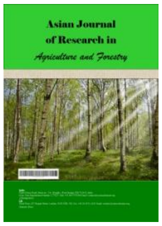

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The Effects of Fish Pond Sediments and Cow Dung on the Early Growth of *Afrormosia elata* Harms Seedlings

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

More often than not, the emphasis is laid on the essence of employing organic manures for raising plant seedlings and even in improving the nutrient status of their growth media for higher productivity. Afrormosia elata has numerous medicinal uses but not very much available. Thus, the study on the effects of fish pond sediments (FPS) and decomposed cow dung (DCD) on the early growth of A. elata seedlings was carried out at the nursery 'A' of the Federal College of Forestry, Ibadan, Nigeria. A. elata seeds were sown in a finely perforated sieve (filled with washed river sand) and seedlings were pricked – out 2 weeks after seedling emergence into polythene pots with varying levels of FPS and DCD. The experimental design was Completely Randomized Design (CRD) consisting of nine treatments and eight replicates. Treatments include; T_1(2 kg of FPS + 2 kg of topsoil); T_2 (2 kg of DCD + 2 kg of topsoil); T_3 (1.5 kg of FPS + 2 kg of topsoil); T_4 (1.5 kg of DCD + 2 kg of topsoil); T_5 (1 kg of FPS + 2 kg of topsoil); T_6 (1 kg of DCD + 2 kg of topsoil); T_7 (500 g of FPS + 2 kg of topsoil); T_8 (500 g of DCD + 2 kg topsoil); and 2 kg of topsoil without any treatment served as control). Morphological parameters such as seedling height, collar diameter and leaf count as well as leaf biomass were assessed and the data collected were subjected to Analysis of Variance (ANOVA). The result showed that T_3 (1.5 kg FPS + 2 Kg

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TS) had the best performance in height, leaf area and leaf biomass with mean values of 11.02 cm, 21.65 cm^2 and 1.16 g respectively. Though, there were no significant differences amongst the growth parameters assessed for this study. But T_3 (1.5 kg FPS + 2 Kg TS) could be employed in raising the seedlings of this plant for faster growth rate.

Keywords: A. elata; fish pond sediments; cow dung; topsoil; growth parameters.

1. INTRODUCTION

Aquaculture has been widely developed in recent years for food security and income generation [1]. Lin and Yakupitiyage [2] had also reported that successful management of tropical fish pond for biologically optimal fish growth requires the supply of necessary pond inputs including nutrients in a balanced manner via fertilization and supplementary feeding. However, [3] stated that the accumulation of the sediments enriched with organic matter and other nutrients is a major concern affecting the intensification and management in ponds. Therefore, maintenance of pond volume and its environment by sediment removal is a helpful practice for profitable fish production. Pond sediments had become a widespread concern but on the contrary, the use of pond sediments in agricultural and forest land as fertilizer supplement and soil conditioner have proved to be the best management option which can be used in raising agricultural crops as well as forest tree species [4]. Similarly, urban dwellers are beginning to show more interest in fish farming to improve household nutrition. It is therefore imperative to employ animal wastes such as fish pond sediments and cow dung (as manure) for boosting forest and agricultural crop production.

Cow dung is an organic fertilizer *that* is cheap, popularly used and readily available for use in enhancing soil nutrient status and improving crop yield especially in semi-urban areas [5]. Akande et al. [6] described it as a type of farmyard manure which is mainly excreta collected from cattle which can be applied as manure in the formed slurry or dried to improve soil physicochemical properties that are important for plant growth. Moreover, the need to increase the productivity of tree species which has great economic importance and high value in the international market cannot be overemphasized. *Afrormosia elata* (Harms) is one of such tree species that possess these qualities.

