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# Evaluation of Seven Taro Cultivars [*Colocasia esculenta* (L.) *Schot*] for Yield and Corm Quality under Poultry Manure Fertilization in Anyigba, Kogi State, Nigeria

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## ABSTRACT

The study was conducted at the Prince Abubakar Audu University Research and Demonstration Farm, Anyigba, during the 2021 Cropping Season to evaluate seven taro cultivars for yield and corm quality under poultry manure fertilization. Treatments consist of 7 cultivars (1 local cultivar inclusive) combined factorially with two poultry manure levels (0 and 6 t/ha). A total of 14 treatments was obtained and laid in a Randomized Complete Block Design (RCBD) with three (3) replications giving a total of 42 plots. Results showed that all cultivars differed significantly ($P<0.05$) in yield and yielded attributing characters. Though Local cultivar had the highest corm yield/ ha but was significantly indifferent from those of NCe 003, NCe, 002 and Akirimgbawa. The longest corm of 23.78cm was produced by NxS 003. Plots treated with poultry manure (6 $tha^{-1}$) produced significantly more corms (15), Longer corm (20cm), and heavier corms (70g) per plant than the control plots, on average, plots treated with 6$tha^{-1}$ produced 5.95$tha^{-1}$ of corm compared with the control plots 4.476 $tha^{-1}$. Interaction of cultivar x poultry manure on Number of corms, Corm length, Average yield/Corm and total corm yield/ha, indicated differential response of cultivar to poultry manure. On corm quality, the highest crude protein (13.41%), fat (1.70%), crude fibre (0.69%) and carbohydrate (29.05%) was obtained with NCe 003, Local, NCe 003 and NxS 003 cultivars respectively. Poultry manure significantly influenced corm quality vis-a-vis crude protein, (48.8%) crude fibre (20.9%) and a decrease of 2.4% in carbohydrate content. The best cultivar with respect to corm weight/ha (i.e. total yield/ha) is Local (7.0 $tha^{-1}$), NCe 003 appeared to be of higher nutritive value than other. Further study involving graded level of the nutrients (poultry manure) with few cultivars (NCe 003, Nce 002 and Local) should be experimented for identification of optimum levels of the manure for maximum yield.

## INTRODUCTION

Cocoyam is a root crop in the *Araceae*, family; subfamily *Aroideae* mostly cultivated for edible corms (Lebot, 2009). It has been traced to the humid tropical rainforest regions of Southeast Asia (Lebot, 1999). African continent has reportedly been responsible for a bulk of overall world taro production where it served as staple food for millions of people (Amsalu, 2003). As reported by FAO (2008), African countries, including Nigeria, Cameroon, Ghana, Ivory Coast, and Congo, are key cocoyam producers. Similarly, 73,454 ha of Eastern African lands have reportedly yielded up to 407,437 MT (with average of 5.5 t/ha) of cocoyam (FAO, 2004). FAOSTAT (2001) holds that yield of 900 - 1,707 MT of cocoyam has been reported in Ghana between year 1990 and 2000, respectively.

Cocoyam is a robust tool for strengthening food security, increasing foreign exchange earnings and overall means for rural development (Angami *et al*., 2015). According to FAO (1999), cocoyam is widely used during religious festivities as a mild laxative, in relief of wounds, snake bites, and lowering body temperature in feverish conditions, among others (Liu *et al*., 2006). Huang, *et al.* (2007) stressed the need to embrace information on the nutritional contents of root crops as a result of much emphasis placed by consumers. Njintang, *et al.* (2007) had reported a 73 - 80 % starch in cocoyam while enumerating the low protein and fat content in corms, he reported high carbohydrates, fiber and minerals respectively in corms. Variety, soil type, climate, moisture and nutrient availability, post-harvest handling, and storage have reportedly influenced cocoyam's nutritional composition (El-Sirafy *et al*., 2008; McPharlin & Lancaster, 2005; Mare, 2009; Melese, 2017; Adane *et al*., 2013; Jirarart *et al.* 2006 and Ezeocha *et al.* 2014). Research into determining corm quality relative to different varieties is thus necessary for effective cultivation and utilization as there have been no known documentation on local cocoyam cultivars.

