

**REPOSITIONING FORESTRY
FOR SUSTAINABLE ECOSYSTEMS
AND LIVELIHOOD**

44TH ANNUAL CONFERENCE

**of the Forestry Association of Nigeria
held in Ogun**

21st - 26th November, 2022

Edited by:

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**REPOSITIONING FORESTRY FOR
SUSTAINABLE ECOSYSTEMS AND
LIVELIHOODS**

**Proceedings of the 44th Annual Conference
of the Forestry Association of Nigeria**

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EARLY GROWTH PERFORMANCE OF PARKIA BIGLOBOSA (JACQ. R.BR.) BENTH UNDER DIFFERENT GROWTH CONDITIONS

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ABSTRACT

The study involved evaluation of the effects of different growing conditions on the early performance of *Parkia biglobosa* seedlings. The experiment was laid out in a 3×4 factorial in a completely randomized design with sowing medium and manure as the two factors, and watering regime in a completely randomized design. Twelve trays were used for each treatment, making 36 trays for the study. Twenty seeds were sown in each tray making 240 seeds per sowing medium. The seedlings were pricked-out and potted using 16.3 by 8 cm polythene pots. Eight weeks after germination, height, collar diameter, leaf number and leaf area were measured before seedlings were potted. Second readings were taken on growth parameters after stabilizing, and manures were applied. They were left to grow for 14 weeks, after which third readings were taken. The result revealed that there were no significant differences in mean germination percentages among the watering regimes ($P > 0.05$). There were no significant differences among the mean seedling heights under different sowing medium and manure ($P > 0.05$). Similarly, the interaction effect between sowing medium and manure was not significant ($P > 0.05$). Sowing medium and manure had no significant effects on leaf numbers ($P > 0.05$). Also, the interaction between the two factors was not significant ($P > 0.05$). However, the effects of the two factors were significant on collar diameter ($P < 0.05$). Follow-up test (LSD) results showed that seedling collar diameters are similar for sawdust and river sand, but differed between sawdust and topsoil also between river sand and topsoil with the highest mean of 0.49 ± 0.15 cm recorded in topsoil, and least in sawdust (0.29 ± 0.29 cm). There were no significant differences in mean collar diameters among the manures but they were significantly different from the control. The result further revealed that there were no significant differences among the mean leaf areas under different sowing media and manure just as the interaction of the two factors ($P > 0.05$). *Parkia biglobosa* is a slow-growing species, which may make the various treatments effect not to have been fully expressed at the expiration of the study. Therefore, it is recommended to make further observations at field stage.

Keywords: Sowing media, Organic manures, Seedling emergence, Growth parameters

INTRODUCTION

Parkia biglobosa is an indigenous species of family Fabaceae. It has the tendency of improving soil nutrients when its leaves are decomposed and nutrients released (Oyebamiji et al., 2017). African locust bean is also known as monkey cutlass tree, it is called narghi (Fulani), ogiri okpi (Igbo) in Nigeria (Orwa et al., 2009). *Parkia biglobosa* is a perennial deciduous tree with a height ranging from 7 to 20 m, although it can reach 30 m under exceptional conditions. The crown is large, spreads wide with branches low down on a stout bole, amber gum exudes from wounds, bark dark grey brown, thick and fissured (Orwa et al., 2009). African locust bean is a multipurpose tree. The seeds, pods, fruit pulp, and leaves are edible, which are used as cooking or drinking ingredients. It makes valuable baby food, and it is used to make a refreshing drink. The leaves can be boiled, mixed with cereal flour and eaten as vegetable. Flower buds are edible and added to salads (Sina et al., 2002). Locust bean trees are the most prioritized woody component of the Nigeria Savannah parkland system because of their drought and fire resistance, and their culinary, therapeutic and industrial raw material values. In Nigeria, the tree is encountered in many savannah land uses, including improved fallow, silvo-pastoral system, and homestead woodlots (Popoola and Tee, 2001).

