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THE EFFECT OF SOURCE OF NITROGEN AND FREQUENCY OF MOISTURE SUPPLY ON GROWTH AND MACRONUTRIENT DISTRIBUTION IN SEEDLINGS OF THE AFRICAN LOCUST BEAN, *PARKIA BIGLOBOSA*

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The semi-arid northern region of Nigeria is being threatened by the encroaching Sahara Desert. Consequently, afforestation programmes are being embarked upon to enhance rapid vegetation cover. *Parkia biglobosa*, an indigenous legume recognised as a multipurpose tree in the Sudan savanna of Nigeria, is a potential tree for such programmes. To enhance production of seedlings of high morphological and physiological grade, information on moisture and nutrient requirements is needed.

This study was designed to investigate the effect of source of nitrogen and frequency of moisture supply on the growth and chemical composition in seedlings of *Parkia biglobosa* grown in a semi-arid environment in Nigeria.

A split-plot experimental design with three replications was used with three sources of nitrogen: urea (N1), calcium ammonium nitrate (N2), and cowdung (N3), as the main plot treatment, and daily watering (F1), 2-day interval (F2), 4-day interval (F3), and 6-day interval as the sub-plot treatments. The quantities of each source of nitrogen used (0.11 g urea, 0.77 g calcium ammonium nitrate and 4.0 g air dried cowdung per seedling) were optimal values obtained for *Parkia biglobosa* in a semi-arid zone (Awodola & Nwoboshi 1990). *Parkia biglobosa* seedlings germinated in acid-washed sands at 4-6 leaf stage were transferred to the polypots of size 23 by 12 cm (one seedling per pot) and watered daily for two weeks to enhance establishment. At the commencement of the third week after transplanting, seedlings under each source of nitrogen were divided into four groups. Each group was subjected to varying frequency of moisture application (F1, F2, F3, F4) to pot capacity. The experimental treatments lasted for twelve weeks. During the growth period, measurements of plant height and collar diameter were taken at two-weekly intervals while leaf number was counted. Leaf area was estimated by direct planimetry of traced outlines. The seedlings were harvested and separated into leaves, stems and roots. Total fresh weights of the seedling component parts were obtained. Dry weights were obtained after oven drying at 80 °C for 24 h. The various component parts were prepared and analysed for nitrogen, phosphorus, potassium, calcium and magnesium.

Source of nitrogen significantly ($p < 0.5$) influenced important seedling morphological characteristics. Levels of nitrogen, phosphorus, potassium, calcium and magnesium in plant component parts were strongly influenced by source of nitrogen (Table 1). The results show that seedling performance was best in trees grown on urea and least in cowdung potting media. These results are in agreement with the works of previous investigators (Muirheed *et al.* 1985, Aluko 1989, Praven Kumar *et al.* 1989). Muirhead *et al.* (1985) compared several nitrogen fertilisers applied in surface irrigation systems and showed that urea as a source of nitrogen was superior to the ammonium forms, while Aluko (1989) showed that there was generally better seedling response to calcium ammonium nitrate than urea. The findings in this study suggest that the optimal response of seedlings to urea was influenced by frequency of moisture application. This is because at reduced frequency of watering, growth is depressed and in extreme cases, wilting commences. Seedling performance using either calcium ammonium nitrate or cowdung did not differ significantly.

Table 1. Effect of sources of nitrogen on some morphological parameters independent of frequency of watering on seedlings of *P. biglobosa*

Morphological parameter	Sources of nitrogen		
	Urea	CAN	Cowdung
Leaf number	13.6a	12.08a	12.91a
Seedling height (cm)	13.58a	13.25a	12.00b
Collar diameter (cm)	.25a	.21b	.22b
Root length (cm)	18.958a	17.87a	18.67a
Shoot to root ratio	.739a	.788	.714a
Total fresh weight (g)	2.34a	1.68b	1.35b
Total dry weight (g)	.707a	.483b	.359b
Root weight (g)	.352a	.168b	.124b
Shoot weight (g)	.138a	.119a	.102b
Leaf weight (g)	.223a	.172ab	.141b
Leaf area (cm^2)	55.01a	55.61a	43.97b
Relative water content	1.648a	1.314ab	.994b

Note: CAN = calcium ammonium nitrate. Same letters along a row indicate non-significance at 5% probability level.

Table 2 presents the effect of frequency of moisture supply on morphological parameters in seedlings of *P. biglobosa*. The results indicate that irrespective of source of nitrogen, seedling height, fresh and dry weights, shoot weight and leaf area increased with increased frequency of moisture application. This agrees with the works of previous investigators (Fasehun 1979, Brown & Archer 1990). Irrespective of source of nitrogen, root length increased with reduced frequency of watering up to F3 (watering at 4-day interval) beyond which root growth was hindered. Increased frequency of watering enhanced nitrogen, phosphorus and potassium but not calcium and magnesium concentrations in the leaves (Table 3). Although seedlings subjected to weekly moisture application suffered most due to increasing moisture stress, the trend indicated that watering either at 2 - or 4-day intervals produced seedlings of high morphological and physiological grade.

