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Preliminary Assessment on Effects of Organic Manure on Early Growth Performance of African Mahogany (*Afzelia africana* Sm. ex Pers.) Seedlings in Tertiary Institutional Forestry Nursery, Makurdi, Nigeria

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ABSTRACT: *Afzelia Africana (*African mahogany), *commonly known as* African oak, is a tropical African tree. It is valued for its high-grade timber but has good potential to provide fodder for livestock and food. The objective of this work there is to conduct a preliminary assessment on the effects of organic manure on early growth performance of African mahogany (*Afzelia africana* Sm. ex Pers.) Seedlings in Tertiary Institutional Forestry Nursery, Makurdi, Nigeria using standard methods. Data collection on seedling height, collar diameter, number of leaves and leaf length were measured at biweekly for eleven (11) weeks. The findings showed that the growth response and production of *Afzelia africana* seedlings were improved by both sources of organic manure. At eleven (11) weeks following manure application, the results showed that plants that got 6g CD were superior, with a mean height of 34.53 cm, a mean collar diameter of 4.40 mm, and a mean number of leaves of 15.73 (count). The mean leaf length (7.13m) was gained from CD (6g) and PD (9g) respectively. The results also revealed that seedlings of *Afzelia africana* yielded better growth at every two weeks of assessment except for collar diameter where control show a considerable result and leaf length where there was a decrease in their performance. According to the results, when compared to control and poultry droppings, cow dung at a rate of 6g recorded significantly higher growth performance. Consequently, farmers could use cow dung in their fields, which has more advantages in terms of improved growth characteristics than poultry manures and control.

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*Afzelia africana(*African mahogany), *commonly known as* African oak, is a tropical African legume tree found in the humid and dry forest savanna, medium to large, deciduous, up to 40 m high (Ayanwale and Ayanwale, 2007) and with high socio-economic, industrial, cultural and ecological importance (Donkpegan *et al*., 2014). It is a timber species with high forage for livestock (Nacoulma *et al*., 2014), economic and pharmacological values and used for soil conservation and improvement (Agbogidi and Onomeregbor, 2007). The heartwood is golden-brown to light red-brown, sometimes with darker veins; it is clearly demarcated from the 2-8cm wide band of yellow-white sapwood. The bark is 2 cm thick, scaly, very aromatic, grey to dark brown in colour. The bark is very effective in the treatment of many diseases. The seeds contain 31% oil and have potential for industrial use. The crown is large, spreading and its shape (flat or rounded) depends on age and growing conditions (Ejikeme *et al*, 2010). The predicament for the foresters is how to increase the yield and quality of products for rapidly expanding wood based industries and for use by a rapidly expanding human population and simultaneously maintaining the environmental