Farmers have always been involved in using fertilizer as a last resort but this has not been economically feasible because the nature of the soil in the tropics do not allow for maximum utilization of nutrients from chemical sources. This is because they are characterized by the possession of low activity clay, which is their parent rock material. These soils, with their fewer charged surfaces for exchange of ions, have low ion exchange capacity (Oyebamiji et al., 2019). Hence, study has shown that this problem could be solved through the incorporation of mycorrhizae into the savannah or tropical soils and other soil media before raising savannah seeds and seedlings in balancing nutrient absorption with nutrient replenishment (Liasu, 2000). Moreover, *Parkia biglobosa* trees are also such vital components of the ecosystem that have productive, protective and recreational functions (Atiku et al., 2013). They control soil erosion, stabilize regional and global climates, provide carbon sinks, and helps in pollution control. The extent to which this forest tree is being exploited calls for urgent attention, and to resuscitate its biological diversity is the major focus of this study.

Many countries have exploited the water hyacinth for economic benefits. The plant is used to produce fertilizers, fodder, biogas, briquettes, furniture, and handicrafts, and to clean water waste through phytoremediation processes (Patel, 2012). Water hyacinth is a weed rich in potassium, nitrogen, phosphorus and calcium. Water hyacinth is a monocotyledon belonging to the family of Pontederiaceae. It is a perennial floating macrophyte with thick rounded green leaves, lavender blue flower with a yellow dot organized in spike inflorescence and dark purple to black roots with rhizomes and stolons (Gettys, 2014). According to Patel (2012), water hyacinth is classified as one of the ten most-invasive aquatic plant species in the world. Accessibility to inorganic fertilizers by farmers are difficult and at high cost (Tanko, 2000). Inorganic fertilizers are mainly used

in the world today; and they have adverse effects on soil and plant. This has generated concern and worry to farmers and foresters. Research on the use of readily available organic fertilizers such as cowdung as a substitute is now getting attention by researchers. Despite this, few studies have been conducted on the effects of organic manures on growth performance of *Parkia biglobosa* seedlings. Study has shown that water hyacinth is rich in Nitrogen, Phosphorus and Potassium, which makes it serve as good organic manure to plant (Khaing, 2016). Nevertheless, the potential of water hyacinth to improve the growth of *Parkia* has not been fully-explored.

Parkia trees control soil erosion, stabilize regional and global climates, provide carbon sinks, and act in pollution control. The extent to which this forest tree is being exploited calls for urgent attention and to resuscitate its biological diversity is the major focus of this study (Atiku et al., 2013). The main objective of this study is to evaluate the effects of organic manures on the early growth of *Parkia biglobosa*. There is need to check the effect of organic fertilizer on tree species growth since inorganic fertilizer has been discovered to have effect on man and the environment. More so, it is costly and scarce. Organic fertilizer breaks down and releases nutrients to improve the structure of soil, pH, and enhance the electrical conductivity and nutrient absorption (Davarnejad et al., 2002). Organic materials plays an important role to enhance the physical properties of the soil, such as bulk density, improve microbial activities, water absorption and nutrient availability to plants (Mohanty et al., 2006).

Cow dung manure, for example, is high in organic materials and rich in nutrients. It contains about 3% nitrogen, 2% phosphorus and 1% potassium (Reference). Composted cowdung provides numerous benefits to the soil. It contain large amounts of organic matter, by mixing this into the soil, the moisture-holding capacity is improved, helps to reduce frequent watering, improve aeration, helps to break down compacted soils and contains beneficial bacteria (Igbokwe, 2017). *Parkia biglobosa* is an important multipurpose tree and is known in many African countries. It is especially important in traditional medicines.

