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Comparative Evaluation of Different Organic Fertilizer Effects on Soil Fertility, Leaf Chemical Composition and Growth Performance of Coconut (*Cocos nucifera* L.) Seedlings

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Authors' contributions

This work was carried out in collaboration between the two authors. The main author designed the study, wrote the protocol, and the first draft of the manuscript, managed the literature searches and statistical analyses of the study while the second author managed the experimental process. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims: Planting healthy coconut seedlings will reduce cost of establishment and increase total yield of coconut fruits for high economic value. Therefore, two experiments were carried out in 2010/2011 and 2011/2012 cropping seasons to evaluate the effects of different fertilizers on the soil fertility improvement, leaf chemical composition and growth performance of coconut (*Cocos nucifera L*) seedlings in the nursery.
Design: The experiment was laid out in a randomized complete block design and replicated three times
Place and Duration of Study: The experiment was carried out at Akure in the rainforest zone of Nigeria, West Africa
Methodology: Four organic fertilizers[6t/ha] treatments were used namely: goat manure, poultry manure, oil palm bunch ash and wood ash .A control treatment(no fertilizer, no manure) and inorganic fertilizer applied at 400kg /ha NPK 15-15-15 were also used.
Twenty Coconut seed nut were sown at a spacing of 0.25m by 0.25m between and within rows per seed bed. Adequate watering daily both morning and evening continued till the commencement of the rainy season in the following year.
At 10th week after planting, sown coconut seed nuts were recorded for sprouting and

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emergence. Also, at 12 weeks after planting, growth parameters (plant height, stem girth, leaf area and leaf population) of the coconut seedlings were measured and this continued every 2 weeks till 38 weeks after planting.

Results: The result showed significant (*P=0.05*) increases of plant height, stem girth, leaf area, leaf number, shoot weight, the contents of soil and leaf N, P, K Ca and Mg, pH and organic matter (0.M) compared to the control treatment. For growth parameters, poultry manure increased the plant height, stem girth, leaf area, leaf number and shoot weight of coconut seedlings by 24.8%, 14%, 18%, 16.6% and 37.5% respectively compared to wood ash treatment. When compared to NPK 15-15-15 fertilizer, it also increased the growth parameters as well as the concentration of N, K, Ca and Mg in leaf than NPK 15-15-15 treatment whereas inverse case was observed for P concentrations.

For soil chemical composition, Oil palm bunch ash and wood ash had the highest values of soil pH, K, Ca and Mg compared to goat and poultry manures. However, poultry manure had the highest values of soil N and P. with relative increase of K[96%], Ca[95%], Mg[25%], pH[87%] and 0.M[74%] contents compared to NPK fertilizer which has decreased soil 0.M and pH because of high K.Ca, K/Mg and P/Mg ratios.

Conclusion: Poultry manure applied at 6t/ha showed the highest performance, leaf and soil chemical composition and growth parameters of coconut seedling.

Keywords: Coconut seedlings; improving soil and leaf chemical composition and growth performance using organic fertilizers.

1. INTRODUCTION

Coconut (*Cocos nucifera L*) belongs to the Arecaceae family and it is grown in warm humid tropics of the world [1]. It is also known for its great versatility as seen in the many domestic, commercial and industrial uses of its different parts (copra, water and fibre) providing food, drink, medication, shelter and raw materials for agro-allied industries [2].

Edward and Craig [3] also reported that coconut had many agro forestry uses such as coastal stabilization and wind break. In addition, it was reported that coconut is used as source of handicrafts (i.e. cane furniture, brooms, baskets and so forth) which helped to improve rural economy through employment and income generation [3].

Coconut is currently grown commercially in 92 countries covering 11.9 million hectares of land in the tropical belt. However, out of this figure, 8 million hectares of land are under coconut cultivation in India, Indonesia, Brazil, Philippines and Sri Lanka which together accounted for 78% to world production of the crop [4].

In spite of the significant economic and nutritional importance of the crop in the agrarian economy of developing countries including Nigeria, coconut production (nursery and establishment of field plantation) is below the optimum level.

In Nigeria, coconut production has nose-dived seriously except in pocket areas such as Badagry, Lagos State and Nigerian Institute for Oil Palm Research (NIFOR) in Benin Edo state. Nair et al. [1] reported that cultivation of coconut is in scattered holdings especially in the mangroves of the Rainforest zone. In addition, it was reported that an estimated 36,000 hectares of land is presently under cultivation mostly in Lagos and River States.

These problems were due to insufficient training of farmers on nursery techniques and field establishment, challenges of poor soil fertility as consequence of continuous cultivation in the same piece of land without fertilizer application and vagaries of weather conditions [5], hence, the value chain of coconut is rudimentary and poor. Uwubanmiven et al. [6] also reported that the high import tariffs have put commercial/inorganic fertilizers out of reach of small scale producers of coconut, thus, leading to low yield.

