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Effects of Poultry Manure Application on the Early Seedling Development of *Treculia Africana* (Breadfruit)

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Abstract

This study was carried out to ascertain the effects of different rates of poultry manure on early seedling development of *Treculia africana*. The experiment was carried out at Nnamdi Azikwe University Awka. Randomized Complete Block Design was used for the study. A total number of 18 perforated poly bags (48cm×40cm) containing 10kg of soil were laid out in the screen house in a Randomized Completely Block Design (RCBD) with 6 treatments in 3 replicates. The levels of treatment were, 0.0g, 17g, 34g, 51g, 68g, and 85g of poultry manure per 10kg of soil which were sun-dried to conserve the nutrient properties and for easy handling, weighed properly and incorporated into the soil 2 weeks prior to sowing. Growth parameters such as changes in length, girth, leaf area and number of leaves were measured on bi-weekly bases and recorded accordingly. The physicochemical properties of the soil sample and poultry manure is shown in Table 1. The table revealed that the soil sample contained higher composition of sand than silt and clay. The poultry manure contained higher pH, organic carbon, available phosphorus, potassium ion and calcium ion than the soil samples. The effect of different rates of poultry manure on percentage germination of *Treculia africana* was shown in Table 2. The result of the effect of different rates of poultry manure on the germination of *T. africana* revealed that rate of 68g/10kg gave the highest percentage germination of (85.17±0.208 %), 85g/10kg gave the highest increase in stem girth from 1.02±0.026cm in week 2. the number of leaves of *T. africana* indicated that the rate of 85g/10kg gave the highest increase in the number of leaves from 3.50±0.015 in weeks 2 to 5.01±0.010in weeks 8, while 85g/10kggave the highest increase in leaf area from 26.65±2.904cm^2 in weeks 2 to 47.80±0.046cm^2 in weeks 8. Due to the ecosystem pollutions caused by use of inorganic materials, this study has demonstrated the potential of poultry manure in enhancing the early seedling growth of *T. africana* in fairly low nutrient soil. There was an increase growth rate of the seedlings with

increasing rates of poultry manure. All the parameters of *T. africana* seedling responded positively to various rate of poultry manure with the seedlings with 85g/10kg rate of the poultry giving the best performance while the control plants gave the lowest performance.

Keywords: Breadfruit; Manure; Poultry; Organic; Seedling; Development; Productivity; Soil; *Treculia Africana.*

1. Introduction

The growth of plants depends on the availability of nutrients from the soil. It is therefore important that the soil should be able to provide nutrients for the growth and development of plants. Prolonged uptake of nutrients by growing plants depletes the soil of vital nutrients, adversely affecting growth of plants. Also organic manures (poultry manure) can be added in order to compensate for the losses due to leaching and uptake by existing plants from the soil. The use of organic manure is a more practical way of improving and maintaining soil fertility. It is more economical and has a long lasting effect on soil, when decomposed totally or partially by soil microbes and is also environmental friendly. This is because nutrients contained in organic manures are released more slowly and are stored for a longer time in soil, thereby ensuring a long residual effect [1]. In many tropical soils, organic manure has been reported to be the major sources of nitrogen, phosphorus, potassium, calcium as well as magnesium [2]**.** Though high in nitrogen and phosphorous, the excreta of bird ferment quickly. In his observation, Smailing [3] noted that almost all the Nitrogen in poultry manure is combined with organic substances and is only released when decayed. It readily supplies phosphorous to plants than other organic manure [4]**.** Organic manure when properly applied has the potentials of improving soil infiltration capacity, as, well as impact beneficial effects on the structure of the soil [4].

