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Early Germination and Growth Trial of *Anogeissus leiocarpus* Seeds Sourced from Three Locations in Nigeria

Zacchaeus Tunde Egbewole[1, *], Olumuyiwa James Jayeoba[2], Kuje Emmanuel Dauda[1], Odunayo James Rotowa[3], Luke Olawole Falade[1], Umar Danlami Abass[1], Ibrahim Ibrahim Osagye[4], Badarudeen Sani Abdulazeez[4], Fada Rinse Leni[1]

[1]Department of Forestry and Wildlife Management, Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia-Campus, Nigeria

[2]Department of Agronomy, Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia-Campus, Nigeria

[3]Department of Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Krakow, Krakow, Poland

[4]Department of Forestry and Wildlife Management, Federal University of Lafia, Lafia, Nigeria

Email address:

tundeegbe@gmail.com (Zacchaeus Tunde Egbewole), tundeegbe@nsuk.edu.ng (Zacchaeus Tunde Egbewole)

[*]Corresponding author

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Abstract: The study investigated early germination and growth trial of *Anogeissus leiocarpus*. The seeds were collected from three locations; (Akwanga, Nasarawa State, Zaria, Kaduna State and Toro Bauchi State). Seeds were soaked in cold water for 24 hours before sowing in germination beds accordance to specification of location. Three beds for each location. The experiment was laid out in a 4 x 3 factorial experiment in a Randomized Complete Block Design. The results revealed that, Seedlings treated with poultry manure combined with cow dung recorded the highest mean height (18.71±7.22^{a}cm), while the least height of (14.65±4.58cm) was obtained in cow dung treated seedlings. Seedlings sourced from Kaduna had the highest mean height of (17.78±9.96^{a}cm). While the least height of (14.58±7.31^{b}cm) was obtained in Nasarawa sourced seedlings. The results of analysis of variance showed that the effect of manure types had a high significant impact on seedlings height,, collar girth, branches and numbers of leaf (0.000**) respectively (P>0.05). The effect of seed sources also had a high significant impact on seedlings height (0.000**), collar girth (0.000**), branches (0.000**) and numbers of leaf (P>0.05). The results of Regression Analysis of parameters assessed on seedlings against height increment revealed that seedlings height yielded coefficient of determination (R^2 = 0.573). This implied that the assessed growth variables had about 57.3% effects on the seedlings height. It was concluded that the treatment with Cow dung and poultry manure performed better; therefore it should be adopted in raising the seedlings in the nursery so as to guarantee its sustainable supply to wood industry.

Keywords: Growth, *A. leiocarpus*, Seedlings, Poultry Manure, Cattle Dung

1. Introduction

A. leiocarpus (DC) Gill & Peer is a deciduous tree species that can grow up to 15 - 18m of height and measure up to 1m diameter [1]. Bark greyish and scaly, branches often drooping and slender, leaves alternate, ovate–lanceolate in shape, 2 - 8cm long and 1.3 - 5cm across [2]. The leaves are acute at the apex and attenuate at the base, pubescent beneath. Inflorescence globose heads, 2cm across, yellow; the flowers are bisexual, petals absent. Fruits are globose, cone like heads; each fruit is broadly winged, dark grey, 3cm across. It can be reproduce by seeds as well as vegetative propagation [2, 3]. The plant is popularly known as African birch, Axle wood tree [4] “Marike” in Hausa, “Orin-odon” in Yoruba and “Atara” in Igbo language of Nigeria [4, 5].

The plant belongs to the family *Combretaceae*. It is a species found on wet soils, especially around ponds, in river valleys and forest galleries. The tree is an excellent fire wood

and charcoal. The leaves are a source of yellow dye; green or dry, they make fodder for cattle, sheep and goats. *A. leiocarpus* is a drought and salt resistant tree and it is highly competitive producing allele-chemicals, killing species of grass. Its area of occurrence extends from Nigeria and Senegal in West Africa to Sudan and Ethiopia in East Africa. *A. leiocarpus* occurs in various habitats ranging from desert and dry savanna to wooded bush lands and moist woodlands such as gallery forests with a mean annual rainfall ranging from 200-1900mm. *A. leiocarpus* is a very sensitive to fire. However, after the bushfire season, it has the ability to produce new coppice from the surface root [6]. *A. leiocarpus* can grow on wide variety of soil types, including vertisols (clays soils) [7].