Varieties of cocoyam has been described according to the International Plant Genetic Resources Institute (1999) with an attempt to differentiate varietal characteristics placed by breeders (Del Rosario *et al*., 2014). Varieites such as dilisor, dirraousch, kerdeu, meltalt, merii, housted, dois, erderid, dirrubong and dirratengadik has been described with pronounced differentiating growth, yield and physiological and morphological characteristics such as height, leaf colour, blade and margin, corm shape, weight and flesh colour, flower morphology, vein differentiation, maturity petiole pattern among others (IPGRI/IITA 1999). Cocoyam is a heavy feeder of nutrient and thus its performances is heavily dependent on its level of fertilization. Reports has it that cocoyam



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responds well to fertilizer application (Mare and Modi 2009). However, other several other authors have reported that organic fertilizers are cheap, less easily leached and likely to pollute ground water when compared to mineral fertilizers (Sridhar & Adeoye, 2003).

Poultry manure is an efficient organic source of plant nutrient capable of elevating crop production (Onwudike *et al.* 2015; Ojeniyi *et al.* 2013; Adekiya & Agbede 2016) as it remediates soil physical structure, its' rich organic matter content has reportedly increased crop yield (Ayeni, 2011). As reported by Reddy and Reddi (1995), poultry manure contains an average 3.03% N, 2.63% $P_2O_5$ and 1.4% $K_2O$.

Cultivation of crops like cassava, yam and to some extent sweet potatoes has gained prominence in most parts of the country and by contraction Anyigba. The seemingly low to non-cultivation of cocoyam by most farmers may not be unconnected with the inherent low yield occasioned by lack of improved cultivars (Tattiyakul, *et al.*, 2006). Most of the local cultivar grown by the local farmers give low yield and to further worsen the situation (Roy *et al.*, 2006), are usually grown on marginal soils with low fertility level due to continuous cropping (Hartemink *et al.*, 2000). The need to therefore screen improved cultivar along with organic manure (cheap nutrient source) application for specific ecological niche cannot come at a better time than now, and therefore justified this work. Identifying specific cultivar x poultry manure application will to me be one of the greatest achievement in agronomic research (Sibyala 2013; Dwivedi & Sen 2001; Das *et al.*, 2018), by this we will not just identify promising cultivars, but more specifically and importantly matching them with poultry manure requirements. This study therefore evaluates seven (7) seven cultivars of cocoyam under poultry manure fertilization for growth attributes, yield and yield attributes and corm quality (Crude protein, Fat content, Ash, Crude fibre and Carbohydrate yield) and possible interaction taro cultivars x poultry manure on yield and yield attributes in Anyigba, Kogi State, Nigeria.

## MATERIALS AND METHODS

The field study was conducted during the rainy season of 2021 at Kogi State University Anyigba (Now Prince Abubakar Audu University) Teaching and Research Farm, Anyigba, Kogi State, Nigeria, located on latitude ($7^0 29^1$N and longitude $7^0 11^1$E) on elevation of 420 m above sea-level. Anyigba which is located within the Southern Guinea Savannah Ecological Zone of Nigeria, is characterized by an average rainfall of about 180 mm mostly distributed between the months of April and October. Mean monthly minimum and maximum temperature of about 17° C and 36.2° C respectively. The soils generally are sandy to sandy-loam. Temperature shows some variation throughout the years. Mean monthly temperature varies between 15.1°C and 31.3°C (Amhakhian *et al.*, 2012). Treatments consisted of 7 breeding lines (6 improved and 1 local) of taro which include NxS 002, NCe 003, NCe 002, Akirimgbawa, NxS 001, NxS 003 and Local coded as $V_1$, $V_2$, $V_3$, $V_4$, $V_5$, $V_6$ and $V_7$ respectively and two levels of pure poultry manure $P_1$ (0tha$^{-1}$) and $P_2$ (6 tha$^{-1}$) devoid of floor bedding materials. These treatments were combined factorially to obtain a total of 14 treatments. The experimental site measures 0.085ha. The experiment was laid in a Randomized Complete Block Design (RCBD) with three (3) replications. Each replicates contained 14 plots and a total of forty-two (42) plots was obtained with each plot measuring 13.50 m$^2$. Each plot consists of four ridges of 3.0m long and plant population of forty (40), giving a total of one thousand six hundred and eighty (1680) plants in the whole experiment. Taro cultivars were obtained from the National Root Crops Research Institute (NRCRI), Umudike, Abia State and one Local Cultivar obtained from Anyigba market as check and the pure poultry manure was collected from a Mu'cobs farm Lokoja Kogi State. Planting was done at 45 cm spacing within ridges and 75cm between ridges, 15cm deep, covered with 2 – 3 cm of soil on the 10th day of June 2021. Only one viable daughter corm was planted per hole after planting, soil around the planted corms was patted down gently and watered until the taro got soaked. Poultry manure was incorporated into the soil during tillage two weeks before planting for rapid decomposition and nutrients release to the crop. Weeding was done manually starting from three (3) weeks after planting. The experiment was kept weed free throughout the period of the work. This was done to allow effective results. For the control of insect pests such as cluster caterpillars, nematodes, aphids, taro beetles and horn worms, which were observed on the field, organic insecticides neem oil extract, was used plus one inorganic Fungicide (Thiopsin 70% ppm) which was applied. These applications were repeated every three weeks to control taro beetles at the rate of 30ml/16litres of water using a knapsack sprayer. Harvesting was done in the month of November 2021.