Poultry manure, sometimes called chicken manure is an excellent soil amendment that provides nutrients for plant growth. The chemical composition of poultry manure varies with factors such as source of manure, feed on the birds, age and condition of birds, storage, handling of manure and litter used. Poultry manure consists of the droppings, wasted feed, broken eggs, dead birds and hatchery waste which all contain high amount of protein and calcium. Ipinmoroti, *et al.* [5] reported that addition of poultry and cattle manure to the soil lead to increase in soil pH, Organic Carbon, Nitrogen, Phosphorus, Calcium, Potassium, Magnesium, Sodium and CEC. The hazardous environmental consequences and high cost of inorganic fertilizers make them not only undesirable but also uneconomical and out of reach of the poor farmers who still dominate the Nigerian Agricultural sector [6]**.** This has led to increase use of manure, a readily available alternative, which proves more environmentally friendly [7][. In recent times, attention has been directed towards organic manure because of the rising cost of inorganic fertilizers coupled with their inability to give the soil the desired sound health.

Treculia africana is a multipurpose tree species commonly known as African breadfruit. It belongs to the family Moraceae, order Rosales and genus *Treculia*. It grows in the forest zone, particularly the coastal swamp zone [8]**.** The species is one of the multi-potential Nigerian indigenous tropical tree food crops that significantly mitigate seasonal food scarcity. In Nigeria, particularly in the southern states, the species is widely grown for its seeds which rank first among the popularly consumed food [9, 10] and is variously named by different ethnic tribes across Nigeria as "ukwa" (Igbo), "bere foo foo" (yoruba), "ediang" (Efik and Ibibio), "ize"(Benin), "bafufuta" (Hausa), though "ukwa" is more popular. The most highly sought after part of the species is the seeds that are variously consumed as food such as in pottage, food compliment, snack [11] and it is alternative to rice and yam [11]**.** The species is a large tree which grows up to 30m high and it flowers between October and February [12].

Also, *Treculia africana* is an important food security in Nigeria commonly available during most strategic periods (season) in the year, when the conventional staples and vegetables are scarce referred to as “ugani” literally related as “hungry season” [13]**.** Again, due to the abundant seeds of the species, Okafor [14] described it as a component of sustainable livelihood in Nigeria. Report by Breadfruit Revolution shows that breadfruit was one of the few trees that withstood the 1993 drought in Southern Ghana and was eaten extensively during that time [14]. The aim of this study was to find out the effects of different rates of poultry manure application on the early seedlings growth of *Treculia africana* (African breadfruit).

2. Materials and Method

2.1. Study Area

The experiment was carried out at the Botany screen house located beside the botany laboratory in Nnamdi Azikiwe University Awka**.** This investigation was carried out between the period of August and November, 2019.

2.2. Source of Materials

The plant sample (*T. africana* fruit head) was gotten from African bread fruit tree in Ochuche-Umuodu community, Ogbaru L.G.A in Anambra state and identified by a plant taxonomist in the Department of Botany Nnamdi Azikiwe University Awka. The soil sample was collected by breaking the soil 0-5cm depth with a shovel and weighed before bagging into polythene bags which are perforated for drainage and aeration. The organic manure (poultry droppings) was obtained from a poultry farm at Aroma, Awka.

2.3. Reagents and Equipment Used

The reagent used includes water while the equipment includes weighing balance, shovel, hand trowel, potting bags, watering can, measuring tap, rope and masking tape.

2.4. Experimental Procedure

A total number of 18 perforated poly bags (48cm×40cm) containing 10kg of soil were laid out in the screen house in a Randomized Completely Block Design (RCBD) with 6 treatments in 3 replicates. The levels of treatment were, 0.0g, 17g, 34g, 51g, 68g, and 85g of poultry manure per 10kg of soil which were sun-dried to conserve the nutrient properties and for easy handling, weighed properly and incorporated into the soil 2 weeks prior to sowing. The samples that were left without treatments serve as the control to check the growth rate of the treated samples. The treated soil samples were wetted daily for two weeks before planting. Fresh seeds of T. Africana were extracted from the fruit head, then viability test was done by soaking in water and air dried for few minutes before sowing. 6 Seeds of *T. africana* were sowed on each potted bag at 2cm depth after two weeks then kept under screening room and were moistened at 2days intervals while being observed for germination. First germination was noticed 10 days after planting and data on seedling emergence was taken to assess the germination percentage from the first day of germination to a period of 3 weeks after which the following parameters: stem girth, leaf area, number of leaves and height of *T. africana* on different concentration of the poultry manure were assessed at 2 weeks intervals and recorded accordingly to check for the growth rates.

