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EFFECT OF DIFFERENT RATES AND TYPES OF FERTILIZERS ON GROWTH OF IMPROVED COCONUT *(Cocos nucifera)* SEEDLINGS

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ABSTRACT
Comparative effects of different rates of inorganic and organic fertilizers on the performance of improved coconut palms (hybrid and dwarf cultivars) were evaluated using coconut seedlings planted in 15kg soils in polythene bags at screen house of NIFOR main station, Benin City, Edo State. The reference fertilizer used was NPK Mg 12:12:17:2 and was applied at rate 0, 28, 42, 56 and 72g/pot (this was applied in three equal doses) to determine the optimum rate needed for the application of the different organic fertilizer sources (Decomposed Sunflower, DSF; Palm Kernel Cake, PKC; and Compost), used for both cultivars. The hybrid cultivar responded optimally to NPK Mg at 28-42g/pot while the various organic fertilizer sources at 32.3, 59 and 133.3gN/pot respectively of DSF, PKC and Compost were optimum for the hybrid seedlings. The seedlings treated to DSF, PKC and Compost had similar performance with the reference fertilizer but this was significantly different from the control (without fertilizer) among all the growth parameters. The dwarf cultivars responded optimally to NPK Mg at 72g/pot, while DSF, PKC and Compost at 83.1, 151.9 and 342.4gN/pot were the respective amounts require to supply optimum nutrition to the dwarf seedlings. Significant interaction occurred between fertilizer rates and cultivars. It was evident that the organic fertilizer materials could be used for the production of improved coconut seedlings instead of the usual expensive inorganic NPK Mg 12:12:17:2 fertilizer.

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INTRODUCTION
Coconut palms are of major importance to the economic of countries in Africa, Asia and Latin America, It is a lowland crop of the humid tropics, with its grooves found in both costal and inland soils. At seedling stage they can be raised in sand bed and polythene bags before transplanting to the field for more intensive care and safer handling of the seedling. Fertilizing the nursery coconut is essential in spite of the fact that seedling received nutrient supply from the endosperm during the first few months of germination (Ohler,1999). In Nigeria due to lack of insufficient information on coconut seedling fertilization optimum application rate of oil palm has been adopted (Onwubuya,1982), Ikwenobe *et al*, (1991) reported that this rate did not enhance the growth of tall coconut variety raised for one year in the nursery, but his work did not take other coconut varieties into consideration. The inorganic form of

fertilization are fast releasing minerals with more than one nutrient element formulated in their available form, but these types are hardly available and usually very expensive to the rural farmers. Onvrier and Taffin (1985) estimated that less than 1% of the world's coconut groves are regularly fertilized. Farmers are therefore, advised to seek alternative source of organic fertilizer which are locally sourced, less costly, easily accessible and environmentally friendly. Despite the abundance of organic fertilizer, there has been no report on the use of these cheap environmentally friendly, easily accessible, materials for growing coconut palm. This research work investigates the comparative effect of different rates of NPK-Mg fertilizers and some agricultural waste on coconut cultivation in soils of NIFOR main station.

MATERIALS AND METHODS

This study was conducted at the screen house of the Nigeria Institute of Oil Palm Research (NIFOR), Benin City Edo State from August 2013 – March 2014. The soil on NIFOR main station fall within subdivision of the acid sands (Vine, 1956). Sprouted seeds of hybrid (dwarf and tall) and dwarf varieties were sown in Polythene bags at their one leaf stage.