### Observations and Data Collection

All observation on were made on yield parameters; Number of Corms/plant, Corm Length, Corm Diameter, Average yield/corm, Total yield (corms + cormels). Qualitative test was carried out using final daughter corm and cormels (from final yield) and actively growing leaves from the discard rows before harvest to determine carbohydrate, crude protein, crude fibre, fat and ash content respectively.

### Analysis of Data

All data on yield parameters and quality assessment on corms, cormel and leaves were subjected to Analysis of Variance (ANOVA) using the Statistical Tool for Agricultural Research (STAR) to enable us accept or reject the null hypothesis of no treatment effect on corm and quality of taro (cocoyam) in Anyigba. Significant different treatment means were separated using the New Duncan Multiple Range (N-DMRT) as described by Duncan (1955).

**RESULTS**

The result of soil analysis above (table 1) shows that the soil is Sandy Clay Loam and slightly acidic with a pH of 4.61. It had an organic matter content of 1.52% and organic carbon of 0.88%. The N, Mg and K contents were 0.04%, 2.74mg kg-1 and 2.31cmol kg-1 respectively which are considered to be significantly low. The result from this table indicates that the soil can support the growth of the Taro if supported by Nitrogen from mineral or organic source.

Pure poultry manure used throughout the period of the experiment was analyzed and the result showed that the manure constituted 1.86 % Nitrogen, 1.78 % Phosphorus and 0.89 % potassium which are major nutrient requirement of taro crop and can sufficiently support growth and yield in Anyigba, their deficiencies in the soil relative to the crop requirement and their ration in the poultry manure utilized for this experiment informed the rates applied.

Yield characters were significantly affected ($P<0.05$) by cultivar, poultry manure fertilization and interaction respectively (table 2).

Number of corms/plant varied significantly with cultivars. NCe 003, NCe 002 and Local cultivars had the highest number of corms though but were significantly indifferent. This was followed by those obtained with NxS 003, Akirimgbawa, NxS 001 in that order. NxS 002 cultivars produced the lowest number of corms. Application of 6 tha$^{-1}$ poultry manure performed significantly higher than the control plots for number of Corms.

Corm length obtained with NxS 003 was highest, other cultivars had corms whose length were statistically at par. Poultry manure had no significant influence on corm length also. There was significant V x PM interaction on number of corms/plant and corm length respectively. There was no significant effect of cultivars, poultry manure and V x PM interaction on corm diameter ($P\geq0.05$).

Average yield/corm was significantly influenced by cultivars yield obtained with NxS 002 was though highest but significantly indifferent from those of Akirimgbawa and NxS 003 which were also statistically at par. Yield/corm from other cultivars were lowest and statistically indifferent. Poultry manure had no significant influence on the yield/corm.

Total yield (tha$^{-1}$) – Local and Akirimgbawa cultivars had the highest yield though, but these were significantly indifferent. This was followed by yield obtained with NCe 003 and NCe 002 which were statistically at par, following this, yield obtained with NxS 002 and NxS 003 were also statistically at par. Lowest yield was obtained from NxS 001 variety. V x PM interaction was significant for average yield/corm and total yield respectively.

**Interactions of Cultivar and Poultry Manure on Yield characters of Taro**

Table 3 shows that NxS 003 had the highest response to poultry manure by producing plants with the longest corm under the application of 0 t/ha poultry manure. responses to poultry manure by other cultivars such as NxS 002, NCe 003, NCe 002, and Akirimgbawa were statistically at par. NCe 002 showed the lowest response under control treatments too.