In Nigeria, Burkina Faso, Niger, Ivory Coast and Ghana decoctions of various parts of the plant are used for against abdominal pain, ulcers, skin infectious diseases, fungal infection, bacteria vaginousis and for wound healing [8, 9]. The yellow or brown fruits are small (3mm) with two wings. The plant has been reported to be used traditionally for the treatment of different ailments including the treatment of diabetic ulcers, general body pain, blood clots, asthma, coughing, jaundice, pile and tuberculosis [10, 4, 11], Malaria, Trypanosomiasis, Helminthiasis and dysenteric syndrome [12] and also, it is used against stomach infections and fungal infections such as dermatitis and Mycosis [13]. Recent studies have revealed that the plant exhibits a variety of pharmacological activities including Antiplasmodial [14], Antioxidant and hepatoprotective [15, 16] Leishmanicidal [17] Anthelmintic [18] Trypanocidal [17, 19] antimicrobial [20, 21]. The bark and seed of the tree is used for the treatment and prevention of worm infestation in equine species. Traditional healers in the north eastern part of Nigeria also believe that the bark of the plant is very effective in the treatment of African *trypanosomiasis* [22].

1.1. Geographical Distribution and Habitat of A. leiocarpus

A. leiocarpus is typical element of woodlands and savannas of the Sudanian regional centre of endemism [1]. It has large ecological distribution ranging from the boarders of Sahara up to the out layer humid tropical forests. In West Africa, from Senegal to Nigeria, Cameroon and extends to Ethiopia and East Africa. It grows in dry forests and gallery forests [2]. The tree species is an elegant tree of Africa, commonly known as "Axle wood tree or African birch" because of the silvery cast of the foliage like the temperate birch. It extends from the Sahel to forest zones and Senegal to Sudan and Ethiopia with savanna regions as its habitats.

1.2. Effects of Organic and Inorganic Fertilizers on Soils and Plant Growth

In recent times, attention has been drawn to the use of organic fertilizers which used to be an ancient practice of maintaining soil fertility. The attention directed towards organic manure is as a result of the high cost of chemical fertilizers and their long term negative effect on the chemical properties of the soil [23]. Organic fertilizers have the ability to improve soil organic matter, soil structure, soil chemical properties and soil microbial activity.

The complementary application of organic and inorganic fertilizers to plants has been found to meet the immediate soil nutrient deficits, improve the soil physical properties and enhance yield stability [24]. Organic materials have many positive effects on physical, chemical, and biological characteristics of soils thereby enhancing the growth of plants. So they have an important function in improving soil fertility. Carl, *et al* [25], reported that manure is a valuable fertilizer that can be used to enhance plant growth and has been used for centuries to supply needed nutrients for plant growth. Manure is also a valuable source of organic matter, increasing soil organic matter, improves drainage in fine-textured clay soils and provides a source of slow release nutrients.

1.3. Challenges of Sustainable Production of A. leiocarpus

Production of *A. leiocarpus seedlings* from seeds remains a difficult process because of the low germination rate registered in nurseries as well as in screen houses. However, this is also due to the low fertility rate of fruits. Until now this tree species have not occupied a very important part in the afforestation program partly because of the difficulties of production in nurseries and very low germinating rates. The rate at which the tree species is being felled for commercial and other purpose is at high risk of extinction whereas the regeneration and afforestation of the tree species is low.

1.4. Utilisation and the Need for Mass Production

A. leiocarpus is one of the most important tropical tree species, with varying uses and great economic values. As at today, there is no adequate information on seed germination, and the type of organic manure and rate of application require improving the growth and production process of the tree species. In view of the potential of this specie, the rate at which the tree species is being felled for commercial and other purpose is high whereas the regeneration and afforestation of the tree species is low or does not happen. Therefore, this research seeks to investigate the effect of seeds germination from three different locations and the application of organic manure on the seedling growth with a view to investigate early germination and growth trial of *A. leiocarpus* seeds.

2. Materials and Methods

2.1. The Study Area

This experiment was carried out in the Department of Forestry and Wildlife Nursery of Nasarawa State University Keffi, Faculty of Agriculture Shabu-Lafia Campus Lafia is located between longitudes 08° 35 N and latitude 08° 33 E, in Guinea Savannah zone of North Central Nigeria at an altitude of about 177m above the sea level. The mean monthly maximum temperature range is between 35.06°C to

36.40°C and 20.16°C to 20.50°C, relative humidity of 40-89% and average of day light of 9-12 hours [26] (Figure 1).