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diversity (Dachung and Kalu, 2019). *A. africana* is facing an overexploitation by communities across West African countries (Bonou *et al*, 2009), resulting in a decline of its natural populations. Therefore, it is considered as a threatened species in many countries. *A. africana* is included in the International Union for Conservation of Nature (IUCN) Red list of threatened species as vulnerable because of overexploitation (Gerard and Louppe, 2011). The high demand for *A.africana* leaves, seeds, roots and barks for various uses has resulted in corresponding increase in the exploitation at such a rate that sustainability of this natural resource cannot be guaranteed. Despite the threats reported by some authors on the species (Assogbadjo *et al*., 2008), few conservation data are available on *A. africana*. However, it is well understood that the loss of diversity may be minimized in a sustainable manner through increasing the number of species used in production forestry through domestication of indigenous timber species. In order to regenerate a forest and maintain it, the soil has to be enriched with nutrients. This enrichment could be in form of fertilizer application, which may be organic or inorganic forms, all of which furnish plants with nutrients necessary for their growth (Offiong *et al*., 2010). The use of organic manure as fertilizer releases many important nutrients into the soil and also nourishes soil organisms, which in turn slowly and steadily make minerals available to plants (Erin, 2007). Manures are organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. They release nutrients after their decomposition. Organic manures help in improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micronutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH (Alabadan *et al*., 2009). The nutrient content of animal manures varies depending on the type of animal. Poultry manure is said to be rich in Nitrogen (N) and phosphorus (P) and low in potassium (K) when compared to sheep, horse, and pig manure (Therios, 1996). Cow manure is a good source of Nitrogen (N), Organic carbon (C), Magnesium (Mg), and Calcium (Ca) (Adegunloye *et a*l., 2007). According to numerous studies (Awodum *et al*., 2007; Adebayo *et al*., 2017; Agera *et al*., 2019; Majolagbe *et al*., 2020; Unagwu and Ayogu 2020; Yisau *et al.,* 2020; Ibode *et al*., 2022), animal manure has positive impacts on plant growth and development. According to Unagwu *et al*. (2019) the growth performance of a plant is not only determined by the type of manure applied but the quantity and quality of manure applied also plays a key role. Excess nutrients may be detrimental, while inadequate nutrient application may not be enough to stimulate the desired growth in plants. Consequently, the need to acquaint farmers with the most successful soil or manures that could enhance the growth of *A. africana* seedlings cannot be overemphasized. Therefore, efforts must be made to identify manure preference to this species with reference to its effective usage by the plant in order to ensure the right domestication, sustainable use, and management of this species. Therefore, the objective of this work there is to conduct a preliminary assessment on the effects of organic manure on early growth performance of African mahogany (*Afzelia africana* Sm. ex Pers.) Seedlings in Tertiary Institutional Forestry Nursery, Makurdi, Nigeria.

MATERIALS AND METHODS

Study Site: The experiment was carried out at the Forestry Nursery of the Joseph Sarwuan Tarka University, Makurdi (JOSTUM). The Forestry Nursery lies between Longitude 8° 21' and 9° E and Latitude 7° 21' and 8° N within the Southern guinea savanna ecological zone. The climate of the area is tropical sub-humid with high temperatures and high humidity. The maximum temperature is 35 0C while the minimum temperature is 23 0C (Seibert, 2007). The climate is characterized by two distinct seasons namely, rainy and dry seasons with an annual rainfall of 1200mm-1500mm. The vegetation of the area has been described as Southern guinea savanna. The major occupations of the people include; farming, fishing, trading and hunting; the major.

Sample collection and preparation: Seeds (plate 1) of *Afzelia africana* were purchased at Obollo-Afor market Udenu, Enugu state.. The seeds were soaked in water for 24 hours to stimulate germination. The manures: poultry droppings (PD) and cow dung (CD) were collected at the JOSTUM research Farm. They were air dried, milled, sieved and mixed thoroughly with topsoil and riversand at different treatments rate of T1(3g), T2(6g) and T3(9g) and T4(0g) as control after three weeks of transplanting the healthy seedlings.

Experimental set up: The seeds of *Afzelia africana* were sown on a seedbed and watered twice (morning and evening) until the completion of germination (3 weeks). The sowing media used was topsoil and river sand, which was made to pass through 2mm sieve. After three (3) weeks of germination, the sprouted seedlings (2 each) were selected and transplanted into polythene pots of 15 × 8.5 cm size filled with topsoil and riversand in the ration 3:1 for early growth assessment. Manures from poultry droppings (PD) and cow dung (CD) were then applied to the seedlings

at the rate of 3g, 6g and 9g using ring method (Dachung and Kalu, 2019). Seedlings that did not receive manure served as control (0g). The experiment was arranged in a 2 x 4 in a completely randomized design (CRD) (table 1) and replicated three (3) times

Plate 1: ***Afzelia africana*** seeds

Table 1: Treatment combination of 2 x 4 factorial

Rate of application	Manure application	
	PD	CD
T1	PDT1	CDT1
T2	PDT2	CDT2
T3	PDT3	CDT3
T4	PDT4	CDT4

Note: PD= Poultry droppings, CD= Cow dung, T1= 3g, T2= 6g, T3=9g, T 4(0g) control

Data collection: Plant growth measurement: Plant growth parameters were measured at two (2) weeks interval for the period of the assessment. These were; plant height, collar diameter, number of leaves and leaf length.

