67	79.07	98.12	0.10
	Every 2nd day	9.32	33.30	65.93	93.68	0.11
	Every 4th day	6.29	32.98	62.31	90.58	0.13

Similarly, the root lengths and the number of lateral roots produced by *L. leucocephala* seedlings from different soil samples following different watering treatments (Tables 3 and 4) increased with the frequency of watering. The root lengths obtained in this study could be described as long when compared to those obtained in previous

studies and the age of the seedlings. The development of long taproots is a distinct feature of *L. leucocephala* (Ezenwa and Atta-Krah, 1990) and ecological strategy that safeguards this species against droughts (Anon, 1984). Statistical analyses (P=0.05, ANOVA) revealed that although there were no significant differences in the root lengths and number of lateral roots produced by the seedlings from different soil samples but there were significant differences in the root lengths and number of lateral roots produced by different watering treatments on the seedlings in different test soil samples. The development of lateral roots is being considered as a critical factor in the relatively ecological success of this species. The lateral roots are the major point of attachment of the nodules (Anon, 1984, Ezenwa and Atta-Krah, 1990).

Table 3. Root lengths of seedlings of *L. leucocephala* given three watering treatments

Watering Treatment	Root lengths of seedlings/soil*		
	Fallow	Cultivated	Degraded
Everyday	104.72a	88.09a	80.01a
Every 2nd day	74.42b	80.25ab	63.90b
Every 4th day	67.62c	70.56b	62.50b

Table 4. Lateral roots development by seedlings of *L. leucocephala* given three watering treatments

Watering Treatment	Root lengths of seedlings/soil*		
	Fallow	Cultivated	Degraded
Everyday	75a	68a	67a
Every 2nd day	62b	61b	59b
Every 4th day	58b	54c	50c

Results obtained in this study also revealed that the number of lateral roots produced by seedlings of *L. leucocephala* is affected by the frequency of watering. Other factors that could also result in low number of lateral roots include the confinements of the seedlings to pots (Venkateswarly *et al.,* 1990) and age of the seedlings (Ezenwa and Atta-Krah, 1990).

The number of lateral roots produced has direct consequences on the amounts of nodules produced. Study by Vankateswarly and Singh (1988) had showed that the

periods of nodules formation and rapid increase in the number of nodules coincided with the period of proliferation of lateral roots. The number of nodules was affected by the frequency of watering. Statistical analyses, at 5% level, showed that both the soil type and the frequency of watering had significant effects on the number of nodules (Tables 5 and 6). The soil type also had significant effects on the dry weight of nodules but no significant differences were produced by the different watering treatment on the dry weights of nodules. Both the soil types and the different watering treatments did not significantly affect the dry shoot and root weights.

Table 5. Nodule development by seedlings of *L. leucocephala* given three watering treatments

Watering Treatment	Number of nodules			Nodule dry weight (g)			Nodulation index		
	FL	CL	DL	FL	CL	DL	FL	CL	DL
Everyday	35.5	12.6	11.9	0.89	0.18	0.20	0.14	0.04	0.04
Every 2 days	30.6	9.5	11.7	0.64	0.14	0.19	0.11	0.06	0.07
Every 4 days	30.5	6.3	3.0	0.70	0.14	0.10	0.16	0.06	0.04

* FL: Fallow soil CL: Cultivated soil DL: Degraded soil

Table 6. Biomass production by seedlings of *L. leucocephala* given three watering treatments

Watering Treatment	Dry shoot weight (g)			Dry root weight (g)		
	FL	CL	DL	FL	CL	DL
Everyday	6.56	4.54	5.18	0.98	0.63	0.53
Every 2nd day	5.59	2.31	2.92	0.62	0.36	0.32
Every 4th day	4.29	2.35	2.43	0.46	0.32	0.20

* FL: Fallow soil CL: Cultivated soil DL: Degraded soil

Acknowledgement

The authors would like to thank the New Forest Project, USA for the provision of the seeds and Laboratory staff of the Department of Plant Science, University of Ado-Ekiti, Ado-Ekiti, Nigeria who facilitated the field studies.

References

Annon, 1984. *Leucaena: promising forage and tree crop for the tropics.* National Research Council, Washington, DC. 100pp.

Cobbina,J., K. Mulongoy and A. N. Atta-Krah, 1990. Soil factors influencing initial growth of Leucaena and gliricidia in an alfisol of southwestern Nigeria. *Leucaena Research Reports,* 11: 94-98.

Ezenwa, I. V. and A.N. Atta-krah, 1990. Initial growth and nodule development of *Leucaena* and *Gliricidia. Leucaena Research Reports,* 11: 99-101.

Hughes, R. M. and D. F. Herridge, 1989. Effects of tillage on yield, nodulation and nitrogen fixation of soybean in far north-coastal New South Wales. *Australian Jour. of Experi. Agric.* 29: 671-77.

Manidol, C. 1984. *Utilization of tree legumes with crop residues as animal feeds in Thailand*. Proceedings of International Workshop on Relevance of Crop

Nyawuame, H. G. K. and L. S. Gill, 1990. Epidermal morphology and antogeny of stomata in *Leucaena leucocephala* (Lam.) De Wit. *Leucaena Research Reports* 11: 104-106.

Nyawuame, H. G. K. 1992. Leaf cuticle variations in *Leucaena leucocephala* as indicators of environmental pollution. *Leucaena Research Reports,* 13: 62 -64.

Venkateswarly, B. and R.P. Singh, 1988. Nodulation and nitrogenase activity patterns of *Leucaena leucocephala* and *Gliricidia sepium* during early stages of growth. *Leucaena Research Reports,* 9: 55-58.

Venkateswarly, B., Korwar, G.R. and R. P. Singh, 1990. Nodulation N_2ase activity and growth of *Leucaena leucocephala* as influenced by container size and time of inoculation. *Leucaena Research Reports,* 11: 62-64.