In preparation for planting, the soil was thoroughly air dried, crushed and passed through a 2mm sieve to remove debris and large stones. The sieved soil was bagged in black polythene bags of 35 cm wide and 45cm depth before planting sprouted seeds. The experiment was laid out as factorial arrangement in randomized complete block design replicated three times. The treatments comprised two coconut cultivars and five fertilizer rates in the phase 1 of the experiment [NPK Mg (12:12:17:2) at 0, 28, 42, 56 and 72g /15kg soil in three equal doses at 0, 2 and 4 months of planting] while the phase 2 involved two coconut cultivars and three treatments (decomposed sunflower plant (DSF), Palm Kernel Cake (PKC) and Compost). The optimum N fertilizer rate derived from the use of inorganic fertilizer was used as basis to calculate the amount (in grams) of nitrogen contained in the various organic fertilizers used for the phase 2 of the study. The three organic fertilizers (mixed with the soil in each polythene bag at 0, 2 and 4 months of planting) were decomposed sunflower plant (DSF), Palm Kernel Cake (PKC) and compost with 32.3, 59 and 133.3g N/15kg soil, respectively for the hybrid since the optimum was 28g/15kg soil while 83.1, 151.9 and 342.4g N/15kg soil respectively were applied to the dwarf cultivar since the optimum was 72g/15kg soil. These were compared with NPK Mg (12:12:17:2) and control (without fertilizer application) in the phase 2 of the experiment. Weeding was first carried out at 2 weeks after planting and thereafter at 3 weeks interval. Measurements were taken in respect of plant height, stem girth, number of leaves and leaf area at 2, 4 and 6 months after planting. Plant height was measured with the aid of a meter rule. Leaf area was determined by summing up the product of the length and the broadest width of each leaf. Tomi N was determined by micro-kjeldahl method and available-P by the Bray-l method (Bray *et al.,* 1945]. The exchangeable-K was extracted by ammonium acetate and determined by flame photometer. The hydrometer method was used for dispersing the soil into sand (2.00-0.05 mm), silt (0.05-0.002 mm) and clay (<0.002 mm) fractions. Data collected were subjected to analysis of variance (ANOVA) as described by (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Table 1 and 2 contain data on properties of test soil and composition of organic fertilizers respectively.

Table 1: Physical and chemical characteristics of the soil before planting

Parameter	Value
pH (1:1 H_2O)	5.5
Organic carbon (gkg^{-1})	0.32
Total Nitrogen (gkg^{-1})	0.06
Available P mg kg^{-1})	8.6
Exchangeable cations ($cmol\ kg^{-1}$)	
Ca	12.1
Mg	3.6
K	2.9
Mechanical analysis (gkg^{-1})	
Sand	928
Silt	35
Clay	26
Textural class	Sandy soil

Table 2: Nutrient composition of the organic fertilizer materials used in experiment two

Parameter	PKC	DSF	COMP
N (%)	5.69	10.62	8.69
P (%) K	3.80	5.01	3.30
(%) Mg	3.20	3.64	5.46
(%)	0.60	0.63	0.24

PKC = Palm Kernel Cake, DSF = Decomposed Sunflower, COMP = Compost.

Effects of NPK Mg 12:12:17:2 Fertilizer Application Levels on the Growth of improved Coconut-Palm Seedlings

This work is meant to assess the impacts of NPK-Mg on improved cultivars of coconut seedlings, under the acid sand environment of the main station. The result showed that at 2 and 3 month of planting the various treatments had no significant effects on the growth of seedlings compared to the control. However, responses were observed after 4 months of application. This confirmed the findings of Foale (1968) that coconut seedlings depend entirely on the endosperm for dry matter yield up to 4 months after germination.

The hybrid cultivars recorded the highest leaf area at 28g and 42g application rate per 15kg soil (Table 3). Seedlings that were treated with 28, 42, 56, and 72 gram were significant different from the control. With respect to leaf area, plant height, numbers of leaves and stem girth. The use of inorganic fertilizer NPK-Mg has synergistic effects and expedited growth and development of the crop. The rationale of this work is to determine the response of coconut seedling to different levels of NPK-Mg in order to optimize the appropriate rate of this fertilizer for the soil of NIFOR main station.

Table 3: Effects of NPK Mg (12:12:17:2) fertilizer application rates on the growth of Hybrid and Dwarf coconut – seedlings at 6 months after planting

NPK-Mg 12:12:17:2 (g/2kg Soil)	Stem Girth (cm)	Plant Height (cm)	Leaf Area (cm^2)	Number of Leaves
Hybrid Cultivar				
0	22[a]	73.7[b]	2220.0[b]	7[a]
28	19.7[ab]	127.2[a]	4011.0[a]	6.7[a]
42	19.2[ab]	123.2[a]	3818.8[a]	7.7[a]
56	15.3[b]	113.7[a]	3453.3[a]	7.0[a]
72	15.5[b]	120.3[a]	3857.3[a]	6.3[a]
LSD ($p<0.05$)	5.6	27.9	1174.7	4.07
Dwarf Cultivar				
0	12[a]	89.7[b]	1480.3[b]	6.3[a]
28	13.6[a]	97.7[b]	2523.3[b]	6.7[a]
42	13.6[a]	105[b]	2957.2[b]	7.0[a]
56	14[a]	113.7[b]	3323.3[b]	6.6[a]
72	14.8[a]	128.3[a]	4654.4[a]	7.3[a]
LSD ($p<0.05$)	3.6	94	1280.1	0.9

* Treatment means followed by similar letters are not significantly different at $p \leq 0.05$.