The height of seedling (cm) in each poly pot was measured using a graduated meter rule. The seedling height was measured from the bottom to the terminal bud of the seeding with a graduated ruler.

Collar diameter (mm): The stem diameter of each seedling was measured slightly above the collar height with a digital vernier caliper

The number of leaves(count): The total number of leaves present on each seedling was counted by physical observation .

Leaf length (cm). The graduated meter rule was used to measured leaf length

Data analysis: Data collected were subjected to Analysis of Variance (ANOVA) and means were separated using Duncan multiple range test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Effect of organic manure on early growth performance of Afzelia africana seedlings: The result conducted on the growth variables assessed shows that the type of organic manure received significantly affects growth of *Afzelia africana* seedlings. Highest mean height (34.53cm) was observed in the 6 g of cow dung treatment in the 11th week after application, followed by the cow dung at 9g with mean height (29.13) cm while the lowest was cow dung at 3g (20.67 cm)(table 2). The highest mean collar diameter was observed in cow dung at 6g(4.40mm) followed by control(0g)(4.13mm) while the least was observed in cow dung at 3g (3.13mm) (table 2). The highest mean number of leaves was obtained in cow dung at 6g (15.73) followed by control(0g)(12.67) while the least was observed in cow dung at 3g(10.07)(table 2).The highest mean leaf length was observed in cow dung and poultry droppings at 6g and 9g respectively (7.13 and 7.13 cm) followed by poultry dropping at 6g (7.07cm) while the least is control(0g)(5.00cm)(table 2).The results obtained from the study also showed that seedlings treated with 6 g cow dung performed best in all the parameters measured (Fig. 1). This treatment showed healthy growth in seedling height, collar diameter, number of leaves produced and leaf length. *Afzelia africana* seedlings maintained an appreciable increase of growth variables every 2 weeks of assessment throughout the experiment (Fig. 2). Except for leaf length, where there was a decrease in trend. However, there was no significant difference on the seedling growth variables at the end of 11 weeks as illustrated in fig 2.

Table 2: Growth performance of *Afzelia africana seedlings* subjected to types and rate of organic manure application at 11 weeks of assessment

Treatments	Rate	SH(cm)	CD(mm)	NL(count)	LL(cm)
PD	**T1**	22.60±4.19^{b}	3.80±0.68^{c}	10.33±5.53^{a}	6.13±2.69^{c}
	T2	21.80±8.28^{b}	3.80±1.08^{c}	10.40±5.53^{a}	7.07±2.34^{c}
	T3	28.13±8.47^{b}	3.67±1.11^{c}	11.47±5.44^{a}	7.13±2.35^{c}
CD	**T1**	20.67±7.17^{b}	3.13±1.06^{c}	10.07±3.88a	6.47±1.89^{c}
	T2	34.53±7.14^{d}	4.40±0.74^{c}	15.73±3.49a	7.13±1.36^{c}
	T3	29.67±6,23^{b}	4.00±0.38^{c}	12.40±4.66a	6.40±2.35^{c}
	T4	27.27±9.55^{b}	4.13±1.25^{c}	12.67±5.25a	5.00±1.73^{c}

Note: *Mean carrying the same alphabet did not vary significantly at p≤ 0.05; PD=Poultry droppings, CD= Cow dung, T1=3g, T2= 6g T3= 9g, T 4=0g(control); SH=seedling height, CD=collar diameter, NL= number of leaves, LL= length of leaves*