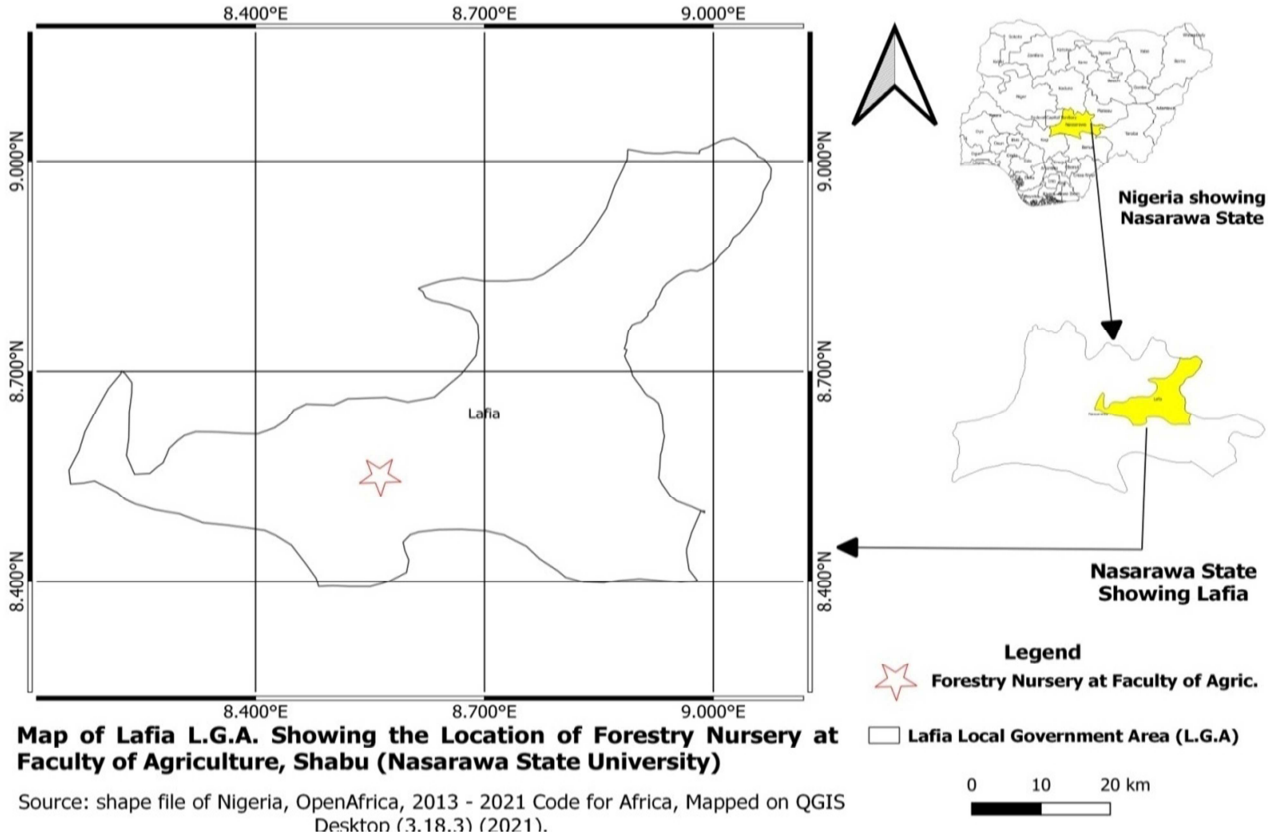

Figure 1. *Showing Map of The Study Area.*

2.2. Seed Collection, Processing and Sowing

A. leiocarpus seeds were collected from three locations; Akwanga local government Area (LGA), Nasarawa State, Zaria LGA Kaduna State and Toro LGA Bauchi State. A total of 2,000seeds/LGA, making a total of 6,000 seeds was collected from trees within the selected locations (Plate 2-5). Poultry manure and cattle dung was obtained from Livestock Farm, Nasarawa State University, Faculty of Agriculture Shabu-Lafia Nigeria while river sand was also collected from streams within the Faculty premises (Plate 6-7).