2.5. Collection of Data

The collection of data was based on the measurement of the various plant parameters mentioned above and was carried out for complete 2 months starting from 2 weeks after planting. Plant parameters measured included height, girth, leaf area and number of leaf.

2.5.1. Plant Height

Height was measured with the use of measuring tape starting from the base of plant to the shoot apex and the values recorded accordingly in centimeter.

2.5.2. Plant Girth

Stem girth was measured using a rope clung around the stem of each seedling and read against the graduated measuring tape and the values recorded accordingly (in centimeters).

2.5.3. Leaf Area

The length and breadth of the leaf were measure using a measuring tape and recorded accordingly in square centimeter. Leaf area was then calculated as;

Leaf area (cm^2) = L x B
Where:
L = length of Leaf
B = Breath of leaf

2.5.4. Leaf Number

The leaves of every seedling in each replicates were counted and the mean per replicate was determined.

2.5.5. Germination Percentage

This was carried out 10 days after **so**wing when the first germination was noticed and it took a period of 2 weeks and 4 days before selection of the best seedlings for investigation and it was calculated as the ratio of the number of seeds germinated to the number of seeds sown multiply by 100;

2.6. Germination Percentage

Number of seed germinated \Number of seed sowed×100%

2.7. Weeding

During the course of the study, this was done at 2 weeks' intervals to get rid of unwanted plants that grew around the seedlings which may compete with the seedlings for space, nutrients, water and light and infestation count was also carried to assess the treatment that gave positive response to weed control.

2.8. Statistical Analysis

Data collected were subjected to Analysis of variance (ANOVA) at 0.05% level of significance and the mean separated by Duncan Multiple Range Test (DMRT). Statistical Package for Social Sciences (SPSS) version 20 statistical tool was used to run the analysis.

3. Results

3.1. Physicochemical Properties of the Soil Sample and Poultry Manure

The physicochemical properties of the soil sample and poultry manure is shown in Table 1. The table revealed that the soil sample contained higher composition of sand (80.20 %) than silt (10.50 %) and clay (6.30 %). The pH of the soil is fairly acidic (5.20) with low organic carbon (0.58 mg kg^{-1}) and total nitrogen content (0.46 mg kg^{-1}).

The poultry manure contained higher pH (7.30), organic carbon (8.50 mg kg^{-1}), total nitrogen (1.36 mg kg^{-1}), available phosphorus (6.45 mg kg^{-1}), potassium ion (8.12 $Cmolkg^{-1}$) and calcium ion (3.08 $Cmolkg^{-1}$) than the soil samples.

Table-1. Physicochemical properties of soil sample and poultry manure

Properties	**Soil sample**	**Poultry manure**
Sand	80.20	-
Silt	10.50	-
Clay	6.30	-
pH (H_2O)	5.20	7.30
Organic carbon (mg kg^{-1})	0.58	8.50
Total nitrogen (mg kg^{-1})	0.46	1.36
Av. phosphorus ($mgkg^{-1}$)	6.45	6.90
Exchangeable base ($Cmolkg^{-1}$)		
Na^+	0.16	0.13
K^+	0.17	8.15
Ca^{2+}	0.92	3.12
Mg^{2+}	1.50	0.45
CH	3.75	-

3.2. Effect of Different Rates of Poultry Manure on Germination of *T. Africana*

The result of the effect of different rates of poultry manure on the germination of *T. africana* revealed that rate of 68g/10kg gave the highest percentage germination of (85.17±0.208 %) which is then followed by the rate of 51g/10kg which gave percentage germination of 83.04±0.069 %. The control however gave the least percentage germination of *T. Africana* (30.19±0.273) when compared to treated samples. Analysis of variance showed a significant difference ($p<0.05$) in the percentage germination of *T. africana* between the rates of poultry manure investigated.