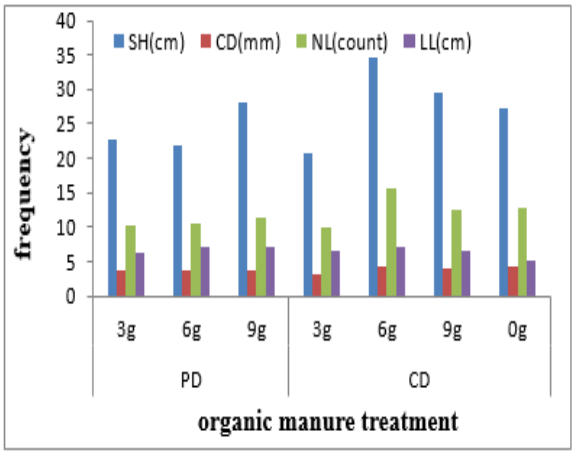
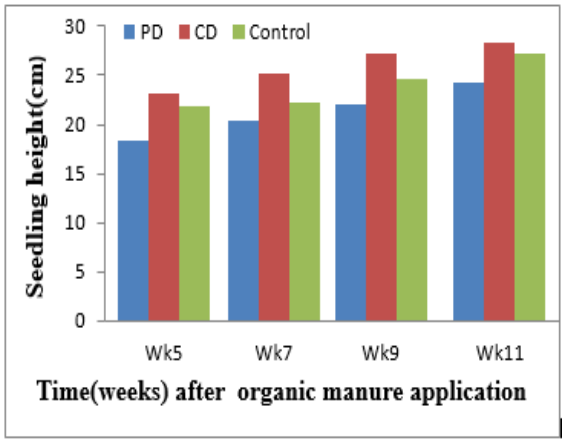
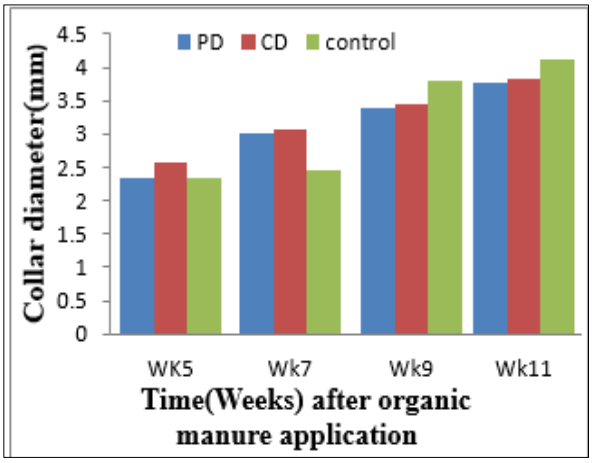
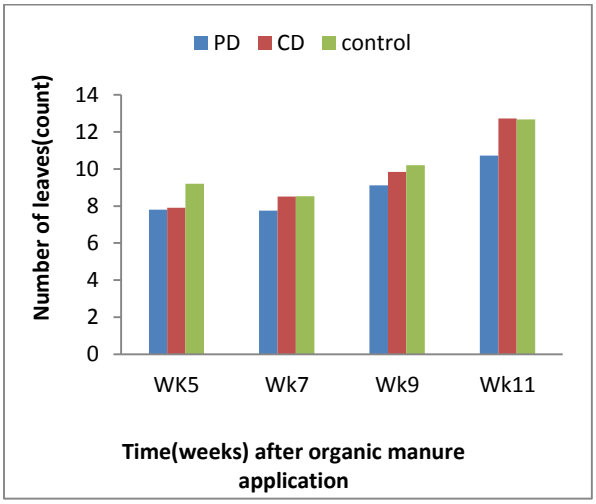


Fig.1: Growth pattern of *Afzelia africana* seedlings as influenced by different rate of manure application



The results of this study revealed that both poultry droppings and cow dung are valuable sources of manure to *Afzelia africana* because they yielded better growth and seedlings quality. The highest mean plant height observed in cow dung is in agreement with earlier reports of Agbo Adediran *et al*. (2020) and Majolagbe *et al*. (2020) who recorded high performance in cow dung with *Entandrophragma angolense and Massularia acuminata*. The high nutrient in the cow dung could be due to the presence of essential elements. The process of seedling height growth includes cell division, and P is one of the essential elements required during cell division in a plant (Unagwu *et al*. 2019). The result contradicts the work of Oluborode *et al*., (2022) who obtained higher results in organic manure (poultry droppings) with *Khaya senegalensis*.