Efforts to increase soil nutrient status for sustainable coconut seedlings using inorganic fertilizers are limited by high cost of purchase at farmers' level and destruction of soil properties and entire ecosystems on continuous use of such fertilizers [7]. This necessitates the need to look into use of low cost organic fertilizers to solve above named challenges.

In recent years, coconut palm cultivation has gained economic importance through the agricultural transformation programme of the Nigeria Government to explore the value chain of coconut production, processing and marketing for local and export consumption. Having reviewed literature extensively except the works of [7,8,9,10] working on coconut germ plasm breeding improvement, control of coconut lethal yellow virus disease and use of inorganic fertilizers to grow coconut palm, there is scarcity of research work on the use of goat manure, poultry manure, oil palm bunch ash, wood ash, organic fertilizers to raise coconut seedlings.

In Nigeria, many of the agricultural wastes are generated from arable, livestock farms and processing units which are not utilized by farmers in form of compost, farm yard manure and so forth. Therefore, the availability and utilization of the organic fertilizers which are of low cost will help to reduce the high cost of inorganic fertilizers. Besides, the use of these organic fertilizers is compatible with the improvement of soil fertility in Nigeria because of high rate of soil erosion, low soil organic matter and low base saturation status.

Hence, there is a strong justification to research into the use of different organic fertilizers to raise healthy coconut seedlings in the nursery for small scale and commercial field plantations.

The objectives were [i] to assess the effect of goat manure, poultry manure, oil palm bunch ash on the growth parameters and leaf nutrient composition of coconut seedlings and [ii] to determine their effects on the soil chemical properties after the experiment.

2. MATERIALS AND METHODS

The experiments were carried out at Akure in the rainforest zone of Nigeria (elevation 10m 7^0 15^1 N, 5^0 15^1 E). The annual rainfall is between 1100 and 1500mm per annum while the annual temperature between 25ºC – 28ºC. The soil is sandy loam, skeletal, Kaolinitic, Isohyperthemic Oxic Paleustalf (Alfisol) [11].

2.1 Soil sampling and analysis before planting

Core soil samples were collected randomly from 0 – 15cm depth on the site using a soil auger, mixed thoroughly and a bulk sample was taken to the laboratory, air-dried and sieved to pass through a 2mm screen for chemical analysis.

The soil pH (1:1 soil/water and 1:2 soil/0.01M $CaCl_2$ solutions) was determined using a glass calomel electrode system [12], while organic matter was determined by wet oxidation chromic acid digestion [13].

Soil K, Ca, Mg and Na were extracted with 1M NH_4OAC pH 7 solution, then analyzed with a flame photometer while Mg was determined with an atomic absorption spectrophotometer. The exchangeable acidity (H^+ and Al^{3+}) was measured from 0.01M HCL extracts by titrating with 0.1M NaOH [14] while the micronutrients [Fe, Cu, Zn and Mn] were extracted with 0.1M HCl [15] and read on a Perkin Elmer atomic absorption spectrometer. The mechanical analysis of the soil was done by the hydrometer method [16] and the soil textural name was determined using textural triangle, while the soil bulk density (Mgm^{-3}) was determined by a core method [17].

2.2 Source and preparation of organic fertilizers

Goat and poultry manures were obtained from the livestock unit in Federal College of Agriculture, Akure while wood ash and oil palm bunch ash were obtained from arable and oil palm processing units of the institution. The organic materials were processed to allow decomposition. The oil palm bunch ash and wood ash were sieved with 2mm sieve to remove pebbles, stones and other wastes while the goat and poultry manures were air-dried and stacked to allow a quick mineralization process" for the reduction of C/N ratio Moyinjesu and Adeofun [18], MoyinJesu and Odewande [19]. There are over 10000 Rhode Island birds and 1000 goats kept in the livestock unit of the college, thus, the quantity of the manures needed for the experiment were available. Also, there are many poultry, pig, oil palm and cassava processing farmers in Akure, Ondo state, Nigeria.

2.3 Chemical analysis of the organic fertilizers

Two grams from each of the processed forms of the organic materials were analyzed. The nitrogen content was determined by kjedahl method [20] while the determination of other nutrients such as P, K, Ca, Mg was done using the wet digestion method based on 25-5-5ml of HNO_3-H_2SO_4-$HClO_4$ acids" [21], MoyinJesu and Adekayode [22], MoyinJesu [23].

2.4 Collection of coconut seed nuts for plants

Matured coconut seed nuts were collected from plant breeding division, Nigeria Institute for Oil palm Research, Benin City, kept in a cool dry shade, to undergo curing as described by [24] and planted two weeks later

2.5 Nursery establishment of coconut seedlings

The nursery site of 10m by 6m ($60m^2$) was cleared and prepared into seed beds. A shed was constructed to shade the site from direct evaporation and scorching by the sun, also, the site was fenced with wire mesh to prevent rodent attack. Eighteen seed beds of 1m by1m were prepared and raised 0.3m above the ground level, consisting of six seed beds per block totaling 3 blocks. An alley of 1m between each block was provided for easy routine cultural practices.