Findings from this study suggest that source of nitrogen and frequency of moisture supply are factors which influence the morphology and macronutrient contents in seedlings of *P. biglobosa*. Although seedlings raised using urea were better compared to those from other sources of nitrogen, the results indicate that this response is dependent on the degree of hydrolysis of urea.

Subject to further investigations, it is inferred that beyond 12 weeks of treatment, moisture application on weekly basis even to field capacity retarded growth in seedlings of *P. biglobosa.* It was shown that irrespective of source of nitrogen, moisture supply at not more than 4 days interval to pot capacity will enhance satisfactory seedling production.

Table 2. Effect of frequency of watering on some morphological parameters independent of sources of nitrogen on seedlings of *P. biglobosa*

Morphological parameter	Frequency of watering			
	F1	F2	F3	F4
Leaf number	12a	13a	12b	11b
Seedling height (cm)	13.65a	13.55a	12.54b	11.83b
Collar diameter (cm)	0.238a	0.229a	0.234a	0.223a
Root length (cm)	17.94bc	19.38ab	20.33a	16.33c
Shoot to root ratio	0.848a	0.732b	0.65b	0.759ab
Total fresh weight (g)	2.178a	2.13a	1.818a	1.046b
Total dry weight (g)	0.522ab	0.621a	0.477b	0.477b
Root weight (g)	0.219a	0.263a	0.20a	0.178a
Shoot weight (g)	0.188a	0.128a	0.112b	0.11b
Leaf weight (g)	0.129a	0.204a	0.164a	0.157a
Leaf area	60.01a	62.27a	45.26b	38.57b
Relative turgidity	72.42ab	69.429b	75.674a	41.5c
Relative water content	1.656a	1.66a	1.599b	.599b

Note: Same letter (s) along a row indicate non-significance at 5% probability level.

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Table 3. Interaction effects of source of nitrogen and frequency of watering on macronutrient uptake in component parts of *P. biglobosa* seedlings

Source of nitrogen	Freq. of water.	% Nitrogen			% Phosphorus			% Potassium			% Calcium			% Magnessium			RT
		Leaf	Stem	Root	Leaf	Stem	Root	Leaf	Stem	Root	Leaf	Stem	Root	Leaf	Stem	Root	
Urea	F1	6.073a	6.02c	8.953b	.147c	.019ef	.095b	1.717c	1.4ef	1.953f	2.637d	2.503a	2.103ab	505f	.52d	.414c	76.5ab
	F2	6.093a	6.12c	9.003b	.145a	.036bcc	.104a	1.73c	2.067b	2.467ab	2.637d	1.667g	1.6c	592d	.31g	.361d	59.46b
	F3	3.287bc	6.12c	4.753d	.178a	.071a	.035e	1.9b	2.6a	2.533a	3.547a	1.91e	1.163f	.543e	.297h	.145j	70.16d
	F4	3.187c	3.253d	3.353d	.161b	.038bc	.021f	1.31e	1.4cf	1.463h	2.527e	1.547h	0.963g	.288j	.254j	.12j	40.51d
CAN	F1	6.107a	11.753a	11.807a	.161b	.027de	.55d	1.4de	1.533de	2.25d	3.397b	1.957de	2.023b	.714b	.695a	.978a	57.83d
	F2	6.087a	8.987b	11.853a	.127d	.033cd	.069c	1.5d	1.5e	2.35cd	3.417b	2.353b	2.173a	.628c	.612c	.51b	70.00b
	F3	3.317bc	8.853b	11.853a	.119d	.036bcd	.022f	1.4de	1.73c	2.067e	3.527a	2.183c	2.173a	.919a	.382f	.372d	75.92b
	F4	3.32bc	3.353d	3.387a	.10e	.021cf	.019f	1.147f	1.3fg	1.677g	2.823c	1.363i	1.407de	.588d	.269i	.22g	42.00d
Cow manure	F1	6.173a	6.12c	11.837a	.149c	.045b	.026ef	1.81bc	1.3fg	1.35i	2.3f	1.987d	1.507cd	.438g	.402e	.255f	70.73b
	F2	3.37b	6.153c	11.84a	.155bc	.037bcd	.099ab	2.067a	1.667cd	2.367bc	1.617g	1.767f	1.293e	.394h	.666b	.368d	74.23b
	F3	3.34bc	3.453d	3.373d	.084f	.013fg	.032e	1.3e	1.5e	1.143j	1.583g	1.057j	1.167f	.379h	.263ij	.27e	82.63a
	F4	3.287bc	3.307d	3.287d	.069g	.009g	.02f	1.14f	1.233g	0.85k	1.253h	1.01j	0.847g	.314i	.224k	.187h	41.33d

Note: CAN = calcium ammonium nitrate;

* Same letters along a column indicate non-significance at 5% probability (after Duncan's multiple range test).