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Seed Germination and Early Seedling Growth of *Pterocarpus Osun* (Craib) on Different Sowing Media and Soil Amended With Different Organic Manure

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ABSTRACT: *This study investigates the effect of different sowing media and soil amendments on seed germination and early seedling growth of Pterocarpus osun. The study was carried out at the nursery site of the Department of Forest Resources and Wildlife Management, Ekiti State University, Ado-Ekiti. Sixty seeds were sown in plastic bowls filled with the different sowing media (sawdust, river sand, and topsoil). Watering was done twice daily, while seed germination was monitored for four weeks. The number of seeds germinated per day was recorded for each treatment till no further germination was observed. For the growth experiment, seedlings with relatively uniform height were selected and transplanted into polythene pots filled with topsoil amended with different organic manure (poultry dropping, cow dung, poultry dropping + cow dung). The treatments were replicated ten (10) times. Growth parameters viz; (heights, stem diameter, and number of leaves) were measured over 12 weeks. The study revealed that seeds sown in sawdust had the lowest mean germination time (MGT) of 19.93 days. Time spread of germination (TSG) shows that seeds sown in river sand had the longest germination circle of 12 days. While seeds sown in sawdust had the highest germination percentage (GP) of 96.65 %. The result revealed that seedlings grown on soil amended with cow dung performed best for all the parameters measured throughout the growth period. It is recommended that sawdust should be adopted for germination of Pterocarpus osun and cow dung should be used as organic manure for raising the seedlings in the nursery.*

KEYWORDS: seed germination, seedling growth, pterocarpus osun, sowing media, organic manure.

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INTRODUCTION

There are lots of indigenous forest species (woody plants) that are of local importance such as the provision of sawn timber, fruits, and medicinal herbs for the populace in Nigeria (Uluocha *et al*., 2016). These indigenous wood species are of good quality and are traded widely within and outside Africa. Some played a crucial role in providing food for the people, thereby solving the problem of food security over time as well as means of generating income by both rural and urban dwellers (Kola-Oladiji *et al.,* 2006). *Pterocarpus osun* (Craib) known as camwood, bloodwood (English), Osun dudu, Gbingbin (Yoruba), Akwara (Igbo), Ekme (Edo) belongs to the family Legminnosae and subfamily Papilionaceae.

The tree is about 30m in height and 2.5m in girth with a wide spreading crown (Keay, 1989). It is typical of the savanna ecosystem but has extended to the rainforest fringes due to secondary invasion. Its distribution extends from Senegal on the west coast to Nigeria and Central African Republic (Keay 1989). It is a multipurpose tree, used mainly for herbs (Gills and Bamidele 1987) and also has other medicinal uses including blood purification, control of menstruation pains and treatment of various skin rashes and foot diseases (Abbiw, 1990). This species has a symbiotic relationship with certain soil bacteria, these bacteria form nodules on the roots and fix atmospheric nitrogen (Huxley 1993).

According to Nwoboshi (1982) for many members of the Papilionaceae subfamily, growth is often difficult, until the curricular substance inhibiting germination is removed by a pre-treatment method to overcome dormancy for quick and faster growth. Post-establishment requirement for optimum growth is also critical if a plantation with vigorous seedlings is the goal (Aiyelagbe 1989). Such requirements will include the use of appropriate potting mediums apart from overcoming seed dormancy problems. The quality of the potting medium is universally recognized as being one of the important requirements for the successful growth of any plant in nursery beds or boxes (Bunt 2014). Although topsoil as a potting medium has remained the traditional growth medium for seedlings establishment and growth, most soils when used alone are very poor growing media. At the same time, some of them had been reported as the easiest way through which seedlings become infected either by root-knot nematode or root rot diseases (Egunjobi and Ekundare 1981).

Pterocarpus osun is of great interest to agroforestry systems, as it helps to improve soil fertility. Increased demand for camwood as a timber species is competing greatly with its importance as a source of fodder. One of the problems with this species according to Karsten *et al.*, (2014), is the difficulty of raising seedlings from seeds due to its hard-impermeable seed coats restricting the entry of both water and oxygen that will aid its germination.