Four organic fertilizer treatments were used namely poultry manure, goat manure, oil palm bunch ash and wood ash applied at 6t/ha, 400 kg/ha NPK15-15-15 (2g per seedling) and a

control treatment (no fertilizer nor manure) replicated three times and arranged in a randomized complete blocks design.

The organic materials and NPK 15-15-15 fertilizer were incorporated into the soil using trowel and allowed to decompose for one week, watered to a field capacity. Termicot (termicide) and worm force (nematicide) were applied at 5ml/10 L of water and 50g/seed bed to prevent soil based insects, termites and pathogen from attacking seed nuts.

20 Coconut seed nuts were sown at a spacing of 0.25m by 0.25m spacing between and within rows per seed bed. Adequate watering (80 litres of water per each block) daily both morning and evening continued till the rainy season in the following year.

At 10^{th} week after planting, sown coconut seed nuts were recorded for sprouting and emergence. Also, at 12 weeks after planting, growth parameters (plant height, stem girth, leaf area and leaf number) of the coconut seedlings were recorded and this continued every 2 weeks till 38 weeks after planting.

At 18weeks, part of the shed roof was removed to allow more sunlight to thicken the seedlings. Also, at 36weeks after planting, representative leaf samples from intermediate position parts of the plant were randomly taken packed into labeled envelopes and oven-dried for 24hours at 70ºC. The dried leaf samples were ground and analyzed.

The nitrogen content was determined by kjedahl method [25] while P, K, Ca and Mg contents were determined by wet digestion method using 25-5-5ml of HNO_3-H_2SO_4-$HClO_4$ acids [21].

At 42 weeks after planting, seedlings were carefully uprooted from the seed beds for shoot weight determination and they were ready for transplanting on the field. In-addition, soil samples were taken from each treatment plot, air-dried and sieved through a 2mm screen prior to soil analysis for soil O.M (organic matter).

2.6 Statistical Analysis

All data collected on coconut growth parameters, leaf nutrient contents and soil analysis for the treatments were subjected to ANOVA F-test and their means separated using Duncan Multiples Range Test (DMRT) at 5% level [26].

3. RESULTS

3.1 Initial soil analysis before planting of coconut seed nuts

The physical and chemical properties of the soil used for raising coconut seedlings in the nursery were presented in Table 1. The soil is acidic and very low in organic matter when compared with the established 3% critical levels for the soils in South West rainforest zone of Nigeria [27].

The total % nitrogen was less than 0.15% N which is considered as the optimum for crops [28]. The available soil P was less than 10mg/kg considered as adequate for crop production in the region [27]. Soil exchangeable cations (K, Ca, Mg and Ma) had concentrations lower than 0.02mmol/kg critical level recommended by [29]. The soil exchangeable acidity values

were also high. The soil was sandy loam while the soil bulk density of 1.6 Mgm^{-3} was high and would adversely affect root penetration and growth.

Table 1. Chemical and physical properties of soil before planting coconut seed nuts

Particulars	Values	Methods
Soil pH (H_20)	5.80	Glass calomel electrode system [1]
Soil pH (0.01M $CaCl_2$)	5.65	
Organic matter (%)	0.43	Wet oxidation chromic acid digestion [2]
Nitrogen (%)	0.05	Microkjedahl method [3]
Available P ($mgkg^{-1}$)	5.22	Bray P 1extractant [4]
Exchangeable Bases		1M $NH_4OACpH7$ [5]
K ($mmolkg^{-1}$)	0.08	
Ca^{2+}($mmolkg^{-1}$)	0.10	
Mg^{2+}($mmolkg^{-1}$)	0.13	
Na^{+}($mmolkg^{-1}$)	0.13	
Exchangeable Acidity		0.01M HCL extractant [6] and titrated against 0.1M NaOH
H^{+} ($mmolkg^{-1}$)	4.20	
Al^{3+}($mmolkg^{-1}$)	1.40	
Micronutrients		0.1M HCL extractant [7]
Fe (mg/kg)	8.30	
Zn ($mgkg^{-1}$)	3.80	
Cu ($mgkg^{-1}$)	2.00	
Mn ($mgkg^{-1}$)	1.80	
Particle Size Analysis (Soil Texture)		Bouycous Hydrometer method [8]
Sand (%)	79.40	
Silt (%)	14.80	
Clay (%)	5.80	
Bulk density (Mgm^{-3})	1.60	
% Porosity	41.81	Core method [9] MoyinJesu [23]

3.2 Chemical Composition of the Organic Fertilizer Used

The results of chemical analysis of organic fertilizers used for the experiment were presented in Table 2. The poultry manure had higher amount of N and Ca when compared with goat manure while wood ash had the highest amount of K, Ca and Mg concentrations compared to goat manure, poultry manure and oil palm bunch ash. However, oil palm bunch ash still had higher N and P concentrations than wood ash. Goat manure had the highest concentration of P compared to other organic materials.