At 6 months of growth, the dwarf coconut seedlings that received 72g/15kg soil (table 3) were the tallest and were significantly taller than those treated with 28g, 42g, 56g and untreated (similar growth rate). Reason could be that dwarf coconut cultivar needs more nutrient supply than the hybrid type. Nutrient removal by coconut depends on soil condition as well as on coconut variety and yielding capacity (Ohler, 1999). Remison and Jose (1991) found complete mixture of NPK-Mg fertilizer significantly increased growth of dwarf coconut seedlings raised in the nursery for one year and suggested that dwarf seedlings could respond to higher rate than 112g/seedlings. Significant difference however occurred in leaf area among seedlings treated with 72g and the applications at other levels, including the control. Those supplied with 28, 42 and 56g as well as those without fertilizer were significantly lower. Number of leaves was more among seedlings treated with 72g while the least number was produced by untreated seedlings.

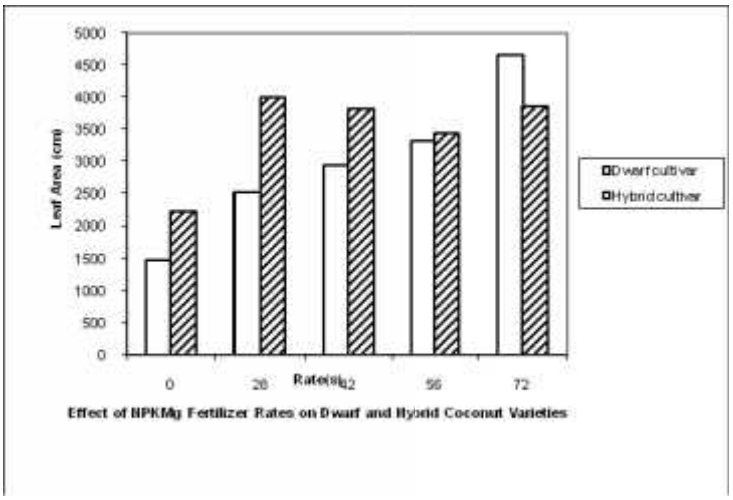

Figure 1: Application rates of NPKMg (12:12:17:2) fertilizer (x) in relation to leaf area (y) of improve coconut seedlings(Dwarf and Hybrid Cultivar) at six months after planting.

Effects of various organic fertilizer sources on growth of Coconut palm seedlings (Hybrid cultivar)

Responses to the various organic fertilizer treatments were observed at 4 and 6 months after planning. At 6 months of growth, Palm kernel cake treated seedlings recorded the highest in both height and leaf area (Table 4). This gave no significant difference from the other treated seedlings (both organic and inorganic were similar). The high performance of PKC and Compost treated seedlings could be due to high mulching effect and low rate of decomposition and mineralization. Mulching conserves moisture and could have enhanced availability of water and nutrient release. The increase availability of water and nutrient is essential for coconut performance (Ohler, 1999).

Decomposed sunflower recorded the lowest in leaf area; this can be related to volatile loss and leaching of N due to quick decomposition and mineralization of the mineral. The mineralized N might have been subjected to leaching loss and or volatilization (Adediran *et al* 1995) this can be controlled through frequent application of the mineral.

Decomposed sunflower, Compost, PKC and NPKMg treated seedlings had similar height and leaf area, which were significantly different from the untreated seedlings. Differences were also observed on height with PKC and DSF producing the tallest seedlings compared to the other treatments except those of Compost and NPKMg treated seedlings with similar heights. The NPKMg increased seedling height relative to control. Compost-treated seedlings produced more leaves than the other treatments while similar data were obtained in respect of DSF, PKC and NPKMg treated seedlings. Seedlings that received Compost had the biggest girth; which was significantly bigger than for untreated seedlings.

Effects of various organic fertilizer sources on growth of coconut palm seedlings (Dwarf cultivar).