METHODOLOGY

The study was carried out at the Department of Agronomy Nursery, Faculty of Agriculture, University of Ilorin, Ilorin-south Local Government, Kwara State, Nigeria. The University of Ilorin is located in the ancient city of Ilorin, about 500 km from Abuja, the federal capital. Ilorin is characterized with both wet and dry seasons. The rainy season begins towards the end of April and last till October, while the dry season begins in November and ends in March. The temperature of Ilorin ranges from 33°C to 35°C from November to January, while from February to April; it ranges from 34°C to 37°C. Total annual rainfall ranges from 990.3 mm to 1318 mm. The relative humidity in Ilorin ranges from 75% to 88% from May to October, while in the dry season it ranges from 35% to 80% (Adeniyi, 2017). Geology of Ilorin consists of pre-cambrian basement complex rock. The soil is made up of loamy soil with medium to low fertility due to the high

seasonal rainfall coupled with the high temperature. There is tendency for lateritic soil to constitute the major types in Ilorin due to the leaching of minerals nutrients of the soil (Ajibade and Ojelola, 2004).

Parkia biglobosa seeds were obtained from Oja-Oba, Ilorin, Kwara State. The viability test was carried out using floatation method. The seeds were poured in a container filled with water; the seeds that floated were not viable and were removed. *Parkia biglobosa* was pre-treated by soaking it in concentrated H_2SO_4 for one minute, and then air-dried before sowing. Topsoil was obtained at Agronomy nursery from an exposed land at not greater than 15 cm depth from the soil surface. River sand was obtained from the river near the Forest Resource Management Nursery, and it was sterilized by boiling for 30 minutes to remove the organic matter.

Sawdust of *Anogeissus leiocarpus* (Ayin) was obtained from sawmill. Topsoil, river sand and sawdust were then used for the experiment. Twelve trays were used for each treatment, making thirty-six trays in total. Twenty seeds were sown in each of the trays making two hundred and forty seeds per each medium. The seeds were sown 3rd of January and the seeds started sprouting on the 6th day. The seedlings were pricked-out and potted using 16.3 by 8 cm polythene pots after eight weeks of germination. The germination trays were watered once daily, twice daily and every-other-day using a 150 ml container. Seedlings were left to stabilize, and second readings were taken on growth parameters three weeks after potting, with manures applied on the seedlings. The seedlings were left to grow for another 14 weeks, after which third readings were taken on growth parameters.

The dung was placed in an open-air container that would be easy to turn. Dry organic material (water hyacinth) was first spread in the container, then the manure was spread on it, the pile was watered and then covered with a black nylon to preserve the heat. The pile was turned every 3 days, and it was kept moist. The temperature of the pile was hot for some weeks. The compost was used when it stops heating and it is dark brown, crumbly and has an earthy smell, which was used after 7 weeks of decomposing. Water hyacinth was harvested at river along Olofin, Kara Bridge in Ogun State. The water hyacinth was sun-dried for three days before being filled into the container, then the cowdung was then mixed with it. Before the mixture, cowdung and water hyacinth compost were applied singly, and 10 g of manure was applied to the seedlings. The seedlings were allowed to stabilize three weeks after potting. 10 g of manure was weighed and applied to the potted seedlings. Seedlings in each sowing media were divided into four parts uniformly. *Parkia* seedlings were watered once daily, and the seedlings were observed for three months after potting. Then the growth parameters of the seedlings were measured.

Data were collected during germination by counting the number of seedling emergence from the first day of the seedling till the eighth week, when no germination was observed. Mean germination rate was computed as follows:

$$\text{Mean germination percentage} = \frac{x}{y} \times 100$$

Where: x = total number of germinated seeds per treatment; y = total number of seeds sown per treatment.

The growth parameters measured:

- (i) Leaf number of the seedlings: number of leaflet were counted;
- (ii) Height of the seedlings: it was measured using meter ruler;
- (iii) The collar diameter of the seedlings: it was measured using vernier caliper
- (iv) Leaf Area: the length and breadth of the leaf was measured using meter rule.

Data were analysed using analysis of variance (ANOVA) at 5% level of significance to determine differences in the treatment effects.

RESULTS AND DISCUSSION

Germination Rate of *Parkia biglobosa*

The result of germination is presented in Table 1. Under different watering regimes, river sand did best in terms of germination with 31.3%, when watered in the morning. The least germination was recorded in sawdust, when watered in the morning and evening with 5%. Details of the results of the germination results are shown in Table 1. Figure 1 shows graphical illustration of the germination rates in different media and watering regimes.