Table 2. Nutrients composition of organic fertilizer used for raising coconut seedlings

Organic fertilizers	C (%)	N (%)	C/N Ratio	P (%)	K (%)	Ca (%)	Mg (%)
Goat manure	20.00	1.83	10.92	1.64	1.00	0.27	0.45
Poultry manure	30.00	4.51	6.65	0.77	0.49	0.52	0.37
Oil palm bunch ash	20.00	1.79	11.17	1.18	2.00	0.92	0.74
Wood ash	18.00	1.51	11.92	0.86	2.23	0.94	0.86

3.3 The Growth Parameters of Coconut Seedlings under Different Organic Fertilizers

There were significant increases ($P<0.05$) in the plant height, stem girth, leaf area, leaf number and shoot weight of coconut seedlings under all fertilized treatments as compared to the control (Table 3).

Poultry manure had the highest values of plant height, leaf area, stem girth, leaf number, and shoot weight of coconut seedlings compared to other treatments"[19]. For instance, poultry manure increased the plant height, stem girth, leaf area, leaf number and shoot weight by 24.8%, 14%, 18%, 16.6% and 37.5% respectively compared to wood ash treatment.

When compared to N P K 15-15-15 fertilizer, poultry manure also increased the stem girth, leaf population, shoot weight, leaf area and plant height of coconut seedlings by 27%, 33% 51% 53% and 59% respectively. However, NPK 15-15-15 fertilizer treatment increased the growth parameters measured relatively higher than wood ash treatment.

Table 3. The growth parameters of coconut seedling between 12 and 38 weeks after planting under different organic fertilizer treatment

Treatments	plant height(cm)	Stem girth(cm)	leaf area (cm^2)	Leaf population	Shoot weight (kg)
Goat manure	118.67d	12.50bc	52.50d	6.67b	1.63c
Poultry manure	144.67e	14.17d	58.80c	8.00d	2.03f
Oil palm bunch ash	119.00d	12.83bc	49.62b	7.00c	1.83c
Wood ash	108.83b	12.17b	48.13b	6.67b	1.27b
N P K 15-15-15	113.83c	12.50bc	50.83c	7.33c	1.73d
Control	59.50a	10.33a	27.43a	5.33a	1.0a

Treatment means within each column followed by the same letters are not significantly different from each other using Duncan Multiple Range test at 5% level.

3.4 Leaf Chemical Composition of Coconut Seedlings under Different Organic Fertilizers

There were significant ($P=0.05$) increases in the leaf N, P, K, Ca and Mg contents of coconut seedlings under different organic fertilizers compared to the control treatment" (22) (Fig. 1).

Among the organic fertilizer, poultry manure increased the coconut seedlings leaf N and P by 86% and 6% compared to wood ash while wood ash increased the leaf K, Ca and Mg by 1%, 35% and 23% compared to the poultry manure. When compared to N P K 15-15-15, poultry manure had higher values of leaf N, K Ca and Mg. However, N P K 15-15-15 fertilizer increased the leaf P by 18% compared with the poultry manure treatment.

Generally, the organic fertilizers (wood ash, goat dung, oil palm bunch ash and poultry manure) increased significantly $P<0.05$ the coconut leaf K, Ca and Mg contents better than NPK 15-15-15 fertilizer. The leaf N, P, K, Ca and Mg contents of coconut seedlings in poultry

manure and oil palm bunch ash treatments were far higher than the recommended critical levels of N (1.5%), P (0.25%), K (1.18%), Ca (0.6%) and Mg (0.02%) as described by [30].

However, the least values of leaf N, P, K, Ca and Mg in the control treatment also reflected in the leaves of coconut seedlings by showing deficiency symptoms of N and Mg yellow leaf coloration and loss of chlorophyll, P (purple coloration), K (burnt leaf margin) the leaf K/Ca, K/Mg and P/Mg ratio under N P K fertilizer were 2:1, 2:1, 9:1 compared to the leaf K/Ca, 1:1, K/Mg 3:1,and P/Mg 4:1 under poultry manure treatment respectively.