At 6 months of growth, NPKMg-treated seedlings produced more leaves compared to the untreated seedlings. The latter produce similar number of leaves compared with all other treated seedlings. Seedlings treated with PKC produced the highest leaf area with no significant difference compared with all treated seedlings (Table 4). The seedlings supplied with NPKMg fertilizer had higher leaf area than control. Seedlings that were treated with PKC were the tallest followed by NPKMg, Compost and DSF treated seedlings

were statistically the same. Numbers of leaves were not significantly affected by fertilizer treatment. The effects of the fertilizer treatments on stem girth showed no difference among both treated and untreated seedlings.

Table 4: Effects of different sources of organic fertilizer on improved Coconut -palm seedlings at 6 months after planting.

Fertilizer sources	Stem Girth (cm)	Plant Height (cm)	Leaf Area (cm^2)	No. of leaf
Hybrid Cultivar				
Control	6.2[b]	3.7[bc]	220.0[b]	7 [a]
NPKMg	19.7[ab]	127.2[b]	4011.0 [a]	6.7 [a]
Compost	22 [a]	131.7[ab]	5037.3 [a]	8.3 [a]
DSF	19.7[ab]	149.5[ab]	5076.3 [a]	7.3 [a]
PKC	19.0[ab]	152.8[a]	6324.5 [a]	7[a]
LSD($p<0.05$)	5.6	24.0	2591.0	3.9
Dwarf Cultivar				
Control	12.0 [a]	89.7[bc]	1480.3[b]	6.3 [a]
NPKMg	14.8 [a]	128.3[ab]	4654.4 [a]	7.3[a]
Compost	13.5 [a]	138[ab]	4095.7 [a]	7.0[a]
DSF	13.8 [a]	111.7[b]	3564.3 [a]	6.3[a]
PKC	14.2 [a]	144[a]	5580.1 [a]	6.7[a]
LSD	4.8	29.0	2031.9	2.4

❖ Treatment means followed by similar letters are not significantly different at $p \leq 0.05$.

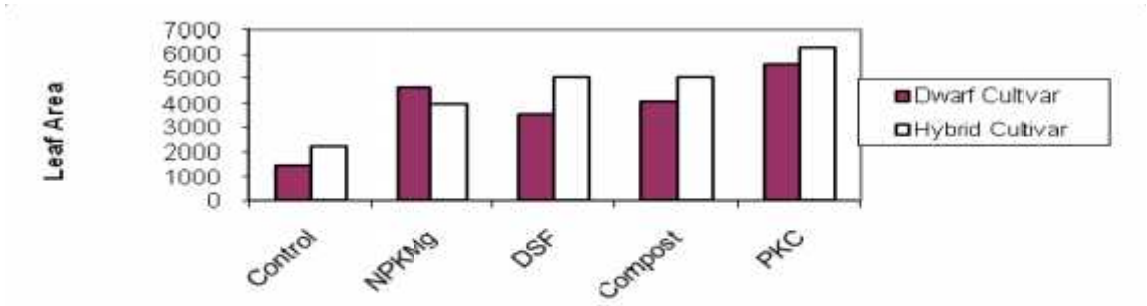

Figure 2: Application of NPKMg and Organic Fertilizer Sources(x) in Relation to Leaf Area(y) on Dwarf and Hybrid Coconut Seedlings at Six Months After Planting.

CONCLUSIONS

In this study, optimum NPKMg (12:12:17:2) fertilizer application rate for improved coconut seedlings are 28-42g/15kg soil (for hybrid seedlings) and 72g/15kg soil (for dwarf seedlings). Compost, Decomposed Sunflower (DSF) and Palm Kernel Cake (PKC) proved to be potential substitutes for inorganic fertilizer source (NPKMg 12:12:17:2). The fertilizer sources were effective in the order: PKC =Compost=DSF=NPKMg>Control. For the production of both the hybrid and dwarf coconut seedlings, application of DSF, PKC, and Compost at 32.3,59 and 133.3gN/15kg

soil, respectively for hybrid cultivar and 83.1, 151.9 and 342.4gN/15kg soil respectively for dwarf cultivar would be sufficient.

The results of this investigation with coconut seedlings give credence to previous assertions that agricultural waste could be re-used as fertilizer in large scale production. .

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