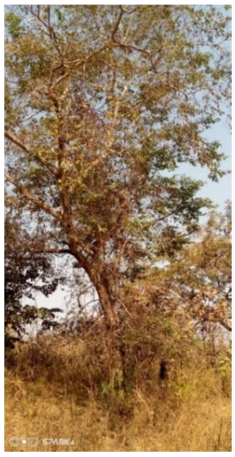

Figure 2. *Mature A. leiocarpus tree.*

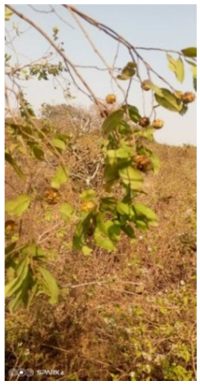

Figure 3. *Branch of the tree with seeds.*

Figure 4. *Unprocessed seeds.*

Figure 5. *Processed seeds.*

Figure 6. *A. leiocarpus seedlings at 4WAP.*

Figure 7. *A. leiocarpus seedlings 8WAP.*

2.3. Experimental Layout and Data Analysis

The experiment was laid out in a 4 × 3 factorial experiment in a Randomized Completely Block Design (RCBD). The research comprised of four treatment. Treatment A = poultry manure (PM), B = Cattle dung (CD), C = Poultry manure and cattle dung and Treatment (PM +CD) and D = serve as the control. Treatment A = contained 20kg of poultry manure mix with 25kg of river sand. B = 20kg of cattle dung max with 25kg of river sand. C = contained 10kg of poultry manure and 10kg of cattle dung mix with 25kg of river sand while treatment D = no fertilizer application which serve as the control. The media was filled into polythene with the aid of hand trowel and arranged according to seed sources. Nine (9) germination beds were constructed, 3 for each location and 1500 seeds were sown per beds according to location. Records on germination ware monitored and taken at 2days interval for four weeks until emergence ceased after which seedlings were pricked out and transplant into polythene pots. Each treatment consist 45 experimental pots replicated three times given a total of 135 per treatment. A total of 540 experimental pots ware set up for the research. Parameters access includes; plant height, collar girth, number of leave, and number of branches. Seedlings parameters such as; plant height was determined from the collar region to the tip of the seedling by the used of meter rule. Collar girth was measured using veneer caliper. Number of leaves was determined by manually counting the number of leaves on the seedlings. Leaf length was also determined by using meter rule (Plate 6-7).

Table 1. *Experimental layout.*

Treatment	1.00	Poultry Dropping	359
	2.00	Cow Dungs	360
	3.00	Poultry Dropping + Cow Dungs	360
	4.00	Control	360
Location	Bauchi		480
	Kaduna		480
	Nasarawa		479
week	4.00		240
	7.00		240
	10.00		240
	13.00		240
	16.00		240
	19.00		239

This was adopted in order to facilitate the interpretation of the main and interacting effect that could be evolve and the mathematical model is;

$$Y_{ijk} = \mu + A_i + B_j + AB_{ij} + {}_{kij1} \quad (1)$$

Where: Y_{ijk} = individual observation, μ = General mean, A_i = effect of factor A (Location of seed collection), B_j = effect of factor B (effect of manure), AB_{ij} = Effect of interaction between factor A and B, ${}_{kij1}$ = Experimental error, i = level of factor A = 3 locations Bauchi (Toro LGA), Kaduna (Zaria LGA) and Nasarawa (Akwanga LGA), j = level of factor B = Manure (Cattle dung, Poultry manure, Poultry manure + cattle dung and control), k = Number of observation, [28]. Data collected on growth variables were subjected to mean and analysis of variance (ANOVA) was used to show the comparative performance between the treatment Multiples Range Test (DMRT) was applied to locate where the significant difference occur among the treatment.

2.4. Seed Pre-treatment

Seeds were soaked in cold water for 24hours before sowing in germination beds in accordance to specification of

location. A total of 1500 seeds were sown per beds base on selected locations. Watering was carried out morning and evening. Hand picking of weeds was carry out in other to reduce competition for light, water and nutrients between seedlings and the weeds. Shade was provided to reduce the water evaporation. The fertilized seedlings in the nursery pots were then allowed to adjust to the fertilizer treatments for 4weeks after transplanting before measuring height, number of leaves and collar diameter, leave length and leave width fortnightly, Plate 6.

2.5. Site Preparation

A portion of the Nursery site was cleared and germination beds of 3m x 3m were constructed. Light shade was constructed above the cleared portion to reduce the rate of evaporation. Germination was monitor until emergence ceased after which seedlings were pricked out and transplanted into polythene pots.