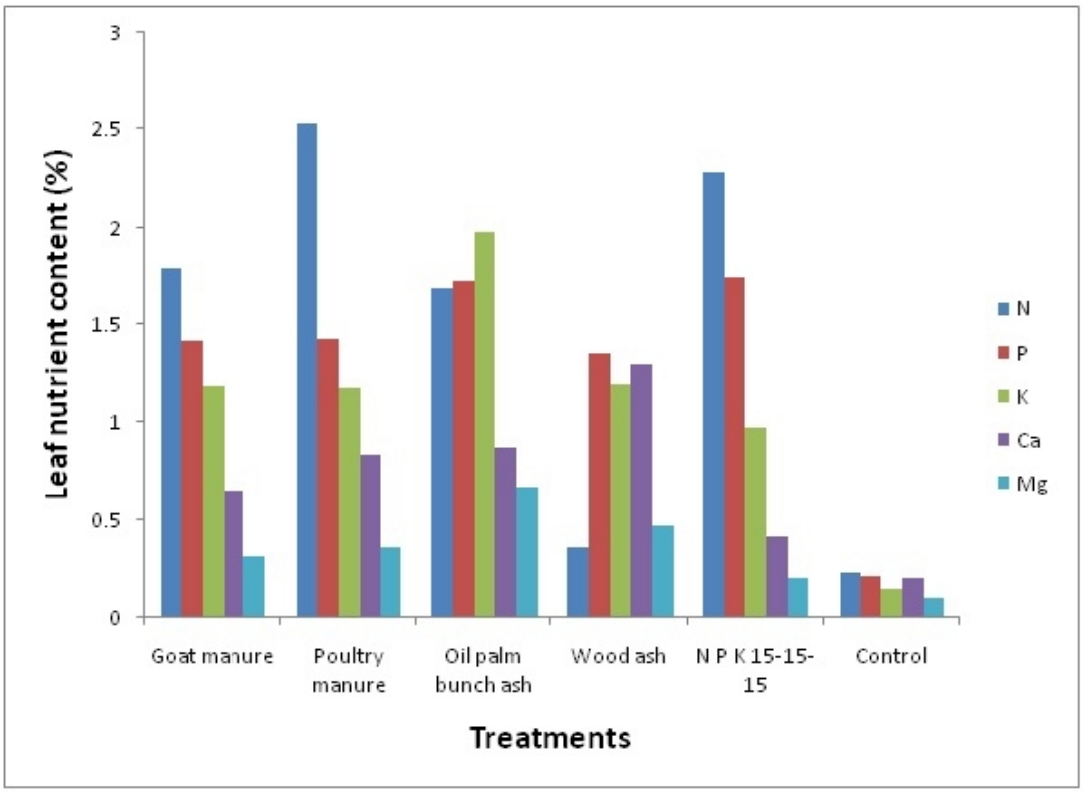

Fig. 1. The leaf chemical composition of coconut seedling under different fertilizer treatments at 40 WAP

3.5 Soil Chemical Composition after the Nursery Experiment

There were significant increases ($P<0.05$) in the soil pH, O.M, N, P, K, Ca and Mg under different organic fertilizer compared to the control treatment (Table 4)

Poultry manure increased the soil N, P, K, Ca, Mg, pH and O.M by 74%, 32%, 96%, 95% and 89% respectively compared to NPK 15-15-15 fertilizer. Also, NPK 15-15-15 fertilizer. In addition, the NPK 15-15-15 fertilizers decreased soil 0.M and pH.

Among the organic fertilizers, oil palm bunch ash and wood ash had the highest values of soil pH, K, Ca and Mg compared to goat and poultry manure respectively. However, poultry manure had the highest values of soil pH, N and P nutrients respectively compared to

others. The values of soil K/Ca, K/Mg and P/Mg ratios in the N P K fertilizer treatment were 21:1, 21:1, and 918:1 respectively compared to 2:1, 2:1 and 46:1 under poultry manure treatment. The high soil K/Ca, K/Mg and P/Mg ratios under NPK 15-15-15 fertilizer were evidence of nutrient imbalance in the soil.

Table 4. The soil chemical composition after the experiment on coconut seedlings under different organic fertilizers

Treatments	Soil pH	0.M %	N %	P mg/kg	K $mmolkg^{-1}$	Ca $mmolkg^{-1}$	Mg $mmolkg^{-1}$
Goat manure	6.65b	0.79e	0.19c	14.63d	0.51b	0.37a	0.18c
Poultry manure	6.90c	2.35f	0.30e	25.10e	0.92d	0.75d	0.55e
Oil palm bunch	7.10d	0.75d	0.20c	7.05e	1.63f	0.89e	0.66f
ash	7.20e	0.56c	0.17b	5.34b	1.42e	0.90f	0.36d
Wood ash	5.20a	0.31b	0.34d	27.55f	0.63c	0.03b	0.03b
N P K 15-15-15	5.20a	0.20a	0.04a	3.01a	0.03a	0.02a	0.02a
Control							

Treatment means within each column followed by the same letters are not significantly different from each other using Duncan Multiple Range test at 5% level

4. DISCUSSION

The lowest values of coconut seedling growth parameters such as plant height, leaf area, stem girth, leaf number and shoot weight, leaf chemical concentrations and soil nutrient contents were obtained under the control treatment" consistently with the initial low nutrient status of the soil(18). Therefore, coconut seedlings showed nutrient deficiency symptoms of yellow, purple coloration and the marginal burn of leaves as N, P, K and Mg deficiencies respectively and corroborating with the work done by Adepetu et al. [31] who reported a drop of about 58% in soil O.M in continuous cultivation over seven yearsin Iwo soil. Therefore, soil nutrient deficiencies can be reflected by its organic matter content. Otherwise, the increase of soil organic matter by amendment might enhance soil mineral concentration as consequence of humification and mineralization process [31]. Hence, soil organic matter may be an indicator of tropical soil fertility.