Seed germination is influenced by many factors such as the type of substrate used, and environmental factors such as oxygen, light, water and temperature for some plant species (Dolor,

2011). Also, Sa'id *et. al*. (2015) noted that the quality of seedlings raised is significantly influenced by the growth medium because, plant roots are limited by the size and content (moisture, nutrient and air) of the nursery container. Growth media has been documented to be a vital agent in the nursery that determines the growth of seedlings (Baiyeri and Mbah, 2006). It also plays the role of a reservoir for moisture and nutrients (Dolor, 2011). It has been found to affect seedling emergence, growth and quality (Okunlola, 2016).

Organic manure mixtures play a key role in improving soil properties which increase the rate of seedling growth by creating a suitable environment with proper aeration, sufficient water, nutrient supply and an excellent root system which, in turn, results in the luxurious growth of plants. Also, a suitable sowing medium will help to reserve water and nutrients, provide support or anchorage and allow oxygen to diffuse to the roots of the plant. However, the use of any type of organic manure depends largely on its economic, physical and chemical characteristics as well as its availability.

Moreover, there appears to be a scarcity of information relating to silvicultural activities on *Ptericarpus osun*, hence, the low level of information on its germination and growth. Therefore, to promote its active cultivation/planting and inclusion in regular farming or plantation establishment there is a need for additional silvicultural information on the species.

MATERIAL AND METHODS

Study Area

The research was conducted at the Nursery site of the Department of Forest Resources and Wildlife Management, Faculty of Agricultural Sciences Teaching and Research Farm of Ekiti State University, Ado State. It lies between latitude 7° 31' and 7° 94' N. and longitude 5° 5' E and longitude 5° 25' E. The soil in the study site belongs to the broad group Alfisol (Kayode *et, al.* 2009). The soil is highly leached, with low to medium organic matter, a deep red–clay profile, and with top sandy loam texture (Akintomide and Osundare, 2015).

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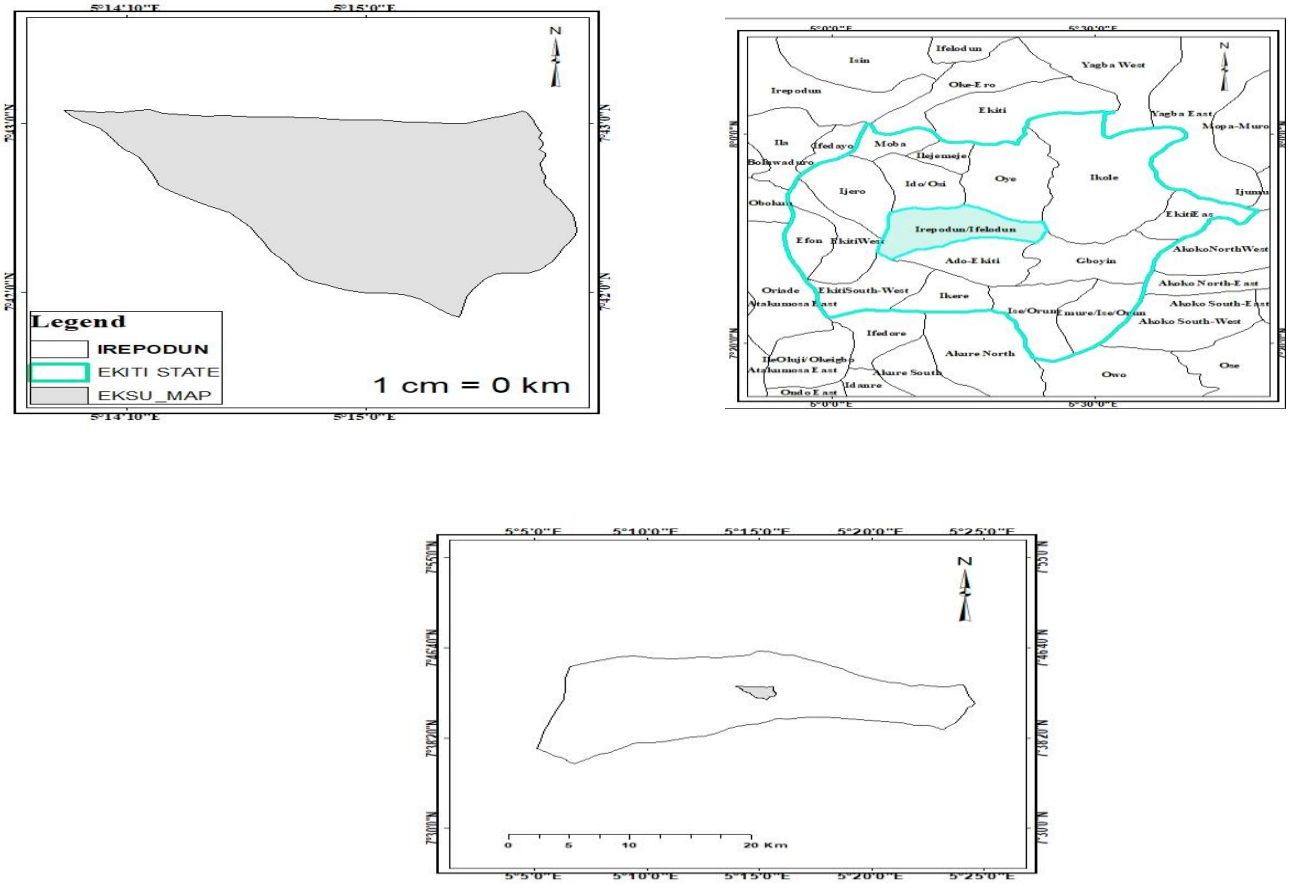