3. Results

3.1. Results of Effects of Organic Manure and Seed Sources and Week Interval on the Growth Variables of Anogeissus leiocarpus Seedlings

The results of effects of organic manure and seed sources on the growth variables of *A. leiocarpus* seedlings revealed that, the mean leaf count of 16.11±9.25, plant height of 15.84±8.06cm, Collar girth of 0.80±0.53cm. While, the number of branches was 1.90±2.15 at 19weeks after planting (WAP). Seedlings treated with poultry manure combined with cow dung recorded the highest mean height (18.71 ± 7.22^{a}cm) followed by seedlings with control treatment 15.22 ± 11.64^{b}cm, the poultry manure treated had mean of (14.76 ± 6.38^{b}cm) while the least height of (14.65 ± 4.58^{b}cm) was obtained in cow dung treated seedlings of *A. leiocarpus* (Figures 8 and 9). Similar trend was observed in the leaf count of seedlings. seedlings treated with poultry manure combined with cow dung recorded the highest leaf count of (20.11 ± 6.90^{a}) followed by cow Dung treated seedlings which had 15.81 ± 9.81^{b}, while the least leaf count of (12.78 ± 5.85^{c}) was obtained in control seedlings. Seedlings treated with poultry manure combined with cow dung recorded the highest mean Collar girth (1.37 ± 0.52^{a}cm) followed by seedlings with cow dung treatment 0.82 ± 0.37^{b} cm. While the least Collar girth of (0.45 ± 0.23^{d} cm) was obtained in Poultry Dropping treated seedlings. Similar trend was observed in the number of branches of seedlings. seedlings treated with poultry manure combined with cow dung recorded the highest number of branches of (3.11 ± 2.62^{a}) followed by cow Dung treated seedlings which had 1.97 ± 1.89^{b}, while the least leaf number of branches (1.36 ± 1.79^{c}) was obtained in control seedlings at 19weeks after planting (WAP), (Table 2). The results indicated that the influence of types of manure applied was significant (P>0.05) on the early growth of variables: leaf count, plant height, collar girth and branch of seedlings of *A. leiocarpus.*

Seedlings sourced from Kaduna had the highest mean height of (17.78 ± 9.96^{a}cm) followed by seedlings sourced from Bauchi (15.16 ± 6.065^{b}cm). While the least height of (14.58 ± 7.31^{b} cm) was obtained in Nasarawa sourced seedlings of *A. leiocarpus*. Similar trend was observed in the leaf count of seedlings. seedlings sourced from Kaduna recorded the highest leaf count of (16.88 ± 9.90^{a}) followed by seedlings sourced from Bauchi which had 16.27 ± 10.09^{a}, while the least leaf count of (15.17 ± 7.46^{b}) was obtained in Nasarawa sourced seedlings. Seedlings sourced from Nasarawa recorded the highest mean Collar girth (0.83 ± 0.55^{a}cm) followed by seedlings sourced from Kaduna which had 0.80 ± 0.58^{a}cm. While the least Collar girth of (0.75 ± 0.46^{b}cm) was obtained in Bauchi sourced seedlings. Similar trend was observed in the number of branches of seedlings. seedlings sourced from Bauchi recorded the highest number of branches of (3.07 ± 2.95^{a}) followed by Kaduna sourced seedlings which had 1.35 ± 1.40^{b}, while the least number of branches (1.28 ± 1.10^{b}) was obtained in Nasarawa sourced seedlings at 19weeks after planting (WAP), (Table 2).

The results indicated that the influence of seed sources was significant (P>0.05) on the early growth of variables: leaf count, plant height, collar girth and branch of seedlings of *A. leiocarpus.*

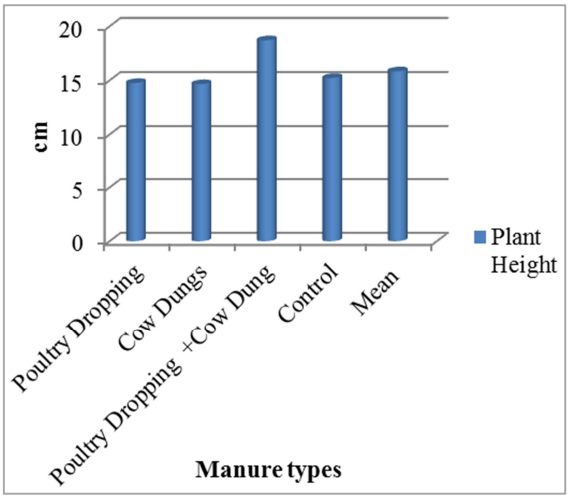

Figure 8. *Plant height variations on types manure applied on Anogeissus leiocarpus Seedlings.*