Table-2. Effect of different rates of poultry manure on the germination of *T. africana*

Poultry Rates	**Percentage Germination**
CTR	30.19±0.273
17g/10kg	42.24±0.212
34g/10kg	65.03±0.058
51g/10kg	83.04±0.069
68g/10kg	85.17±0.208
85g/10kg	55.27±0.137
LSD	0.316
P-value	.000

Results are in mean±standard deviation

3.3. Effect of Different Rates of Poultry Manure on the Stem Height of *T. Africana*

The result of effect of different rates of poultry manure on the stem height of *T. africana* indicated that the rate of 85g/10kg gave the highest increase in stem height from 11.92±0.025 cm in weeks 2 to 25.69±0.035 cm in weeks 8. The performance of 85g/10kg is followed by the rate of 68g/10kg which gave increase in stem height from 10.31±0.015 cm in weeks 2 to 23.92±0.026 cm in weeks 8. The control gave the least increase in stem height from 4.20±0.047 cm in weeks 2 to 14.51±0.026 cm in weeks 8. Analysis of variance showed a significant difference ($p<0.05$) in the stem height of *T. africana* between the poultry rates investigated from the second weeks after planting to the eight weeks.

Table-3. Effect of different rates of poultry manure on the stem height of *T. Africana*

Poultry Rates (per 10kg)	**Bi-Weekly Stem Height of *T. africana (cm)***			
	Week 2	**Week 4**	Week 6	Week 8
Control	4.20±0.047	7.42±0.015	11.12±0.02	14.51±0.026
17g/10kg	5.59±0.21	9.31±0.025	13.41±0.021	16.69±0.025
35g/10kg	7.19±0.038	11.41±0.015	15.40±0.044	18.78±0.035
51g/10kg	8.69±0.015	13.31±0.015	18.21±0.031	22.21±0.025
68g/10kg	10.31±0.015	14.81±0.021	20.51±0.021	23.92±0.026
85g/10kg	11.92±0.025	15.81±0.015	22.72±0.026	25.69±0.035
LSD	0.052	0.032	0.05	0.052
P-Value	.000	.000	.000	.000

Results are in mean± standard deviation

3.4. Effect of Different Rates of Poultry Manure on the Stem Girth of *T. Africana*

The result of effect of different rates of poultry manure on the stem girth of *T. africana* indicated that the rate of 85g/10kg gave the highest increase in stem girth from 1.02±0.026cm in weeks 2 to 2.08±0.029cm in weeks 8. The performance of 85g/10kg is followed by the rate of 68g//10kg which gave increase in stem girth from 0.79±0.032cm in weeks 2 to 1.89±0.026 cm in weeks 8. The control gave the least increase in stem girth from 0.02±0.000cm in weeks 2 to 0.79±0.036cm in weeks 8. Analysis of variance showed a significant difference ($p<0.05$) in the stem girth of *T. africana* between the poultry rates investigated from the second weeks after planting to the eight week.

Table-4. Effect of different rates of poultry manure on the stem girth of *T. africana*

Poultry Rates (per 10kg)	**Bi-Weekly Stem Girth of *T. africana (cm)***			
	Week 2	Week 4	Week 6	Week 8
Control	0.02±0.00	0.09±0.036	0.51±0.010	0.79±0.036
17g/10kg	0.12±0.020	0.53±0.015	13.41±0.021	16.69±0.025
35g/10kg	0.29±0.038	0.70±0.042	15.40±0.044	18.78±0.035
51g/10kg	0.62±0.032	0.89±0.032	18.21±0.031	22.21±0.025
68g/10kg	0.79±0.032	1.09±0.036	20.51±0.021	23.92±0.026
85g/10kg	1.02±0.026	1.30±0.015	22.72±0.026	25.69±0.035
LSD	0.049	0.055	0.057	0.08
P-Value	.000	.000	.000	.000