Plate A: Ekiti State University Nursery

Climate

Ado-Ekiti metropolis experiences tropical climatic with two seasons viz; rainy and dry season. The rainy season is between March and November and the annual rainfall varies from 1,200 mm to 1,500 mm, with the peak between September and early October. The mean monthly temperature is generally high throughout the year. it ranges from 21^0 C to 32^0 C. Annual average relative humidity is about 90 % at 7.00 am and 65 % at 4.00 pm.

Materials

Seeds of *Pterocarpus osun*, perforated polythene pots, sowing media (topsoil, river sand and sawdust), organic manure (cow dungs and poultry droppings), measuring tape calibrated in centimeters (cm), a digital Vernier caliper, label tags, record book, watering can, pen, ruler, plastic bowl, sandpaper, and polyethylene pots (medium size).

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Seed Collection and Processing

The seeds of *Pterocarpus osun* were collected from mother trees at the International Institute of Tropical Agriculture (IITA), Ibadan. The seeds were obtained by removing the wing to extract the seed. Viability test was carried out through the floatation method, the ones that float are regarded as not viable while the ones that sank were used for the study. The viable seeds were dried under shade at normal room temperature.

Procedure of the experiment

The study consists of two experiments viz:

i. Germination experiment
ii. Growth experiment

Germination experiment

Sixty seeds were sown in plastic bowls (of equal sizes) filled with the different sowing media. Watering was done twice daily (morning and evening) while seed germination was monitored for four weeks.

Growth experiment

Seedlings with relatively uniform height were selected from all the treatments and then transplanted into polythene pots filled with soil amended with different organic manure (cow dung and poultry droppings) and soil without organic manure, for the early growth experiment. Growth parameters viz; heights, stem diameter and number of leaves were measured for 10 weeks.

Calculation and Data Analysis

- Germination Percentage $\frac{Number\ of\ seeds\ germinated}{Total\ number\ of\ seeds\ planted}$: x 100
- Emergence Index = $\frac{Number\ of\ seeds\ germinated\ per\ day\ X\ Day\ after\ planting}{Total\ number\ of\ seedlings\ germinated}$
- Emergence rate index = $\frac{Emergence\ Index}{Germination\ percentage}$

The data collected was computed and subjected to analysis of variance (ANOVA) by adopting the completely randomized design (CRD) using Ms. Excel. The observed means were subjected to Duncan's Multiple Range Test for mean separation to determine the most suitable organic manure on the early growth performance of *Pterocarpus osun*.

RESULTS

Effect of different sowing media on germination of *Pterocarpus osun* seed.

The result in Table 1 shows that seeds sown in sawdust had the lowest mean germination time (MGT) of 19.93 days, this was followed by seeds sown in river sand (24.05 days) while seeds

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sown in topsoil had the highest MGT value (25.65days). The result on the first day of germination (FDG) shows that seeds sown in sawdust had the fastest day of germination which occurred on the sixteenth day after planting. This was followed by seeds sown in river sand with FDG on the eighteenth day. Seeds sown in topsoil had their FDG on the twentieth day.