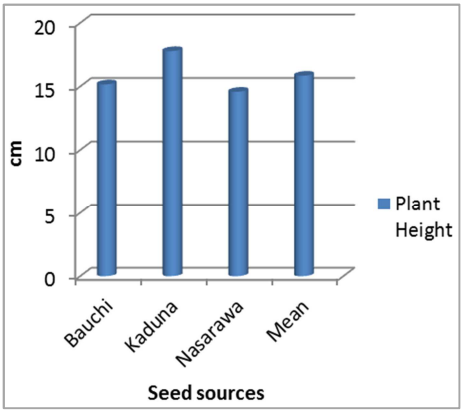

Figure 9. *Plant height on seed sources.*

Table 2. *Effects of organic manure on the basis of treatments, seed sources and on weeks interval of Anogeissus leiocarpus Seedlings at 19WAP.*

	Leaf Count	Plant Height (cm)	Collar girth (cm)	Branch
Poultry Dropping	15.72±11.74[b]	14.76±6.38[b]	0.45±0.23[d]	1.14±1.63[d]
Cow Dungs	15.81±9.81[b]	14.65±4.58[b]	0.82±0.37[b]	1.97±1.89[b]
Poultry Dropping +Cow Dung	20.11±6.90[a]	18.71±7.22a	1.37±0.52[a]	3.11±2.62[a]
Control	12.78±5.85[c]	15.22±11.64[b]	0.54±0.38[c]	1.36±1.79[c]
Mean	16.11±9.25	15.84±8.06	0.80±0.53	1.90±2.15
Location				
Bauchi	16.27±10.09[a]	15.16±6.068[b]	0.75±0.46[b]	3.07±2.95[a]
Kaduna	16.88±9.90[a]	17.78±9.96[a]	0.80±0.58[a]	1.35±1.40[b]
Nasarawa	15.17±7.46[b]	14.58±7.31[b]	0.83±0.55[a]	1.28±1.10[b]
Mean	16.11±9.25	15.84±8.06	0.80±0.53	1.90±2.15
Week				
4.00	10.71±7.61[f]	10.81±4.20[e]	0.47±0.41[f]	0.67±1.0[f]
7.00	12.77±7.56[e]	12.7±64.39[d]	0.61±0.43[e]	1.0±1.21[e]
10.00	14.77±8.11[d]	14.70±4.79[c]	0.75±0.48[d]	1.45±1.59[d]
13.00	17.18±8.53[c]	17.24±11.58[b]	0.87±0.49[c]	2.09±1.96[c]
16.00	19.39±9.36[b]	18.22±5.91[b]	0.96±0.53[b]	2.49±2.40[b]
19.00	21.81±9.32[a]	21.29±9.43[a]	1.11±0.55[a]	3.71±2.66[a]
Mean	16.11±9.25	15.84±8.06	0.80±0.53	1.90±2.15

NOTE: Mean on the same row bearing the same alphabet are not significantly different, NS = not significant, Note: Poultry manure (PM), Cow dung (CD), Poultry manure +cow dung (PM +CD), Control

3.2. Results of Analysis of Variance on the Assessed Parameters on A. leiocarpus Seedlings

The results of analysis of variance showed that the effect of manure types had a high significant impact on seedlings height (0.000**), collar girth (0.000**), branches (0.000**) and numbers of leaf (P>0.05). The effect of seed sources also had a high significant impact on seedlings height (0.000**), collar girth (0.000**), branches (0.000**) and numbers of leaf (P>0.05). The effect of manure types and seed sources also had a high significant interaction on seedlings height (0.000**), collar girth (0.000**), branches (0.000**) and numbers of leaf on *A. leiocarpus* seedlings at (P>0.05) (Table 3).

Table 3. *The results of Analysis of Variance on the assessed growth variables on Anogeissus leiocarpus seedlings.*

Source of variation		Plant Height		Girth		Branches		No of Leaf	
	Df	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Intercept	1	8171.14	0.000**	9637.1	0.000**	3244.08	0.000**	6012.57	0.000**
Treatment	3	30.42	0.000**	658.72	0.000**	174.462	0.000**	52.93	0.000**
Location	2	31.59	0.000**	9.99	0.000**	310.100	0.000**	5.76	0.003**
Week	5	79.58	0.000**	142.52	0.000**	187.457	0.000**	66.87	0.000**
treatment * location	6	16.05	0.000**	21.88	0.000**	45.859	0.000**	5.44	0.000**
treatment * week	15	1.92	0.018*	1.85	0.025*	5.506	0.000**	0.866	0.603ns
location * week	10	1.43	0.161ns	1.75	0.065*	29.022	0.000**	3.04	0.001**
treatment * location * week	30	1.93	0.002**	1.00	0.461ns	2.859	0.000**	1.13	0.268ns
Error	1367								
Total	1438								
R^2			0.35		0.68		0.67		0.31