Similarly, in table 4, NCe 003 showed the highest response by producing the highest number of corms/plant under 6 t/ha PM fertilization. This response was however the same with Local cultivars. Similar but higher response to PM was observed with NCe 002, NxS 001, Akirimgbawa and NxS 003 under 6 t/ha PM fertilization. The least response was obtained with NxS 002 under control treatments.

Table 5 indicates that NxS 003 and NCe 002 had the highest response to PM fertilization by yielding average corm weight of 0.08 kg under 6 t/ha PM fertilization. Similar but lower responses were obtained with NxS 002, NCe 003, Akirimgbawa, NxS 001 and Local cultivars under 6t/ha PM fertilization. The least response was obtained with NCe 003 and local cultivars under control plots.

Similar result was obtained from total yield (table 6). Local and Akirimgbawa varieties produced the highest response with under 6t/ha PM fertilization though did not differ significantly. This response was followed by NxS 002, NCe 003, NCe 002 and NxS 003 respectively. the lowest yield was observed when NxS 001 was allotted 0 t/ha PM.

**Proximate Result**

Table 7 presents the effect of Cultivars and poultry manure on corm quality of taro crop in Anyigba. Crude Protein - NCe 003 had the highest crude Protein content (13.41%), followed by those observed with Akirimgbawa, NxS 001, NxS 003, Local which were significantly indifferent from each other. Cultivars with the least CP content was NxS 002 and NCe 002 which were found at par. Fat – Local cultivar (1.70%) and NxS 003 (1.69%) presented the highest fat content which were found at par also, followed by Akirimgbawa (1.31%). Other cultivars under examination presented the same % fat content. Crude Fibre – Nce 003 had the highest crude fiber content (0.69) which was significantly different from all other cultivars under examination. This was followed by NxS 003, NCe 002, NxS 001 and Local cultivars respectively in that order. The lowest fiber was obtained with NxS 002. Carbohydrate – NxS 003 had the highest carbohydrate content (29.05%). This was however not statistically different from those of Akirimgbawa (26.46%), Local (25.99%) and NxS 002 (23.87%). These were followed by NxS 001 (21.40%) and NCe 002 (19.18%) which were at par. NCe 003 had the lowest carbohydrate content (17.49%). Ash – Nce 003 and NxS 003 was found to be 0.97% and 0.95% Ash which was highest amongst all cultivars examined. This was followed by NxS 002. Ash content of NCe 003 and NCe 002 were statistically at par followed by Local cultivar. NCe 002 presented the lowest ash content (0.093%).

Poultry manure fertilization influenced taro nutrient composition by producing corms with high crude protein content, fat, crude fiber and ash content when 6 $tha^{-1}$ Poultry Manure was used. However, Carbohydrate content of taro corms was an exception as Poultry Manure was found to be insignificant (table 7) in carbohydrate content.

Table 8 present the results of the Nutrient content of taro as influenced by Cultivar x PM interactions. Akirimgbawa cultivar presented the highest response to C x PM interaction on crude protein. It had the highest CP (15.55%) under 6 t/ha PM fertilization. However, other cultivars responded well to PM fertilization as their CP contents were higher under PM fertilization at 6 t/ha. NCe 002 was found to exhibit the least response to PM fertilization (10.83%). Similarly, NxS 003 had the poorest response to interaction with a carbohydrate content of 35.14% under 0 t/ha PM fertilization. Akirimgbawa and NxS 002 behaved in the same manner. Best response to 6 t/ha PM fertilization was observed with Local cultivar. Interaction on Ash content indicated that NxS 003 also had the poorest response to PM fertilization as its performance was optimum under control plot for PM fertilization. Best response was observed with NCe 003 which gave (1.02% ash) under 6 t/ha PM fertilization. Other cultivars behaved alike. Lastly, NxS 003 had the highest crude fat content (2.01%) under 6 t/ha PM fertilization and its thus said to be optimum in its response to PM fertilization. This response was found to be at par with Local cultivar which is 1.9% crude fat. Other cultivars responded better and alike. The least response was observed with NxS 002 which was also at par with NCe 003.