The collar diameter and leaf length by *Afzelia africana* seedlings were not significantly affected by the type of animal manure used and rate of application. Seedlings collar diameter ranged from 3.13 mm (3g cow dung) to 4.40mm (6g cow dung) while leaf length ranged from 5.00cm (control) to 7.13cm (9g of poultry droppings and cow dung). However, when compared to poultry droppings and control, there was a slight

improvement in the collar diameter of *Afzelia africana* seedlings with cow dung at 6g. This could be attributed to high N and low K (N/K) which favour vegetative growth.

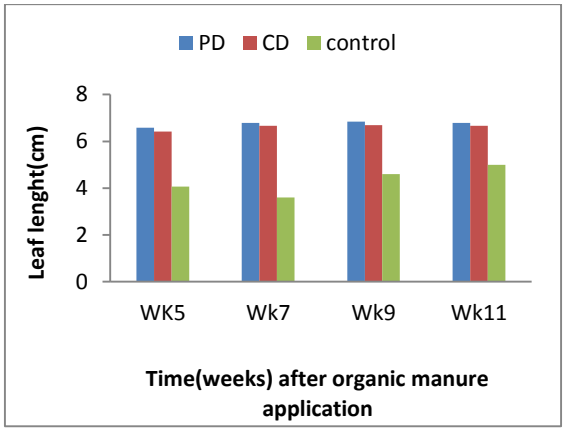


Fig. 2: Time series plot showing the growth trend of *Afzelia africana* based on the type of manure applied.

The result agrees with the work of Iroko *et al*., (2019) on *Entandrophragma angolense.* Majolagbe *et al.* (2020) reported a similar result of no significant difference in collar diameter of *Massularia acuminata* seedlings after being subjected to various animal manures. However, in *Eucalyptus camaldulensis*, a contrary result was observed by Agera *et al*. (2019) in poultry droppings. Differences in species could be the reason for this contradiction. The highest mean leaf length from poultry manure and cow dung corroborates the report of Agera *et al*, (2019), who opined that leaf length was recorded from poultry manure and cow dung. This observation was in agreement with that of Aduradola *et al*. (2016) who opined that an increase in the quantity of organic manure usually leads to better plant growth. Similarly the result agrees with Majolagbe *et al*., (2020) who indicated that both poultry manure and cow dung are valuable sources for growth of tree seedlings because they have greatly improved growth performance of vegetative parts of treated plants. This may be because all animal dung contains essentials minerals including N, P, and K, which are important for plant growth and development (Chmelková and Hejcman, 2012; Gil *et al*., 2012; Tanoi and Kobayashi, 2015). Highest mean number of leaves observed in cow dung agrees with the findings of Adebayo *et al*. (2017) and Adekiya *et al*., (2020) who reported highest number of leaves in organic manure of *Moringa oleifera* seedlings and okra(*Abelmoschus esculentus)*. The findings contradict similar work of Aderounmi, (2019) on *Afzelia africana* in poultry droppings. A steady and appreciable increase in growth variables observed at every 2 weeks of assessment in *Afzelia africana* seedlings throughout the experiment could be attributed to the gradual and steady release of N from organic manure to plant over a longer time for its growth and development (Adekiya *et al*., 2020). Several researchers found that plant growth performance was improved regardless of the type or quantity of manure supplied (Han *et al.* 2015, Imoro *et al.* 2012; Agera *et al*. 2019) when compared to plants that did not receive manure. However, the (control) group without organic manure performed just as well as was seen in this study.

Conclusion: The study demonstrated the positive impact of organic manure on *Afzelia africana* seedling growth and performance. Notably, seedlings treated with 6 g and 9g of cow dung and poultry manure exhibited superior results. Both types of manure were found to enhance seedling growth, highlighting the value of manure for expedited establishment. Cow dung, rich in nutrients, consistently supported growth. Although the control group showed significant growth, suggesting some survival without manure, it's advisable to use cow dung for optimal outcomes in small-scale *Afzelia africana* cultivation

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