A. elata also is known as *Pericopsis elata* (Harms) It is a leguminous species and belongs to the family Fabaceae. *A. elata* is a gregarious species restricted to the drier part of semi-deciduous forest. It is usually found in Central and West Africa. It is a large tree which may be recognized readily by its bark which flakes - off in thin irregular patches leaving bright reddish colour beneath. It is known for its beautiful colour which ranges from golden to darker brown gradually turning to a deeply rich, walnut-like colour [7]. The seeds of *A. elata* germinate/emerge (as seedlings from seeds) rapidly in about 8 days [8]. Burslem and Miller [9] reported that under full sunlight, the seedling emergence rate is low and is only about 5% in localities where seedlings receive full sunlight in the morning but better seedlings' growth is optimal when shaded from direct midday sun.

1.1 The Objective of the Study

The study focuses on the evaluation of the effects of fish pond sediments and decomposed cow dung (organic manures) on the early growth rate of *A. elata* seedlings.

2. MATERIALS AND METHODS

This study was conducted at the greenhouse of the Federal College of Forestry Ibadan, Nigeria. The college is located at Jericho Quarters in Ibadan North West Local Government Area of Oyo State Nigeria. The area coordinates are latitude $70^{o}26^{1}$ N and longitude $30^{o}36^{1}$ E. Regarding the climatic conditions, the area is typically in the rain forest zone, with an annual rainfall of 1,400 mm–1,500 mm, average temperature of about $31.2^{o}C$ and relative humidity of about 65%. The eco-climate of the area is of two distinctive seasons, the dry season usually commences from November and ends in March and the rainy season goes from April to October [10].

A. elata seeds were extracted from its pods and sown directly into a sieve (finely perforated) filled with washed and sterilized river sand. Watering was done daily (morning). After seedling emergence (S.E), 76 seedlings of uniform sizes were selected for further transplanting into already prepared polythene pots with various treatments. Polythene pots of size (23 cm x l9 cm x l3 cm; length, breadth and height respectively) were used for the experiment. The experiment was laid out in Completely Randomized Design (CRD). There were 9 treatments and 8 replicates. Treatments (T) include; T_1(2 kg of FPS + 2 kg of topsoil); T_2 (2 kg of DCD + 2 kg of topsoil); T_3 (1.5 kg of FPS + 2 kg of topsoil); T_4 (1.5 kg of DCD + 2 kg of topsoil); T_5 (1 kg of FPS + 2 kg of topsoil); T_6 (1 kg of DCD + 2 kg of topsoil); T_7 (500 g of FPS + 2 kg of topsoil); T_8 (500 g of DCD + 2 kg topsoil); and 2 kg of topsoil without any treatment served as control. Growth Parameters were assessed for twelve weeks including seedling height (cm), leaf count, stem diameter (mm), leaf area (cm^2) and after the twelfth week; one seedling each were selected at random from each treatment for biomass assessment (g). The selected seedlings for biomass assessment were segmented into stem, leave and root. Samples were dried and oven-dry weights were obtained. Finally, the data collected were analysed with Analysis of Variance (ANOVA).

3. RESULTS AND DISCUSSION

It was observed from the chemical analyses, that cow dung had a higher percentage of nitrogen compared to fish pond sediments with values of 1.34% and 1.15% (respectively). Though, fish pond sediments had higher percentage of phosphorus and potassium (7.34 mg/kg and 5.6 mg/kg respectively) than cow dung (1.0 mg/kg potassium and 1.5mg/kg phosphorus respectively). This corroborated the findings of [11] who affirmed the effectiveness of pond sediments as a soil conditioner (Tables 1 and 2).