**Table 1:** Physical and chemical Characteristics of Soil taken from the Experimental Site before the Establishment

| **Properties** | **0-15 & 15-30cm depth** |
|---|---|
| Physical | |
| Sand | 2.28 |
| Slit | 21.20 |
| Clay | 76.52 |
| Textural Class | Sandy Clay Loam |
| **Chemical** | |
| $_pH$ in $H_20$ (1:2:5) | 4.61 |
| Organic carbon (%) | 0.88 |
| Organic matter (%) | 1.52 |
| Total Nitrogen (%) | 0.04 |
| Available phosphorus (mg/kg) | 5.36 |
| **Exchangeable Cation (Meq/100gm Soil)** | |
| $K^+$ | 2.31 |
| $Mg^+$ | 2.74 |
| $Ca^+$ | 4.39 |
| $Na^+$ | 0.41 |
| CEC | 10.91 |
| Poultry Manure | (%) |
| N | 1.86 |
| P | 1.78 |
| K | 0.89 |

**Table 2:** Yield Components of Seven Cultivars of Taro (Colocasia esculenta) Under Poultry Manure Fertilization in Anyigba, during the 2021 Cropping Season

| **Treatments** | | | | | |
|---|---|---|---|---|---|
| **Cultivars** | **No. of Corms/plant** | **Corm Length** | **Corm Diameter** | **Average yield/ Corm (kg)** | **Total yield ($tha^{-1}$)** |
| NxS 002 | $6.83 \pm 1.71^c$ | 17.13 ± 0.43b | 34.85 ± 5.89 | $0.07 \pm 0.01^a$ | $4.56 \pm 0.22^{bc}$ |
| NCe 003 | $14.83 \pm 0.95^a$ | $17.82 \pm 0.20^b$ | 37.33 ± 5.07 | $0.05 \pm 0.00^b$ | $6.53 \pm 0.44^{ab}$ |
| NCe 002 | $14.83 \pm 0.95^a$ | $16.85 \pm 0.53^b$ | 91.27 ± 12.90 | $0.05 \pm 0.00^b$ | $4.81 \pm 0.14^{ab}$ |
| Akirimgbawa | $11.83 \pm 0.05^{abc}$ | $17.83 \pm 0.20^b$ | 40.90 ± 3.88 | $0.06 \pm 0.00^{ab}$ | $6.96 \pm 0.58^a$ |

| | | | | | |
|---|---|---|---|---|---|
| NxS 001 | 8.17 ± 1.26$^{bc}$ | 17.35 ± 0.36$^{b}$ | 44.32 ± 2.74 | 0.05 ± 0.00$^{b}$ | 2.43 ± 0.93$^{c}$ |
| NxS 003 | 12.83 ± 0.28$^{ab}$ | 23.78 ± 1.78$^{a}$ | 48.47 ± 1.27 | 0.06 ± 0.00$^{ab}$ | 4.22 ± 0.33$^{bc}$ |
| Local | 14.50 ± 0.84$^{a}$ | 18.25 ± 0.06$^{b}$ | 39.57 ± 4.32 | 0.05 ± 0.00$^{b}$ | 7.01 ± 0.58$^{a}$ |
| SE (±) | 01.87 | 01.17 | 20.72 | 0.006 | 1.08 |
| **Poultry Manure (tha$^{-1}$)** | | | | | |
| Control | 9.14 ± 0.94$^{b}$ | 17.37 ± 0.35 | 93.23 ± 13.56 | 0.04 ± 0.00 | 4.47 ± 0.25 |
| 6 tha$^{-1}$ | 14.81 ± 0.94$^{a}$ | 19.50 ± 0.36 | 42.97 ± 3.19 | 0.07 ± 0.01 | 5.95 ± 0.24 |
| LSD $_{(0.05)}$ | 2.90 | 01.82 | 32.20 | 0.008 | 1.69 |
| **Interaction (V x PM)** | | | | | |
| P $_{Value\ (0.05)}$ | 0.895 | 0.354 | 0.351 | 0.618 | 0.896 |
| C.V (%) | 38.2 | 15.5 | 105.5 | 24.7 | 37.8 |

*Means followed by same letter(s) within a parameter are not statically different at 5% level of probability using N-DMRT. Ns - Not Significant, C.V- Coefficient of variation.*