**= highly significant at 5% probability level, ns = not significant
Note: Poultry manure (PM), Cow dung (CD), Poultry manure +cow dung (PM +CD), Control

3.3. The Results of Correlation Analysis of Parameters Assessed on A. leiocarpus Seedlings

Results of correlation analysis indicated that there was a positive but low significant correlation (P>0.05) between the seedlings height and numbers of leaf (0.480^{*}), between Collar girth and numbers of leaf (0.389^{*}), between Collar girth and plant height (0.341^{*}), between Collar girth and numbers of branches (0.423^{*}), between numbers of branches and numbers of leaf (0.484^{*}). While, there was a positive but not significant correlation between the seedlings height and numbers of branches (0.289^{ns}) at (P<0.05) (Table 4).

Table 4. *Correlations Analysis for Parameters Assessed on Anogeissus leiocarpus Seedlings.*

Variables	Treatment	Week	Leaf Count	Plant Height	Collar girth	Branch
Treatment	1					
Week	0.001	1				
Leaf Count	-0.055	0.411^{*}	1			

Variables	Treatment	Week	Leaf Count	Plant Height	Collar girth	Branch
Plant Height	0.075	0.432*	0.480*	1		
Collar girth	0.172	0.408*	0.389*	0.341*	1	
Branch	0.093	0.462*	0.484**	0.289ns	0.423*	1

Note: ** = Correlation is significant at 1% probability level p<0.01, * = Correlation is Significant at 5% level P<0.05.

3.4. The Results of Regression Analysis of Parameters Assessed on Anogeissus leiocarpus Seedlings Against Height Increment

The results of Regression Analysis of parameters assessed on *Anogeissus leiocarpus* Seedlings against height increment revealed that seedlings height yielded coefficient of determination (R^2 = 0.573, SEE = 6.69, Durbin Watson Value = 1.71. This implied that the assessed growth variables had about 57.3% effects on the seedlings height. There was significance differences in the effects of assessed growth variables on the seedlings height (p<0.05) (Table 5).

Table 5. *Regression Analysis of parameters assessed on Anogeissus leiocarpus Seedlings against height increment.*

Model	Unstandardized Coefficients		Standardized Coefficients					
	B	Std. Error	Beta	t	Sig,	R^2	SEE	Durbin Watson
(Constant)	3.339	0.643		5.194	0.000			
Week	0.637	0.062	0.270	10.335	0.000**			
Treatment	0.602	0.162	0.083	3.706	0.000**			
Leaf Count	0.318	0.023	0.364	13.774	0.000**			
Collar girth	1.541	0.394	0.101	3.912	0.000**			
Branch	-0.236	0.102	-0.063	-2.312	0.021*	0.57	6.69	1.71

** = highly significant at 5% probability level, ns = not significant, dependent variables = height increment, S.E.E = Standard error estimate

4. Discussions

The results of the effects of organic manure on the growth variables of *Anogeissus leiocarpus* Seedlings indicated that seedlings treated with poultry manure, cow dung and poultry manure combined with cow dung yielded best growth variables compared to control. This agrees with the report of Egbewole Z. T. et al., and Walen J. K et al. who recorded positive effect on vegetative growth of plant due to application of organic fertilizer [28, 29]. Results on girth revealed that seedlings treated with cow dung yielded the best mean girth. It also agreed with Carle, J. R. et al. that reported that manure is a valuable fertilizer that can be used to enhance plant growth and has been used for centuries to supply needed nutrients for plant growth [25]. Manure is also a valuable source of organic matter, increasing soil organic matter, improves drainage in fine-textured clay soils and provides a source of slow release nutrients. Walen etal [28] Reported that the two most important limiting factors of plant production are water and organic matter. In the same way, usages of organic materials are the most important means to create healthy food for humans. It was confirmed by Egbewole Z. T. et al., that organic materials create fertility in the soil, and increase the availability of phosphorus and micronutrients in a different way [29].