The result shows that seeds sown in sawdust had the fastest germination completion day on the twenty-sixth day after planting, and seeds sown in river sand and topsoil had their germination completed on the thirtieth day. Time spread of germination (TSG) shows that seeds sown in sawdust and topsoil have the shortest germination circle of 10 days while seeds sown in river sand had the longest germination circle of 12 days.

Table 1: Effect of different sowing media on germination of *Pterocarpus osun* seed.

Germination parameters	Sawdust	Topsoil	River sand
Mean Germination Time	19.93 days	25.65days	24.05 days
First Day of Germination	16	20	18
Last Day of Germination	26	30	30
Time Spread of Germination	10	10	12

Effect of different sowing media on germination percentage and emergence index of *Pterocarpus osun* seed.

The result in Figure 1 shows that seeds sown in sawdust have the highest germination percentage (GP) of 96.65 %, this was followed by seeds sown in river sand (66.67 %) while the lowest GP was recorded for seeds sown in topsoil (38.33 %). Emergence index (EI) and Emergence rate index (ERI) was calculated and presented as shown in Table 2. The result shows that seeds sown in top soil had the highest emergence index (25.65) while seeds sown in sawdust had the least emergence index value of 19.93. Emergence rate index (ERI) for all the treatments follow the same pattern with top soil having the highest value of 0.67.

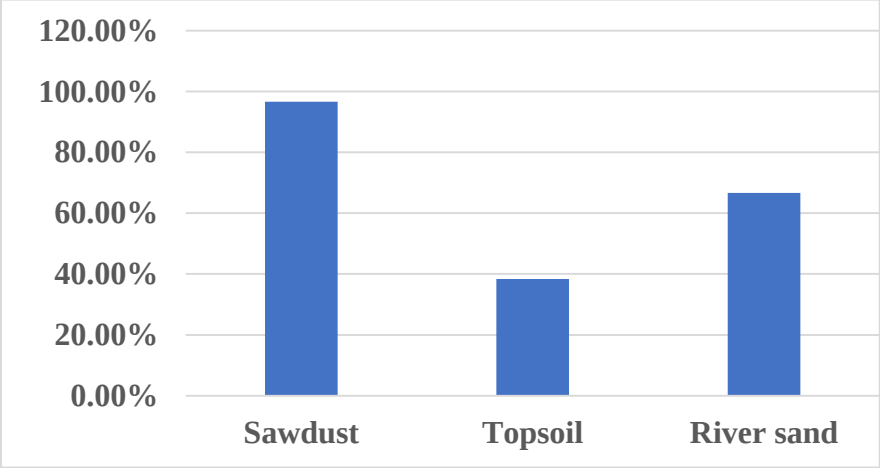

Figure 1: Germination percentage of *Pterocarpus osun* seed

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Table 2: Emergence index

Variables	Sawdust		Topsoil		River sand	
	Emergence (E)	∑ (E x D)	Emergence (E)	∑ (E x D)	Emergence (E)	∑ (E x D)
Total	58	1156	23	590	40	962
GP	96.65%		38.33%		66.67%	
EI	19.93		25.65		24.05	
ERI	0.21		0.67		0.36	

Effect of different organic manures on early growth of *Pterocarpus osun*

Table 3 shows the effect of the different organic manures on seedling growth parameters. Seedlings grown in soil amended with cow dung have the highest mean height, while the lowest height was obtained for the seedlings grown in soil without amendment (control). Seedlings' stem diameter was significantly higher ($p \leq 0.05$) in soil amended with cow dung. Seedling leaf number was not significantly different for seedlings grown in soil amended with different organic manure ($p \leq 0.05$). However, seedlings grown in control treatment have significantly least value.