Table 1. Chemical analysis of cow dung

Parameters	Quantity
Nitrogen (%)	1.34 mg/Kg
Ca+ + (mg/lOOg)	2.34 mg/Kg
Fe++ (cmol/Kg)	3.40 mg/Kg
K-M(mg/100g)	1.22 mg/Kg
K (%)	1.4 mg/Kg
C (%)	8.23 mg/Kg
P (%)	1.5 mg/Kg
Na (%)	1.34 mg/Kg
Mg (%)	0.21 mg/kg
Cu (%)	20.4 mg/Kg
Zn (%)	120.6 mg/Kg
Mn (%)	115 mg/Kg

From Table 4, it was observed that T_3 (1.5 kg of FPS + 2 kg TS) had the overall highest plant height with the mean value of 11.02 cm, followed by T_o (control – 2 kg TS only) with the mean value of 10.77 cm, while T_2 (2 kg of DCD + 2 kg of topsoil) had the least height with the mean value of 8.99 cm. However, in comparison, it was observed that treatment having fish pond sediments in them performed better than those with cow dung and topsoil. This might be due to the fact that fish pond sediments had a higher phosphorus and potassium contents than cow dung hence, as indicated in Tables 1 and 2, thereby improving seedlings growth in addition to the nitrogen content of the topsoil. This corroborated the findings of Rahman and Yakuptiyage [12], who reported that application of Tilapia pond soil provided the required amount of phosphorus to *Ipomoea purpurea* (morning glory) plant which significantly improved the soil aggregate stability and hence supported the plant growth. Though there was no significant difference among the treatments at 5% probability level (Table 5).

Table 6 shows that T_o (2 kg TS) and T_5 (1 kg FPS + 2 kg TS) had a better performance in stem diameter with mean value of 1.61 mm, compared others and followed by T_3 (1.5 kg FPS + 2 Kg TS) with the mean value of 1.52 mm, while T_2 (2 kg of DCD + 2 kg of TS) had the lowest stem diameter with the mean value of 1.38 mm. Furthermore, it was observed that all treatments having fish pond sediments had better performance when compared with those having cow dung. This result is therefore in support of the findings by Rahman and Yakuptiyage [12] who stated that the addition of fish pond sediments to agricultural soil usually favours the development of soil structure and root penetration, aeration and water percolation. Thus, the potential productivity of crop plants is reasonably improved. However, there was no significant difference among the treatments at 5% probability level (Table 7).

Table 8 shows the mean number of leaves of *A. elata* seedlings. The overall best treatment was T_5 (1 kg FPS + 2 Kg TS) with the mean value of 10.32, followed by T_o (2 Kg TS) with the mean value of 8.20, while T_2 (2 kg CD + 2 kg TS) had the lowest leaf count with the mean of 4.52. Furthermore, it was observed that every treatment having Fish pond sediments in them performed better compared with those having cow dung, also, this may be due to higher content of Phosphorus and Potassium in fish

Table 2. Chemical analysis of fish pond sediments

Parameters	Quantity
PH (H_20)	7.12
C (%)	4.78
T.N (%)	1.15
P (mg/Kg)	5.60
H^+	0.30
Particle sizes (%)	
Sand	85.60
Clay	09.00
Silt	05.40
Exchangeable bases (mg/Kg)	
Na	2.28 mg/kg
K	7.34 mg/kg
Ca	2.9 mg/Kg
Mg	1.05 mg/Kg
Micronutrients	
Mn	3.0 mg/Kg
Fe	4.5
Cu	1.0
Zn	1.1

pond sediments compared to that of the cow dung which corroborated the findings of Yang and Hu [13] who reported that fish pond sediments met up with Nitrogen and Potassium requirements for corn growth (Nitrogen from the topsoil augmented the initial quantity in FPS or DCD. However, there was no significant difference among the treatments at 5% probability level (Table 9).

Table 10 shows that T_3 (1.5 kg FPS + 2 Kg TS) had the overall best leaf area with the mean value of 21.65 cm^2, followed by T_5 (1 kg FSP + 2 Kg TS) with the mean value of 20.00 cm^2 while T_2 (2 kg of DCD + 2 kg of topsoil) had the lowest leaf area with the mean value of 13.26 cm^2. It was also revealed that treatments with fish pond sediment had better performance compared with those of cow dung. This study also supported the findings of [14] who stated that since fish pond sediment can be used in mushroom culture as substrate and in the pasture, fruit orchards and turf grass production etc. and it has the potentials of being utilized in agriculture due to its high nutrient status. Once again, there was significant difference among the treatments at 5% level of probability (Table 11).