The reduction in the soil organic matter under the treatment of N.P.K 15-15-15 and control treatment also affected the Ca and Mg contents of the soils. This could be attributed to the increased soil acidity (low pH) under these treatments and initial values of exchangeable acidity (H^+ and Al^{3+}), thereby affecting the base saturations (K, Ca and Mg) and consequently, reduced cation exchange capacity. Furthermore, K/Ca, P/Mg, and K/Mg ratios can also reduce the uptake of P, Ca and Mg as propounded by [32,33,34]. It appears an acidification and unbalance of soil nutrients occurring under the use of chemical fertilizer. These findings were supported by [7,35,36] who reported that arbitrary use of inorganic fertilizers resulted into signs of toxicities, poor growth, yield response and deterioration of soil properties.

Furthermore, the better performance of poultry manure treatment in increasing the values of plant height, stem girth, leaf area, leaf number and shoot weight compared to wood ash, goat manure and oil palm bunch ash and NPK 15-15-15 fertilizer could be traced to its nutrient contents particularly it had the highest value of % N, least value of C/N ratio and moderate values of P, K, Ca and Mg which helped to increase the soil nutrients, organic

matter and consequently improved the uptake of water and nutrients for higher productivity. Moyin-Jesu [5] reported that nitrogen is responsible for good vegetative growth and yield of crops as well as contributory factor to organic matter build up. This could be responsible for good soil nutrient status by poulry manure. Although, other treatments had higher values of P, K, Ca and Mg than poultry manure in term of chemical composition but their high C/N ratios disturbed the rate of decomposition to release the nutrients for crop uptake and reduced the values of soil properties, hence the nutrients are immobilized. Therefore, their high C/N ratios were responsible for their lower soil nutrients compared to their initial chemical composition. The poultry manure was also processed by stacking which allowed a quick mineralization as well as reducing its C/N ratio and subsequently increased the faster release of nutrients for seedlings and soil properties. This observation was similar to the findings of [34] and [1] who reported the exceptional performance of poultry manure in improving the growth and yield of crops.

Also, the performance of the coconut seedlings was also consistent with the leaf nutrients of N, P, K, Ca and Mg under the poultry manure treatment. The application of NPK 15-15-15 fertilizer led to high soil K/Ca, K/Mg and P/Mg ratios associated with soil acidification that could be responsible for the lower concentration of leaf K, Ca and Mg [35] and [36] compared to the organic sources of nutrients used during this experiment. The contribution of the organic fertilizers use in improving the growth parameters, leaf N, P, K, Ca and Mg nutrients, soil K, Ca, Mg, N, P, pH and O.M were also consistent with their chemical compositions as reported by [37]. The organic fertilizers improved the soil organic matter content, reduced soil pH and cation saturations which consequently improved the seedling, the root growth and distribution and subsequently, more nutrients will be available for uptake to the seedlings for both physiological and metabolic activities. These also reflected in the increased growth, leaf and soil properties of coconut seedlings [38,39,40,41,42].

The balanced nutrient supplying power of organic fertilizers [wood ash, goat manure and poultry manure], the good nursery technique of sowing coconut seed nuts on raised beds with required moisture conservation and the shade provided have contributed greatly to the raising of healthy coconut seedlings in the nursery which is the first step in proper establishment on the field when they are transplanted [43]. This experiment is further justified by the fact that the 360 seedlings raised were economically viable for small holder farmers in Africa and Asia because they will cover more than 2 hectares of land when transplanted. [24] reported that yield component of healthy coconut seedlings established at 171 palms per hectare had a copra yield/ha of 2260 kg. Therefore, for 2 hectares of coconut plantations, the yield will amount to 4520 kg/ha and this is really economical for them…In addition, the new technique of planting coconut seedlings on raised seed beds with organic fertilizers had enabled proper sprouting and establishment which will encourage scaling up raising of coconut seedlings on large scale for commercial coconut plantations. This is different from the conventional practice in Nigreia Institute For Oil Palm Research and other coconut farmers which dug holes for planting coconut seed nuts and face problems of sprouting establishment [1]. Therefore, planting heathy coconut seedlings can be able to reduce the cost of establishment and increase total yield of coconut fruits for high economic value. For instance, [2] reported that coconut water and copra have nutrition values which are useful for confectioneries, pharmaceutical industries and boosting export trade of nations which have higher comparative advantage in coconut production. This is in line with meeting millennium development goals in achieving food security, employment opportunities and healthy living.

5. CONCLUSIONS AND RECOMMENDATION

It was found that organic fertilizers applied at 6t/ha increased the soil N, P, K, Ca and Mg concentrations for soil and leaf resulting into an increase of soil pH and O.M contents as well as the growth parameters [plant height, leaf area, stem girth and leaf number] of coconut seedlings.