Table 3: Seedling performance of *Pterocarpus osun* under different organic manures

Treatments	Growth parameters		
	Height (cm)	Stem diameter (cm)	Leaf number
Control	15.68 ± 0.4^{b}	4.22 ± 0.1^{b}	5.41 ± 0.07^{b}
Poultry droppings	15.74 ± 0.4^{b}	4.35 ± 0.1^{b}	5.71 ± 0.07^{a}
Poultry droppings + cow dung	16.47 ± 0.4^{ab}	4.44 ± 0.1^{b}	5.74 ± 0.07^{a}
Cow dung	17.02 ± 0.4^{a}	4.78 ± 0.1^{a}	5.82 ± 0.07^{a}

Means with the same alphabets as superscript in the same column are not significantly different ($p \leq 0.05$)

Effect of different organic manures on height of *Pterocarpus osun* seedling

Figure 1 shows the result for seedling height under different organic manure over twelve weeks after transplanting (WAT). The result shows that seedlings grown in soil amended with cow dung has the highest height value throughout the growth period. This was followed by seedlings grown in soil amended with poultry droppings + cow dung. Seedlings grown in the soil without amendment (control treatment) has the least height value up to 6th weeks after transplanting (WAT), while the height value for seedling grown in poultry droppings was least between the 6th and 10^{th} WAT.

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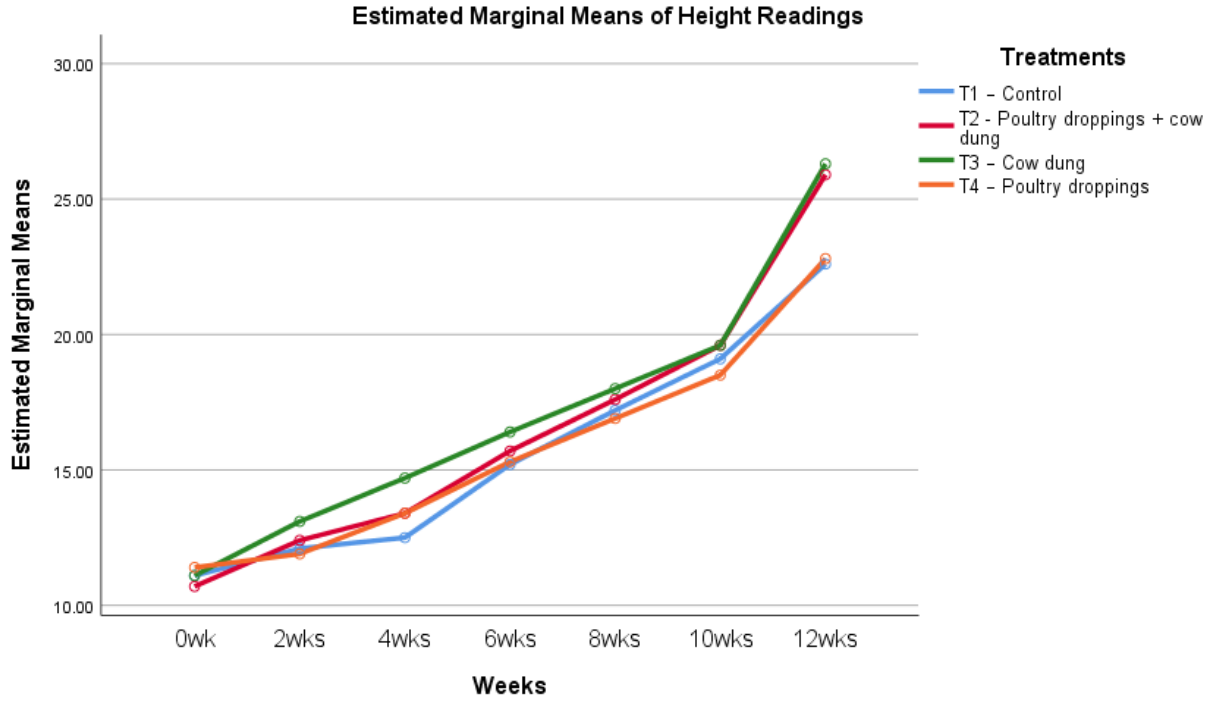
Figure 1: Effect of different organic manures on the height of *Pterocarpus osun* seedling



Effect of different organic manures on the diameter of *Pterocarpus osun* seedling

Figure 2 shows the result for seedling diameter under different organic manure over twelve weeks after transplanting (WAT). The result shows that seedlings grown in soil amended with cow dung have the highest diameter value throughout the growth period. Seedlings grown in the soil without amendment (control treatment) had the lowest diameter value up to 8th weeks after transplanting (WAT), while the diameter value for seedlings grown in soil amended with poultry droppings was lowest between the 10th and 12th WAT.