**Table 3:** Cultivar x Poultry Manure interaction on corm length of taro cultivars during the Cropping season of 2021 in Anyigba

| | **Cultivars** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Poultry Manure** | **V1** | **V2** | **V3** | **V4** | **V5** | **V6** | **V7** |
| Control | 16.17 ± 0.60$^{cd}$ | 17.33 ± 0.29$^{cd}$ | 16.03 ± 0.64$^{cd}$ | 17.33 ± 0.29$^{cd}$ | 14.07 ± 1.16$^{d}$ | 24.43 ± 1.60$^{a}$ | 16.20 ± 0.59$^{cd}$ |
| 6 tha$^{-1}$ | 18.10 ± 0.11$^{cd}$ | 18.30 ± 0.04$^{cd}$ | 17.67 ± 0.20$^{cd}$ | 18.33 ± 0.02b$^{cd}$ | 20.63 ± 0.58$^{abc}$ | 23.13 ± 1.25$^{ab}$ | 20.30 ± 0.49$^{abc}$ |
| SE (±) | 1.65 | | | | | | |

*Means followed by same letters within a parameter are not statically different at 5% level of probability using N-DMRT. C.V- Coefficient of variation, $V_1$ = NxS 002, $V_2$ = NCe 003, $V_3$ = NCe 002, $V_4$ = Akirimgbawa, $V_5$ = NxS 001, $V_6$ = NxS 003 and $V_7$ = Local*

**Table 4:** Cultivar x Poultry Manure interaction on Number of corms/plant during the Cropping season of 2021 in Anyigba

| | **Cultivars** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Poultry Manure** | **V1** | **V2** | **V3** | **V4** | **V5** | **V6** | **V7** |
| Control | 5.67 ± 1.68$^{c}$ | 9.67 ± 0.61$^{bc}$ | 13.00 ± 0.27$^{abc}$ | 9.67 ± 0.61$^{bc}$ | 6.33 ± 0.52$^{c}$ | 9.67 ± 0.61$^{bc}$ | 10.00 ± 0.53$^{bc}$ |
| 6 tha$^{-1}$ | 8.00 ± 1.06$^{c}$ | 20.00 ± 2.14$^{a}$ | 16.67 ± 1.25$^{ab}$ | 14.00 ± 0.54$^{abc}$ | 10.00 ± 0.53$^{bc}$ | 16.00 ± 1.07$^{ab}$ | 19.00 ± 1.88$^{a}$ |
| SE (±) | 1.65 | | | | | | |

*Means followed by same letters within a parameter are not statically different at 5% level of probability using N-DMRT. C.V- Coefficient of variation, $V_1$ = NxS 002, $V_2$ = NCe 003, $V_3$ = NCe 002, $V_4$ = Akirimgbawa, $V_5$ = NxS 001, $V_6$ = NxS 003 and $V_7$ = Local*

**Table 5:** Cultivar x Poultry Manure interaction on Average yield/corm during the Cropping season of 2021 in Anyigba

| | **Cultivars** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Poultry Manure** | **V1** | **V2** | **V3** | **V4** | **V5** | **V6** | **V7** |
| Control | 0.06 ± 0.001$^{ab}$ | 0.03 ± 0.006$^{c}$ | 0.03 ± 0.006$^{c}$ | 0.04 ± 0.004$^{ab}$ | 0.04 ± 0.004$^{ab}$ | 0.05 ± 0.001$^{ab}$ | 0.03 ± 0.006$^{c}$ |
| 6 tha$^{-1}$ | 0.07 ± 0.017$^{ab}$ | 0.06 ± 0.001$^{ab}$ | 0.08 ± 0.006$^{a}$ | 0.07 ± 0.017$^{ab}$ | 0.07 ± 0.017$^{ab}$ | 0.08 ± 0.006$^{a}$ | 0.07 ± 0.017$^{ab}$ |
| SE (±) | 1.65 | | | | | | |

*Means followed by same letters within a parameter are not statically different at 5% level of probability using N-DMRT. C.V- Coefficient of variation, $V_1$ = NxS 002, $V_2$ = NCe 003, $V_3$ = NCe 002, $V_4$ = Akirimgbawa, $V_5$ = NxS 001, $V_6$ = NxS 003 and $V_7$ = Local*