Table 1: Germination Rate under Different Sowing Media and Watering Regime

Factors	Number of seed sown	Topsoil (%)	Sawdust (%)	River sand (%)
Morning and Evening	80	19 (23.8)	4 (5.0)	10 (12.5)
Every other day	80	17(21.3)	17 (21.3)	7 (8.8)
Morning	80	23 (28.8)	24 (30.0)	25 (31.3)

Table 2 presents the result of one way ANOVA for watering regime. The result revealed that there were no significant differences among the watering regimes in terms of seedling emergence.

Table 2: ANOVA Table for Watering Regime

Source of Variation	df	SS	MS	F	P
Watering regime	2	282.8889	141.4444	4.645985	0.060404
Error	6	182.6667	30.44444		
Total	8	465.5556			

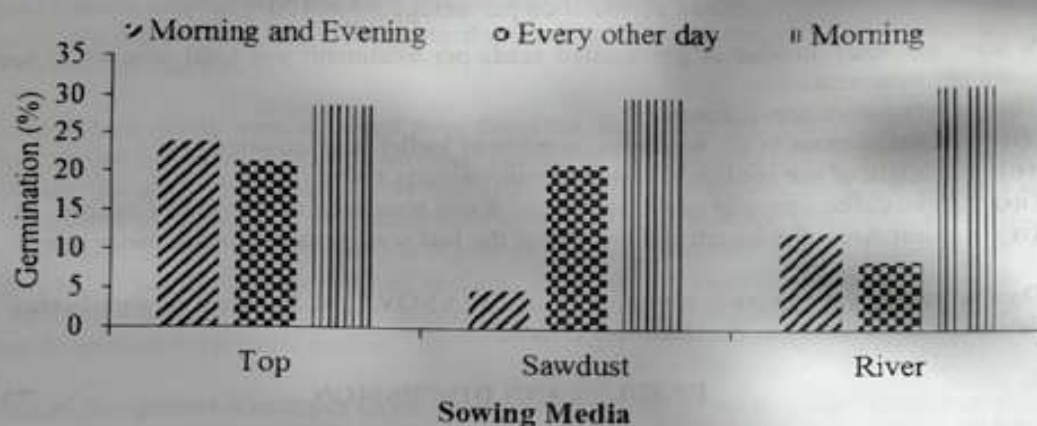


Figure 1: Germination Percentage

The highest germination rate recorded in sterilized river-sand may be due to good aeration and low activities of micro-organisms due to sterilization. This might have played a supportive role in germination of *Parkia biglobosa*. This corroborates the findings of Dickens (2011), who noted apparent high germination rates under river sand for *Irvingia wombolu*. However, this disagrees with the report by Okunomo (2010), who recorded highest germination percentage under topsoil for *Parkia bicolor*. The better outputs observed for *Parkia biglobosa*, when watered in the morning may be due to the fact that heat was lesser in the early hours with low temperature, and this may have allowed the water to percolates into the soil and reaches the roots of the plant without excessive water losses to evaporation. This is in consonance with the findings of Isah et al. (2013) and Olajide et al. (2014), who independently reported good growth performance for *Dialium guineense* and *Acacia Senegal* seedlings watered in the morning Majumder et al. (2010). They added that, when adequate water is available, plant cells remain turgid, and they retain their forms and structures.

Early Growth of Seedlings under Different Media and Fertilizer Applications

Table 3 presents ANOVA results for seedling growth under different sowing media and manures. The result revealed that there were no significant differences among the mean seedling height growths under different sowing media and manure ($P > 0.05$). Similarly, the effect of interaction between sowing medium and the manure was not significant ($P > 0.05$). The effects of the two factors (sowing medium and manure) were not significant on leaf numbers ($P > 0.05$). Also, the interaction between the two factors was not significant ($P > 0.05$). However, the effects of the two factors were significant ($P < 0.05$) on collar diameter but their interactions were not significant ($P > 0.05$). The result further revealed that there were no significant differences among the mean leaf areas under

different sowing media and manures ($P > 0.05$). The interaction effect of the two factors was not significant on the leaf areas ($P > 0.05$).