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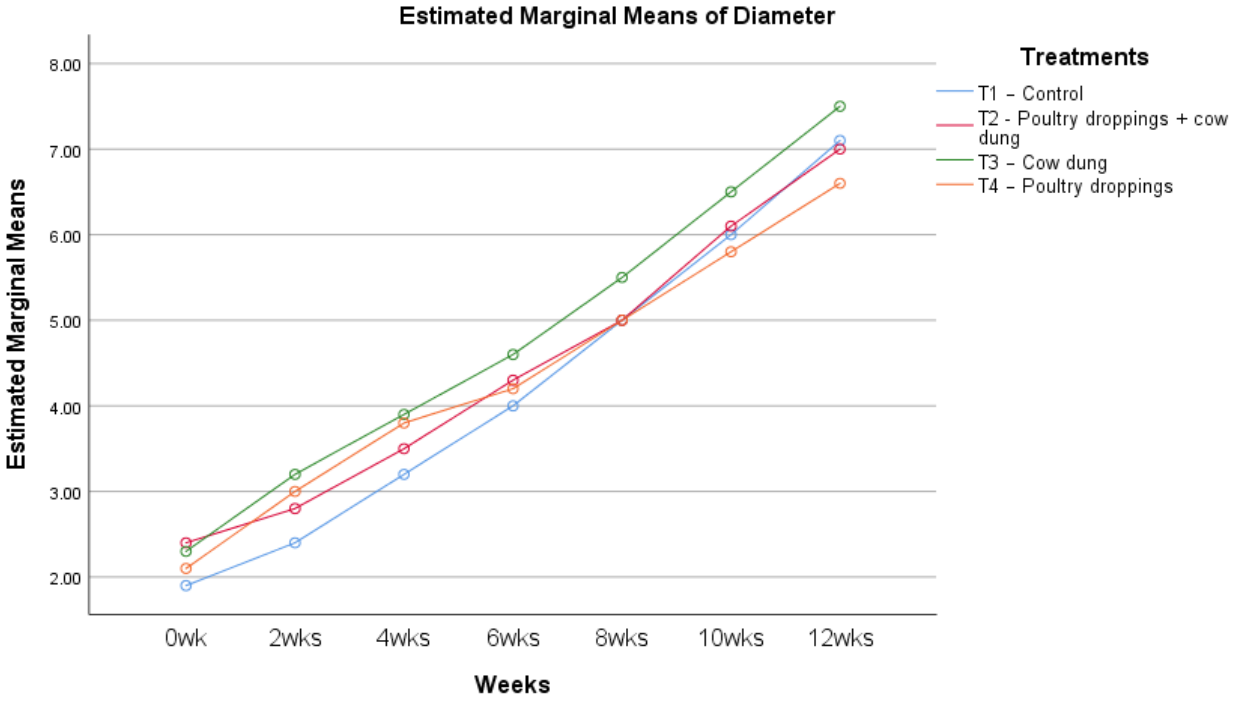
Figure 2: Effect of different organic manures on the diameter of *Pterocarpus osun* seedling



Effect of different organic manures on leaf number of *Pterocarpus osun*

Figure 3 shows the result for seedling leaf number under different organic manure over twelve weeks after transplanting (WAT). Seedlings grown in soil amended with poultry droppings + cow dung had the highest mean leaf number up to 4th WAT, while leaf number was highest for seedlings grown in soil amended with cow dung from 4th to 12th WAT. Seedlings grown in soil amended with poultry droppings have the least leaf number throughout the growth period.