Therefore, poultry manure applied at 6t/ha was the most effective fertilizer material in improving soil health, growth and leaf nutrients of coconut seedlings. In addition, the organic fertilizer materials have beneficial residual effects on soil properties which are in line with growing concern of using environment friendly fertilizer in farming syetem. Finally, the use of poultry manure 6t/ha could substitute for the 400kg/ha NPK 15-15-15 fertilizer in raising healthy coconut seedling for large scale commercial coconut production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nair RV, Odewale JO, Ikuenoibe CE. Coconut nursery manual. Publ NIFOR Benin City ISBN: 978 – 37501-5-1. 2003;1-8.
2. Costa JMC, Aves MCS, Clemente, E Felix EMF. .Physical, Chemical and mineral characteristics of yellow dwarf coconut water at different maturity periods. Jour Acta Scientiarum Agronomy 28920. 2006;173–177.
3. Edward C, Craig RE. Cocos nucifera (coconut) species profiles for pacific Island. Agro forestry www.traditionaltree.org. 2006;1-8
4. Laghar M, Solangi AH. Status of coconut genetic resources. Research Palastan coconut genetic resources IPGRI – Regional Office for Asia, pacific and Oceana, Sedang Malaysia. 2005;604–607.
5. Moyin-jesu EI. Incorporation of Agro-Industrial Biomass and their effects on growth and nutrient content of Arnaranthus. Pertanika Jour of Trop. Agric Science Malaysia. 2003;26(1):49-58.
6. Uwubanmiven IO, Nwane CN, Okere RA, Dada M, Eseigh E. Harnessing the potentials of the coconut palm in the Nigerian Economy. World Jour of Agric Sci. 2011;796:684–691.
7. Ranaweera SRM, Nanayakkara CM, Tennakoon NA. Comparison of the effects of organic fertilizers with inorganic on the growth of eight months old coconut seedling, the nutrient availability and soil microbial activity of soils. Proc 15th International Forestry and Environment Symposium. University of Sri Jayewaedenepura, Sr, Lanka. 2010;93–100.
8. Teekoon NA, Bandara SDH. Nutrient content of same locally available organic materials and their potentials as alternative sources of nutrients for coconut. Cocos nucifera. 2003;15:23–30.
9. Subramanain P, Dhanapal R, Sanil P, Palaniswmi C, Sarim CV, Maheswarappa HP. Gliricicha as green manure in improving soil fertility and productivity of coconut under coastal littoral sandy soil. Jour of Plantation Crops. 2005;33(3):179–183.

10. Solanqi AH, Iqbal MZ Preliminary studies on morphological diversity of coconut (*Cocos nicifera* L.) seedlings of organic and inorganic fertilizers amendments at Katrachi, Palastan Pakistan. J/ Botany. 2012;44(1):161–164.
11. Soil Survey Staff. Soil Taxonomy A basic system for soil classification for making and interpreting soil surveys USDA Handbook No. 436, Washington, D.C, USA 1999.
12. Crockford L, Nowell R. Laboratory manual of physical chemistry. Exp 31 and 32. John Wiley and Sons, New York. 1956;58–59.
13. Walkley A, Black IA. An examination of Degtajaroff method for determining soil organic matter and a proposed modification of the chromic acid filtration Soil Sci. 1934;37:29–38.
14. Mclean EO. Aluminium: Methods of soil analysis part 2, A Sgronomy 9, Amer SOC Argon Madison Wiscousin, USA. MCA Black (eds). 1965;927–932.
15. Ogunwale JA, Udo EJ. A laboratory manual for soil and plant analysis. Agronomy Dept. University of Ibadan, Nigeria. 1978;201–206.
16. Bouycous H. Mechanical analysis of soil using hydrometer method. Analytical Chem Acta. 1951;22:32-34.
17. Ojeniyi SO. Effect of replacement of grass and forest with tree crops on soil textual and chemical properties. A paper presented at International conference on soil fertility, soil tilth and post clearing land degradation in the humid tropics, University of Ibadan. 1985;1–3.
18. Moyin-Jesu EI, Adeofun CO. Effects of different organic fertilizers on the soil and leaf chemical composition and growth of bitter kola (*Garnica colae*). Emirate Journal Of Food and Agriculture. 2008;20(1):31-45.
    Available: http//ejfa.info/index.php/ejfa/article/viewFile/5179/2648
19. Moyin-Jesu EI, Odewande A. Comparative evaluation of different tillage practices and method of planting on soil properties, growth and head yield of cabbage (*Brassica Oleraceae* L). American Journal of Research Communication. 2012;(1):1-20. Available: http/www.usa-journals.com/wp-content/uploads/2012/MoyinJesu.pdf.
20. Jackson ML. Soil chemical analysis Englewood cliffs N.J. Prentice Hall. 1958;59–67.
21. AOAC, Official methods of Analysis 12th Edition. Association of Official Analytical Chemists, Arlington, VA. 1970.
22. Moyin-Jesu EI, Adekayode FO. Comparative evaluation of different organic fertilizers on soil fertility improvement, leaf mineral composition and growth performance of African Cherry nut (*Chrysophyllum albidum* L) seedlings. Journal of American Science. 6(8);217-225.
    Available:http;www.jofamericanscience.org/journals/am-sci/am0608-am0608-217-223.pdf
23. Moyin-Jesu EI. Comparative evaluation of different organic fertilizers on soil fertility, leaf mineral composition andgrowth performance of Dika nut seedlings(Irvingia gabonensis L).Emirate Journa of Food and Agriculture 20(2);1-9.http.ejfa.info/index.php/ejfa/article/viewFile/5185/2654.
24. Marimuthu WMU, Bandaranayake CK. Effect of planting density on the yield of coconut. Cocos Jour. Coconut Research Institute Lunuwila, Sri-Lanka. 1996;11(1):32-39.
25. Jackson ML. Soil chemical analysis Englewood cliffs N.J. Prentice Hall. 1964;59–67.
26. Gomez KA, Gomez AA. Statistical procedure for Agricultural Research 2nd edition, John Wiley and sons. New York; 1984.