Manure application greatly improved the growth of *Parkia biglobosa* seedlings compared to those grown without manures. This is in consonant with the reports of Aderounmu and Olajuyigbe (2020), who stated that the pattern of growth for seedlings of *Vitellaria paradoxa* performed better when manures were added to them. Furthermore, *Parkia biglobosa* seedlings performed better in topsoil compared to sawdust and sterilized river-sand with regards to early seedling growths. This may be because of high organic matters present in topsoil, which provided the seedlings with all the required nutrients needed for good growth. This corroborates the work of Anber (2010), who recorded highest seedling height growths for *Bahunia variegata* and *Delonix regia* in topsoil. However, the result disagrees with Adeyemi et al. (2017), who revealed that seedlings raised with sterilized river-sand performed better compared to topsoil and sawdust for *Pentaclethra macrophylla*.

Table 3: ANOVA for Seedling Growth Parameters in Different Sowing Media and Manures

Parameters	SV	df	SS	MS	F	P-value
Leaf number	Manure	3	234.99	78.33	0.60	0.620
	Sowing media	2	234.55	117.28	0.90	0.410
	Interaction	6	637.76	106.29	0.81	0.560
	Error	70	9147.99	130.69		
Height	Manure	3	191.97	63.99	1.09	0.360
	Sowing media	2	165.77	82.88	1.41	0.250
	Interaction	6	563.20	93.87	1.60	0.160
	Error	70	4118.66	58.84		
Collar diameter	Manure	3	0.07	0.02	3.14	0.030
	Sowing media	2	0.52	0.26	33.62	0.000
	Interaction	6	0.07	0.01	1.56	0.170
	Error	70	0.54	0.01		
Leaf area	Manure	3	4.23	1.41	0.13	0.940
	Sowing media	2	20.87	10.43	0.98	0.380
	Interaction	6	145.90	24.32	2.28	0.050
	Error	70	746.60	10.67		

The result of mean separations (LSD tests) for the seedling growth parameters under different sowing media is shown in Table 4. Leaf number for topsoil produced seedlings with highest mean value of about 39 ± 11 leaves per plant. The seedlings raised in sawdust produced the least number of leaves with a mean of about 34 ± 12 leaves per plant. The seedling raised with topsoil had highest mean seedling height of 35.39 ± 8.72 cm. The least mean height growth of 30.85 ± 7.15 cm was obtained in sawdust. However,

the mean seedling height growth in top-soil was not significantly different from the value recorded for sawdust and river sand. The result revealed that seedlings raised with topsoil had highest mean leaf area of $13.22 \pm 4.40 \text{ cm}^2$. The seedlings grown under river sand recorded the lowest mean leaf area of $11.88 \pm 2.77 \text{ cm}^2$. With respect to the collar diameter, the result revealed that there were significant differences between the mean seedling collars diameters with the highest mean of $0.49 \pm 0.15 \text{ cm}$ recorded for seedlings in topsoil and the least ($0.29 \pm 0.29 \text{ cm}$) recorded under sawdust. However, there was no significant difference in the collar diameter value between sawdust and river sand.

Table 4: Seedling Growth Parameters under Different Sowing Media

Sowing media	Mean $\pm$ SD			
	Leaf number	Height(cm)	Collar diameter (cm)	Average leaf area (cm^2)
Topsoil	39.40 ± 10.84^a	35.39 ± 8.72^a	0.49 ± 0.15^a	13.22 ± 4.40^a
Sawdust	34.41 ± 11.90^a	30.85 ± 7.15^a	0.29 ± 0.29^b	13.11 ± 3.47^a
River sand	37.10 ± 37.10^a	31.72 ± 8.00^a	0.30 ± 0.30^b	11.88 ± 2.77^a

N.B.: Means with the same alphabets as superscripts under each column were not significantly different from each, or one another