Table 12 shows the mean seedlings biomass accumulation of *A. elata.* It was revealed that T_3 (1.5 kg FPS + 2 Kg TS) and T_5 (1 kg FPS + 2 Kg TS) had the better performance with both having the mean value of 1.16 g, followed by T_o (control 2 Kg TS) with the mean value of 1.07, while T_2 (2 kg of DCD + 2 kg of TS) had the overall lowest biomass accumulation with mean value of 0.65. Furthermore, the result shows that all treatments having Fish Pond Sediments in them performed better than treatments with cow dung. This was due to the high content of organic matter in Fish pond sediments which supported the seedlings biomass accumulation. Hence, the study supported the findings of Rahman et al. [14] who reported that fish pond sediments performed multiple function and roles in the overall production of farmland its uses as fertilizer for crops. Then again, there are no differences among the treatments that were significant at 5% probability level.

Table 3. Soil physico-chemical analysis of topsoil

Parameters	Quantity
PH	6.65
Organic Matter (%)	4.54
Total Nitrogen (%)	3.12
Average P (ppm)	23.24
K (mg/kg)	5.30
Ca (mg/kg)	6.80
Mg (mg/kg)	1.26
Cu (mg/kg)	0.72
Na (mg/kg	2.20
Zn (mg/kg)	2.04
Mn (mg/kg)	3.64
Exchange cation (mg/kg)	1.66
ECEC (mg/kg)	23.62

Table 4. Mean plant height (cm) of *A. elata* seedlings

Trt	Wk2	Wk4	Wk6	Wk8	Wkl0	Wkl2	Mean
To	8.58	9.72	10.60	11.36	13.60	15.74	10.77
T1	7.72	8.64	9.93	10.64	12.36	14.10	10.04
T2	6.66	8.08	9.08	9.84	11.28	12.56	8.99
T3	7.82	9.07	10.62	11.98	14.40	17.04	11.02
T4	8.03	8.80	9.70	10.35	12.38	15.23	10.20
Ts	8.73	9.68	10.39	11.03	12.83	14.28	10.59
T6	7.15	8.18	9.60	9.93	11.90	13.38	9.36
T7	8.36	9.26	10.48	11.32	12.50	13.74	10.40
T8	7.90	8.90	10.28	11.08	12.32	13.64	10.14

Note: Trt- treatment, wk- week

Table 5. ANOVA result for seedling height

Source of variation	SS	df	MS	F	P-value	F crit
Treatment	23.91129	8	2.988912	0.497411	0.851572	2.152133
Error	270.402	45	6.008933			
Total	294.3133	53				

Table 6. Mean stem diameter (mm) of *A. elata* seedlings

Trt	Wk 2	Wk 4	Wk6	Wk8	Wk10	Wkl2	Mean
To	0.80	1.57	1.78	2.02	2.29	2,55	1.61
T1	0.64	1.39	1.72	1.83	1.93	2.33	1.47
T2	0.60	1.30	1.55	1.75	1.90	2.00	1.38
T3	0.79	1.47	1 .69	1.92	2.16	2.40	1.52
T4	0.85	1.23	1.42	1.99	2.16	2.29	1.47
T5	0.62	1.43	1.90	2.07	2.35	2.63	1.61
T6	0.72	1.47	1.51	1.92	2.07	2.30	1.49
T7	0.70	1.41	1.69	1.93	2.11	2.35	1.48
T8	0.68	1.39	1.65	1.90	2.07	2.31	1.45

Note: Trt- treatment, wk- week

Table 7. ANOVA result for stem diameter

Source of variation	SS	Df	MS	F	P-value	F crit
Treatment	0.471733	8	0.058967	0.168418	0.994041	2.152133
Error	15.7554	45	0.35012			
Total	16.22713	53				