27. Agboola AA, Corey RB. Soil testing N, P, K for maize in the soils derived from metamorphic and igneous rocks of Western State of Nigeria. Nigeria Jour of West African Science. 1973;17(2):93-100.
28. Sobulo RA, Osiname OA. Soils and fertilizer use in Western Nigeria. Tech Bull, No 11, Institute of Agricultural Research and Training, University of Ife, Nigeria. 1981;8-9:8–9.
29. Folorunso OO, Agboola AA, Adeoye GO, Use of Fractional Recovery (FR) to calculate the K needs of maize (*Zea mays* L). Jour Tech Educ. 1995;2(1):65–75.
30. Jones BJ, Eck HV, Plant analysis as an aid in fertilizing corn and grain sorghum. In: L.M Walsh and J.d Beaten (eds) Soil testing and plant analysis rev. ed soil science soc Arner. Madason, Wisconsim, USA. 1973;349–364.
31. Adepetu JA, Adebayo E, Aduayi EA, Alofe CP,. A preliminary survey of the fertility of soils in Ondo State under traditional cultivation. Ife Jour of Agric. 1978;1(2):134–149.
32. Agboola AA, Obatolu CR. The potential of siam weed (*Chromolena odorata*) as a source of organic matter for soils in the humid tropics. Soil organic matter dynamics and sustainability of tropical agriculture eds. K. Mulongoy and R. Mercix. 1993. (IITA/KV Leuven). 1989;89–99
33. MoyinJesu EI, Adeofun CO. Effects of different organic fertilizers on the soil ,leaf chemical composition and growth of mango seedlings. Emirate Journal of Food and Agriculture. 2008b20(1);19-30.

    Available: http;/ejfa.info/index.php/ejfa/article/viewFile/5142/2620.
34. Moyin-jesu EI, Adekayode FO. Uses of long yam beans (*Sphenostyhs stenocarpa*) as soil amendment for the growth, leaf chemical composition and yield of white yam (*Dioscorea rotundata* L.). Jour of American Science. 2010;6(1):10–17.
35. Moyin-jesu E.I. Comparative evaluation of modified neem leaf, neem leaf and wood ash extracts on soil fertility improvement, growth and yield of maize (*Zea mays* L.) and watermelon (sole and intercrop). Agricultural Sci. J. 2012;1:1-8.
36. Agboola AA, Corey RB. Soil testing N, P, K for maize in the soils derived from metamorphic and igneous rocks of Western State of Nigeria. Nigeria Jour of West African Science Assoc. 1973;17(2):93-100.
37. Folorunso OO, Agboola AA, Adeoye GO. Comparative evaluation of three fertilizer models in determining P and K requirements of maize. Jour Tech Education. 2000;2(1):135–140.
38. Moyin-Jesu EI. Evaluation of different organic fertilizers on the soil fertility, leaf chemical composition and growth performance of coffee seedlings. African Jour Sci and Tech. 2009;(2):1-6.
39. Mohammed RH, Solaiman AHM. Efficacy of organic fertilizers on the growth of *Brassia oleraceae* L [cabbage]. International Journal of Agriculture and Crop Sciences. 2012;4[3]:128-138.
40. Adjei-Nsiah S, Chrisitian BO. Effect of palm bunch ash application on soil and plant nutrient composition and growth and yield of garden eggs, pepper and okra. International Journal of Plant and Soil Science. 2013;2(1):1-15.
41. Achieng J, Ouma G, Odhiambo G. Use of organic inputs in management of Alfisols and Ultisols for sustainable maize production in Western Kenya. American Journal of Experimental Agriculture. 2013;3(4):884-895.
42. Haghighat A, Hossein SRA, Saeid S. Effect of cattle manure and plant density on morpho- physiological traits of sweet corn in second cultivation by different culture method. International Journal of Agriculture and Crop Sciences. 2013;5(2):183-185.

43. Umunarongie-Ilori EG, Sulaiman-Ilobu BB, Ederion O. Imogie A, Imoisi BO, Garuba N, Ugah M. Vegetative growth performance of oil palm (*Elaesis guineonsis* L) seedlins in response to inorganic and organic fertilizers. Greener Journal of Agricultural Sciences. 2012;2(2):26–30.

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