Results are in mean± standard deviation

3.5. Effect of Different Rates of Poultry Manure on the Number of Leaves of *T. Africana*

The result of effect of different rates of poultry manure on the number of leaves of *T. africana* indicated that the rate of 85g/10kg gave the highest increase in the number of leaves from 3.50±0.015 in weeks 2 to 5.01±0.010in weeks 8. The performance of 85g/ha is followed by the rate of 68g/10kg which gave increase in the number of leaves from 2.49±0.026in weeks 2 to 4.50±0.015in weeks 8. The control gave the least increase in the number of leaves from 2.01±0.010 in weeks 2 to 3.01±0.015in weeks 8. Analysis of variance showed a significant difference ($p<0.05$) in the number of leaves of *T. africana* between the poultry rates investigated from the second weeks after planting to the eight weeks (Table 4)

Table-5. Effect of different rates of poultry manure on the number of leaves of *T. africana*

Poultry Rates (per 10kg)	**Bi-Weekly Number of leaves of *T. Africana***			
	Week 2	Week 4	Week 6	Week 8
Control	2.01±0.010	2.29±0.026	2.81±0.010	3.01±0.015
17g/10kg	2.09±0.036	2.49±0.026	3.01±0.010	3.49±0.026
35g/10kg	2.19±0.032	2.79±0.032	3.20±0.015	3.79±0.032
51g/10kg	2.29±0.032	3.01±0.010	3.51±0.010	4.01±0.010
68g/10kg	2.49±0.026	3.49±0.021	4.01±0.010	4.50±0.015
85g/10kg	3.50±0.015	4.01±0.006	4.50±0.015	5.01±0.010
LSD	0.048	0.040	0.021	0.036
P-Value	.000	.000	.000	.000

Results are in mean± standard deviation

3.6. Effect of Different Rates of Poultry Manure on the Leaf Area of *T. Africana*

The result of effect of different rates of poultry manure on the leaf area of *T. africana* indicated that the rate of 85g/10kggave the highest increase in leaf area from 26.65±2.904cm^2 in weeks 2 to 47.80±0.046cm^2 in weeks 8. The performance of 85g/ha is followed by the rate of 68g/10kg which gave increase in leaf area from 22.78±0.025cm^2 in weeks 2 to 39.18±0.044cm^2 in weeks 8. The control gave the least increase in leaf area from 9.46±0.015cm^2 in weeks 2 to 20.94±0.251cm^2 in weeks 8. Analysis of variance showed a significant difference ($p<0.05$) in the leaf area of *T. africana* between the poultry rates investigated from the second weeks after planting to the eight weeks.

Table-6. Effect of different rates of poultry manure on the leaf area of *T. africana*

Poultry Rates (per 10kg)	**Bi-Weekly leaf areas of *T. africana (cm^2)***			
	Week 2	Week 4	Week 6	Week 8
Control	9.46±0.015	13.23±0.068	17.7±0.030	20.94±0.0251
17g/10kg	13.79±0.036	17.40±0.047	20.29±0.038	23.49±0.036
35g/10kg	18.20±0.042	21.60±0.020	24.62±0.025	26.61±0.026
51g/10kg	20.40±0.020	24.18±0.222	26.44±2.870	31.97±0.010
68g/10kg	22.78±0.025	28.49±0.031	33.58±0.025	39.18±0.044
85g/10kg	26.65±2.904	37.37±0.032	44.08±0.049	47.80±0.046
LSD	2.11	0.176	2.085	0.191
P-Value	.000	.000	.000	.000