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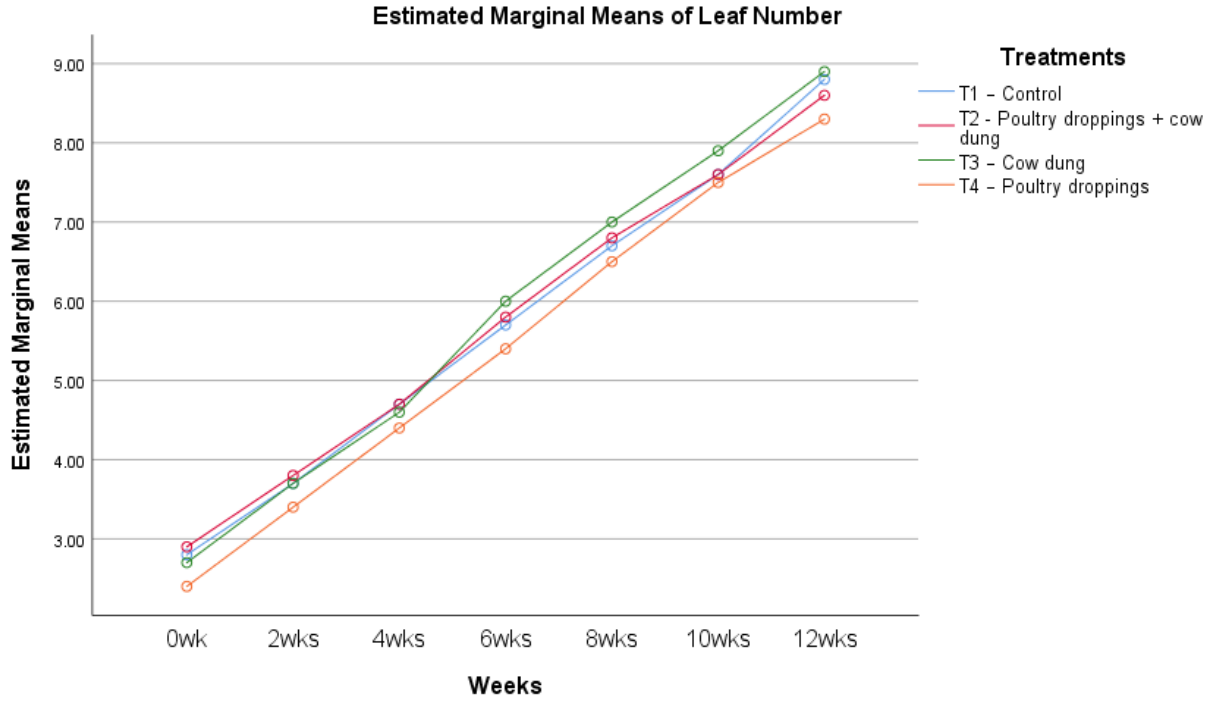

Figure 3: **Effect of different organic manures on leaf number of *Pterocarpus osun***

DISCUSSION

The observed better performance in terms of emergence in the seeds sown in sawdust over other sowing media could be attributed to the light and loose nature of the sawdust which allows easy sprouting and emergence of germinating seeds. On the other hand, the compact nature of the topsoil could have resisted the quick sprouting of the seeds thereby delaying seed emergence of *Pterocarpus osun*. Also, due to the high level of porosity of both sawdust and river sand, the two sowing media are well aerated and therefore provide conducive environment for seed germination. The decomposition process in sawdust due to microbial activities generates heat sufficient enough to supply the required warmth which probably enhances seed germination of *Pterocarpus osun.*

The observed better performance in all the growth parameters assessed in seedlings grown on soil amended with organic manure could be attributed to better nutrient absorption which favored faster seedling growth. The better growth performance of seedlings in soil amended with cow dung over that of poultry droppings is an indication that cow dung is a high-quality manure that decomposes and mineralizes fast to release its nutrients for subsequent seedling uptake. In this case, there is a synchrony between nutrient release and uptake at this early growth stage. This assertion corroborates the findings of Agbo-Adediran *et. al.*, (2020) that cow dung is best used as organic manure for raising seedlings of *Entandrophragma angolense* during its early growth stage in the nursery. On the other hand, the drop in the height and diameter reading of seedlings sown in soil

amended with poultry droppings at 8-12WAT compared with the seedling in the control treatment could be attributed to nutrient immobilization due to increase in microbial population at that growth stage thereby delaying the release of nutrient for seedling uptake.

CONCLUSION AND RECOMMENDATIONS

The study showed that the germination percentage of *Pterocarpus osun* improved significantly with seeds sown in sawdust. This implies that using sawdust will remove the barrier of poor germination of *Pterocarpus osun* species. The study further showed that seedlings grown on soil amended with cow dung manure perform best in terms of growth parameters measured (i.e. height, collar diameter and number of leaves) throughout the growth period. Based on the findings of this research, it is recommended that sawdust should be adopted for the germination of *Pterocarpus osun* and cow dung should be used as organic manure for raising seedlings of *Pterocarpus osun* during its early growth stage in the nursery.

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