**Table 6:** Cultivar x Poultry Manure interaction on Total yield (tha$^{-1}$) during the Cropping season of 2021 in Anyigba

| | **Cultivars** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Poultry Manure** | **V1** | **V2** | **V3** | **V4** | **V5** | **V6** | **V7** |
| Control | 4.70 ± 0.61$^{bc}$ | 7.20 ± 0.05$^{abc}$ | 6.03 ± 0.26$^{bc}$ | 8.13 ± 0.30$^{ab}$ | 2.28 ± 1.26$^{c}$ | 5.63 ± 0.36$^{bc}$ | 7.80 ± 0.21$^{ab}$ |
| 6 tha$^{-1}$ | 7.60 ± 0.16$^{ab}$ | 10.40 ± 0.91$^{ab}$ | 6.97 ± 0.01$^{abc}$ | 10.67 ± 0.98$^{a}$ | 3.73 ± 0.87$^{bc}$ | 5.77 ± 0.33$^{bc}$ | 11.13 ± 1.10$^{a}$ |
| SE (±) | 1.65 | | | | | | |

*Means followed by same letters within a parameter are not statically different at 5% level of probability using N-DMRT. C.V- Coefficient of variation,* $V_1$ *= NxS 002,* $V_2$ *= NCe 003,* $V_3$ *= NCe 002,* $V_4$ *= Akirimgbawa,* $V_5$ *= NxS 001,* $V_6$ *= NxS 003 and* $V_7$ *= Local*

**Table 7:** Corm Nutrient Content of Seven Cultivars of Taro (Colocasia esculenta) Under Poultry Manure Fertilization in Anyigba, during the 2021 Rainy Season

| | | **Percentage of Nutrient Content (%)** | | | |
|---|---|---|---|---|---|
| **Treatments** | **Protein** | **Fat** | **Crude Fiber** | **Carbohydrate** | **Ash** |
| **Cultivars (V)** | | | | | |
| NxS 002 | 8.70 ± 0.88$^{c}$ | 1.06 ± 0.08$^{c}$ | 0.37 ± 0.04$^{e}$ | 23.87 ± 0.17$^{abc}$ | 0.82 ± 0.03$^{b}$ |
| NCe 003 | 13.41 ± 0.68$^{a}$ | 1.08 ± 0.07$^{c}$ | 0.69 ± 0.08$^{a}$ | 17.49 ± 1.95$^{c}$ | 0.97 ± 0.08$^{a}$ |
| NCe 002 | 9.78 ± 0.53$^{c}$ | 1.08 ± 0.07$^{c}$ | 0.50 ± 0.01$^{c}$ | 19.18 ± 1.38$^{bc}$ | 0.093 ± 0.21$^{e}$ |
| Akirimgbawa | 11.24 ± 0.04$^{b}$ | 1.31 ± 0.01$^{b}$ | 0.32 ± 0.04f | 26.46 ± 1.04$^{ab}$ | 0.77 ± 0.01$^{c}$ |
| NxS 001 | 11.77 ± 0.14$^{b}$ | 1.10 ± 0.06$^{c}$ | 0.43 ± 0.02d | 21.40 ± 0.65$^{bc}$ | 0.77 ± 0.01$^{c}$ |
| NxS 003 | 12.31 ± 0.32$^{b}$ | 1.69 ± 0.13$^{a}$ | 0.62 ± 0.05$^{b}$ | 29.05 ± 1.90$^{a}$ | 0.95 ± 0.07$^{a}$ |
| Local | 12.26 ± 0.30$^{b}$ | 1.70 ± 0.14$^{a}$ | 0.41 ± 0.02de | 25.99 ± 0.88$^{ab}$ | 0.58 ± 0.05d |
| SE (±) | 0.30 | 0.04 | 0.02 | 2.36 | 0.03 |
| C.V | 6.5% | 6.9% | 9.3% | 24.7% | 7.7% |
| **Poultry Manure (tha$^{-1}$)** | | | | | |
| Control | 9.26 ± 0.69$^{b}$ | 1.17 ± 0.04$^{b}$ | 0.43 ± 0.02$^{b}$ | 23.64 ± 0.1 | 0.77 ± 0.01$^{b}$ |
| 6 tha$^{-1}$ | 13.45 ±0.69$^{a}$ | 1.42 ± 0.04$^{a}$ | 0.52 ± 0.01$^{a}$ | 23.06 ± 0.09 | 0.88 ± 0.05$^{a}$ |
| LSD(0.05) | 0.47 | 0.06 | 0.03 | | 0.04 |
| **Interaction (V x PM)** | | | | | |
| P – Value(0.05) | 0.000 | 0.000 | 0.0002 | 0.000 | 0.0001 |
| C.V (%) | 6.50 | 6.90 | 17.95 | 24.70 | 7.70 |