Results are in mean± standard deviation

4. Discussion

The *Treculia africana* seeds used responded differently to the different amounts of organic manure (poultry manure). These treatments are in appropriate quantities because too much application may be detrimental to the plants. The responses are manifested mainly through the morphological features of the plants as well as the germination percentage. The first emergence of embryo (germination) was observed in the control plants (plants without poultry manure treatments) due to the fact that poultry manure delays seedling emergence. There was consistent increase in growth rate of various parameters measured from weeks 2 to 8. The plant with higher rate of organic manure (85g/10kg) had a higher growth rate than the ones with lower rates of the manure. The plant that was not treated with poultry manure (control) showed retardation in growth.

From the result of the experiment, it was observed that plants having higher organic manure showed the best performance in terms of stem height (cm), number of leaves, stem girth (cm) and leaf area (cm^2). The high growth rates can be attributed to the enhancing role of the poultry manure over the colloidal properties of the soil [15]. The control plants performed poorly when compared to the plants treated with organic manure. This was due the fact that they lacked some essential nutrients present in the organic manure treatments.

The statistical analysis showed a significant difference in the measurement of the plant heights, stem girth, leaf area and number of leaves. This is the fact that different rates of poultry manure treatments of the soil proffered different quantity of organic matter to the soil thereby improving its fertility. The plants that received 85g/10kg treatments of poultry manure showed a higher mean height of 25.69cm at week 8 while plants that were grown without poultry manure showed the least mean height of 14.51cm. This is in line with the work of Tisdale, *et al.* [16] *w*ho stated that poultry manure gave a significant effect on the stem height of *Telfaria occidentalis.* Also plants with 85g/10kg of the manure showed an increased mean stem girth of 2.00cm at weeks 8, whereas the control plants showed the least stem girth of 0.79cm. The leaf area of plants that received 85g/10kg of the manure was longer and wider in length and width respectively with a mean value of $47.80cm^2$ at weeks 8 while that of the control plants was shorter and narrower with the mean value of $20.94cm^2$. The superiority in the number of leaves of *T. africana plants* based on the treatments with different rates of poultry manure was 85g>68g>51g>34g>17g>0g. These results are in consistent with the study of Bourn and Prescott [17] who observed that soils treated with organic manure (poultry) significantly improved the levels of nitrogen, phosphorus, and potassium in the soil. Bourn and Prescott [18], also showed that poultry manure is a good source of nitrogen, phosphorus and potassium which are essential to plant growth and development.

5. Conclusion

Treculia africana is a valuable evergreen rainforest tree in Nigeria. Its benefits in the diets of man cannot be over emphasized. The seeds and other parts of the plants are beneficial in various ways. The seeds are good source of protein, carbohydrates, oil e.t.c and tools for cultivation and dispersal of the plant from generation to generation. It is a source of revenue to both local and commercial farmers. Thus a good knowledge of its cultivation is important for effective growth of the plant. Poultry manure as the organic manure used in the experiment is very good for its cultivation which is also obtainable and cheaper than inorganic fertilizer [2].

Due to the ecosystem pollutions caused by use of inorganic materials, this study has demonstrated the potential of poultry manure in enhancing the early seedling growth of *T. africana* in fairly low nutrient soil. There was an increase growth rate of the seedlings with increasing rates of poultry manure. All the parameters of *T. africana* seedling responded positively to various rate of poultry manure with the seedlings with 85g/10kg rate of the poultry giving the best performance while the control plants gave the lowest performance.

Recommendations

From the results of the study, pending any further investigation, the application of 85g/10kg of poultry manure to the soil appeared to be the most appropriate rate for the optimum early seedling development and growth of *T. Africana* plants since plants with 85g/10kg treatment showed the highest growth rate in all the parameters measured and it is therefore recommended for medium and large scale propagation of the species.

In addition to the foregoing, understanding of some aspects of the biology of the species is vital for large production of the seedlings.

Conflict of Interest

Authors declare no conflict of interest.

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