Also the results of effect of varying Levels of Organic Fertilizers on the Growth of *Anogeissus leiocarpus* seedlings in Lafia showed that Seedling height was at its best where seedlings received 10g/pot of combined organic fertilizer. This study is not in line with the report of Rotowa, and Adeagbo, who recorded a significant effect on the vegetative growth of *Gmelina arborea* seedlings due to the application of organic fertilizer [30]. Rotowa O. J. et al., [31] in a study carried out on *Eucalyptus torelliana* asserted that poultry manure positively increases plant height more than other sources of manure. It was earlier reported that nitrogenous fertilizers influenced tree growth of tree seedlings, especially tree height, which could favour vegetative growth [32-35]. Carle, *et al.,* [25] opined that applying rates that are too low can lead to nutrient deficiency and low yields while too high rate can lead to nitrate leaching, phosphorus runoff, accelerated, and excessive vegetative growth of some plants. [27] Who investigated the effect of organic fertilizers and rate of application on germination and early growth of *Sterculia setigera* seedlings discover that there was no significant variation between 0g and 15g levels of fertilizer application to the seedlings. At the 5g level of application, cattle dung performed better than at higher levels of application. This result implied that, the maximum leaf length was achieved at 5 g; application of more quantity of cattle dung yielded an insignificant increase.

However, the results of effects of seed sources on the growth variables of *Anogeissus leiocarpus* seedlings indicated that seedlings sourced from Kaduna had the highest mean height of (17.78±9.96cm) followed by seedlings sourced from Bauchi (15.16±6.065cm). While the least height of (14.58±7.31cm) was obtained in Nasarawa sourced seedlings of *A. leiocarpus*. Similar trend was observed in the leaf count of seedlings. seedlings sourced from Kaduna recorded the highest leaf count of (16.88±9.90) followed by seedlings sourced from Bauchi which had 16.27±10.09, while the least leaf count of (15.17±7.46) was obtained in Nasarawa sourced seedlings. The results indicated that the influence of seed sources was significant (P>0.05) on the early growth of variables: leaf count, plant height, collar girth and branch of seedlings of *A. leiocarpus*. The result is in

conformity with [36] who investigated the provenance germination and early growth trial *Vitellaria paradoxa*, they find out that the significant effect of seed sources on virtually all the variables measured could be attributed to the fact that the seeds might have inherent climatic traits helped by poultry manure which contains the macro and micronutrients needed for plant growth and development.

The results of the effects of organic manure on the growth variables of *A leiocarpus*. Seedlings treated with poultry manure combined with cow dung recorded the highest mean height (18.71±7.22cm) followed by seedlings with control treatment 15.22±11.64cm, the poultry manure treated which had mean of (14.76±6.38cm) while the least plant height of (14.65±4.58cm) was obtained in cow dung treated seedlings of *A. leiocarpus*, which indicated that seedlings treated with cow dung and poultry manure combined with cow dung yielded best growth variables compared to poultry manure, cow dung and the control.

Also, the results of effects of seed sources on the growth variables of *A. leiocarpus* seedlings showed that seedlings sourced from Kaduna had the highest mean height of (17.78±9.96cm) followed by seedlings sourced from Bauchi (15.16±6.065cm). While the least height of (14.58±7.31 cm) was obtained in Nasarawa sourced seedlings.

5. Conclusion and Recommendations

5.1. Conclusion

The effect of organic fertilizer on the growth performance of *A. leiocarpus* seedlings had varying effects on the germination and its growth. The treatment with cow dung and poultry give the highest plant height, even though there was no Significant difference in the germination and its growth, but Cow dung and Poultry manure enhanced the growth of the seeds that lead to the significant difference on all the morphological parameters on the seedlings growth such as height, collar girth, leaf count and number of leaf etc. The effect of organic fertilizer on the growth performance of *A. leiocarpus* seedlings significantly influenced the tree species in varying degree. It indicated that seedlings treated with cow dung and poultry manure combined with cow dung yielded best growth variables compared to poultry manure, cow dung and the control.

5.2. Recommendations

Based on the result from this finding, it is recommended that:

1) The cow dung and poultry manure combined with cow dung should be used for mass raising *A. leiocarpus.*
2) Seedlings sourced from Kaduna which had the best growth attributes is recommended for mass raising *A. leiocarpus*.
3) Further research should be carried out to examine the effect of inorganic fertilizer on the growth variables of *A. leiocarpus* seedlings especially in thesame study area.
4) The application of modern crop husbandry, management practices in the nursery and for field establishment will enhance growth and production.
5) Due to the numerous benefits of *A. leiocarpus* in terms of human health, environmental protection and commercial benefits, its conservation will help to mitigate the effects of tropical deforestation, land reclamation as well as provide future timber.

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