Table 8. Mean leaf count *of A. elata* seedlings

Trt	Wk2	Wk4	Wk6	Wk8	Wkl0	Wkl2	Mean
To	5.20	5.60	6.60	9.20	12.60	16.60	8.20
Ti	4.40	5.80	7.20	9.00	11.40	13.20	7.57
T_2	2.40	3.40	3.80	6.40	7.80	9.20	4.52
T_3	3.40	5.80	8.20	8.60	11.60	14.80	7.77
T4	3.25	5.00	6.75	9.50	12.25	16.75	7.93
Ts	5.25	6.50	9.00	13.25	15.75	20.50	10.3
Tf,	4.00	4.50	5.00	7.75	11.75	13.50	7.00
Tv	3.5	4.00	5.00	6.80	8.20	12.20	6.01
Ts	4.20	5.80	7.00	8.60	10.20	12.60	7.20

Note: Trt- treatment, wk- week

Table 9. ANOVA result for leaf count

Source of Variation	SS	Df	MS	F	P-value	F crit
Treatment	145.4298	8	18.17873	1.082811	0.392304	2.152133
Error	755.4804	45	16.78845			
Total	900.9102	53				

Table 10. Mean leaf area (cm^2) of *A. elata* seedlings

Trt	Wk2	Wk4	Wk6	Wk8	Wkl0	Wkl2	Mean
To	11.28	14.03	16.62	18.48	21.18	22.66	16.45
T1	12.50	14.27	6.27	18.83	22.47	27.49	17.41
T2	10.37	11.86	14.44	16.62	17.13	10.03	13.26
T3	13.44	17.67	22.10	25.90	28.36	31.88	21.65
T4	14.19	17.1	18.48	20.72	23.40	20.03	17.98
T5	5.54	16.43	18.87	20.69	25.68	29.11	19.72
T6	11.66	15.23	17.49	26.59	28.78	30.41	20.00
T7	12.49	14.43	17.38	19.57	22.46	24.39	17.28
T8	14.90	14.97	18.49	20.98	23.24	24.75	15.43

Note: Trt- treatment, wk- week

Table 11. ANOVA result for leaf area

Source of Variation	SS	Df	MS	F	P-value	F crit
Treatment	380.7743	8	47.59679	1.379712	0.231295	2.152133
Error	1552.393	45	34.49762			
Total	1933.167	53				

Table 12. Mean biomass (g) accumulation of *A. elata* seedlings

Trt	Wk2	Wk4	V/k6	Wk8	Wk10	Wk12	Mean
To	0.50	0.81	1.01	1.19	1.37	1.56	1.07
Ti	0.39	0.40	0.56	0.78	0.99	0.15	0.71
T2	0.37	0.41	0.54	0.70	0.87	0.99	0.65
T3	0.38	0.45	0.69	1.31	1.94	2.17	1.16
T4	0.55	0.62	0.71	1.10	1.48	1.57	1.01
T5	0.27	0.60	0.84	1.34	1.85	2.08	1.16
T6	0.43	0.45	0 59	0.79	0.99	1.13	0.73
T7	0.41	0.47	0.61	1.15	1.69	1.82	1.03
T8	0.60	0.70	0.71	1.06	1.41	1.43	0.99

Note: Trt- treatment, wk – week

Table 13. ANOVA result for biomass accumulation

Source of Variation	SS	df	MS	F	P-value	F crit
Treatment	2.4742	8	0.309275	1.252697	0.291928	2.152133
Error	11.10993	45	0.246887			
Total	13.58413	53				

4. CONCLUSION

The result obtained from this study revealed that fish pond sediments had the largest values in all parameters assessed while decomposed cow dung had the least performance in all parameters assessed. Although, despite the difference in the result of different growth parameters assessed, there are not differ significantly. Though, fish pond sediments look promising with nutrient compositions and performance but do not differ significantly at 5% level of probability.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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