The results of mean separations (LSD) for the seedling growth parameters under different manures are presented in Table 5. Leaf number for all the manures and control were not significantly different from one another other. The highest mean leaf number of 38 ± 12 was recorded for seedlings treated with the mixture of water hyacinth and cowdung, while the least mean leaf number of 34 ± 12 was recorded for cowdung. There were no significant differences in mean seedling heights among the treatments (manures and control). The highest mean value of $33.47 \pm 6.69 \text{ cm}$ was recorded for seedling treated with the mixture of water hyacinth and cowdung, and the least mean height of $30.49 \pm 7.11 \text{ cm}$ was recorded for seedling treated with water hyacinth. With respect to collar diameter, the result revealed that seedlings treated with cowdung, water hyacinth and the mixture of cowdung and water hyacinth were not significantly different from each other, but they were significantly different from that of control. The highest mean collar diameter value of $0.36 \pm 0.14 \text{ cm}$ was recorded for seedling treated with cowdung, and the least mean of $0.30 \pm 0.10 \text{ cm}$ for seedling with no treatment (control). With respect to the leaf area, there were no significant differences in mean values among the treatments. Highest mean leaf area of $13.30 \pm 3.50 \text{ cm}^2$ was recorded for seedling treated with water hyacinth, while the least leaf area mean of $11.71 \pm 3.22 \text{ cm}^2$ was recorded for control.

Table 5: Seedling Growth Parameters under Different Manure

Manure	Mean $\pm$ SD			
	Leaf number	Height(cm)	Collar diameter (cm)	Leaf area (cm^2)
Cowdung	$34.00 \pm$	$31.95 \pm$	0.36 ± 0.14^a	$13.05 \pm$

	11.61 ^a	9.48 ^a		3.41 ^a
Water hyacinth	36.22 ± 10.55 ^a	30.49 ± 7.11 ^a	0.34 ± 0.13 ^a	13.30 ± 3.50 ^a
Water hyacinth and Cowdung	37.60 ± 11.59 ^a	33.47 ± 6.69 ^a	0.33 ± 0.11 ^a	12.65 ± 3.65 ^a
Control	37.14 ± 11.81 ^a	32.30 ± 8.35 ^a	0.30 ± 0.10 ^b	11.71 ± 3.22 ^a

N.B.: Means with the same alphabets as superscripts under each column were not significantly different from each, or one another

Manure application greatly improved the growth of *Parkia biglobosa* seedlings compared to those grown without manures. This is in consonant with the reports of Aderounmu and Olajuyigbe (2020), who stated that the pattern of growth for seedlings of *Vitellaria paradoxa* performed better when manures were added to them. Furthermore, *Parkia biglobosa* seedlings performed better in topsoil compared to sawdust and sterilized river-sand with regards to early seedling growths. This may be because of high organic matters present in topsoil, which provided the seedlings with all the required nutrients needed for good growth. This corroborates the work of Anber (2010), who recorded highest seedling height growths for *Bahunia variegata* and *Delonix regia* in topsoil. However, the result disagrees with Adeyemi et al. (2017), who revealed that seedlings raised with sterilized river-sand performed better compared to topsoil and sawdust for *Pentaclethra macrophylla*.

CONCLUSION

The results have shown that *Parkia biglobosa* performed better in terms of seedling emergence, when watered in the morning and sown in sterilized river-sand. This may be due to lack of organic matter in the soil. However, the seedlings performed relatively well in topsoil, since topsoil has high organic matter in it, which helps the plant to attain optimal growth performance. The result has further revealed that combination of cowdung and water hyacinth improved seedling growths in terms of collar diameters shows little or no improvement over control. It was also observed that cowdung produced better results among the manures applied to aid seedling growths. Raising the seedlings of *Parkia biglobosa* in topsoil can play an important role in ensuring uniform and maximum germination of the species in the nursery, and any subsequent afforestation or re-vegetation programme should consider its usage. It is recommended that *Parkia biglobosa* should be watered in the morning using 150ml of water to improve its germination in the nursery. Also, application of cowdung can help to improve the growth, quality, and utilization of *Parkia biglobosa*.

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