*Means followed by same letter(s) within a parameter are not statically different at 5% level of probability using N-DMRT. Ns - Not Significant, C.V- Coefficient of variation*

**Table 8:** Cultivar x PM interactions on Corm Nutrient Content of Seven Cultivars of Taro (Colocasia esculenta) in Anyigba, during the 2021 Rainy Season

| | **Protein content** | | **Carbohydrate** | | **Ash content** | | **Crude Fat** | |
|---|---|---|---|---|---|---|---|---|
| | **Poultry Manure (tha$^{-1}$)** | | | | | | | |
| **Cultivars (V)** | **Control** | **6 tha$^{-1}$** | **Control** | **6 tha$^{-1}$** | **Control** | **6 tha$^{-1}$** | **Control** | **6 tha$^{-1}$** |
| NxS 002 | 6.20 ± 1.15$^{h}$ | 11.14 ± 0.87$^{ef}$ | 23.44 ± 0.07$^{bcd}$ | 24.29 ± 0.46$^{bcd}$ | 0.75 ± 0.01$^{e}$ | 0.88 ± 0.00$^{d}$ | 1.01 ± 0.05$^{f}$ | 1.11 ± 0.11$^{ef}$ |
| NCe 003 | 12.48 ± 1.21$^{de}$ | 14.34 ± 0.33$^{abc}$ | 17.38 ± 2.36$^{d}$ | 17.59 ± 2.06$^{d}$ | 0.92 ± 0.05$^{bcd}$ | 1.02 ± 0.05$^{ab}$ | 1.05 ± 0.04$^{ef}$ | 1.12 ± 0.11$^{ef}$ |
| NCe 002 | 8.74 ± 0.19$^{g}$ | 10.83 ± 0.98$^{f}$ | 18.17 ± 2.06$^{d}$ | 20.18 ± 1.08$^{d}$ | 0.85 ± 0.03$^{de}$ | 1.00 ± 0.04$^{abc}$ | 0.92 ± 0.09$^{f}$ | 1.25 ± 0.06c$^{de}$ |
| Akirimgbawa | 6.93 ± 0.87$^{h}$ | 15.55 ± 0.79$^{a}$ | 30.66 ± 2.65$^{a-d}$ | 22.27 ± 0.29c$^{d}$ | 0.68 ± 0.03$^{ef}$ | 0.85 ± 0.01$^{de}$ | 1.27 ± 0.04c$^{d}$ | 1.35 ± 0.02$^{c}$ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NxS 001 | 8.09 ± $0.43g^{h}$ | 15.46 ± $0.76^{ab}$ | 21.41 ± $0.84^{cd}$ | 21.39 ± $0.63^{cd}$ | 0.63 ± $0.05^{f}$ | 0.90 ± $0.00c^{d}$ | 1.04 ± $0.05^{ef}$ | 1.17 ± $0.09^{de}$ |
| NxS 003 | 11.30 $0.77±^{ef}$ | 13.32 ± $0.04^{cd}$ | 35.14 ± $4.34^{a}$ | 22.97 ± $0.03^{cd}$ | 1.03 ± $0.09^{a}$ | 0.87 ± $0.00^{d}$ | 1.37 ± $0.07^{bc}$ | 2.01 ± $0.22^{a}$ |
| Local | 11.03 $0.67±^{f}$ | 13.49 ± $0.02^{bcd}$ | 19.28 ± $1.64^{d}$ | 32.70 ± $3.65^{ab}$ | 0.50 ± $0.1^{g}$ | 0.67 ± $0.08^{ef}$ | 1.50 ± $0.12^{b}$ | 1.90 ± $0.18^{a}$ |
| SE (±) | 0.43 | | 3.33 | | 0.04 | | 0.05 | |

*Means followed by same letter(s) within a parameter are not statically different at 5% level of probability using N-DMRT*

## DISCUSSION

### Effect of Cultivar, Poultry Manure and C X PM Interaction on Yield Characters and Yield of Taro Crop

Our results for yield characters and yield corresponds with the reports of Hota *et al.*, 2014; Ogbonna and Nwaeze, 2012; Ojeniyi *et al.*, 2013; Shiyam *et al.*, 2007; Uwa *et al.*, 2011 who obtained a significant improvement in corm length, diameter and numbers and yield. with poultry manure fertilization. This is also confirmed in the findings of Verma *et al.*, (2012) and Orji *et al.*, (2019). Corm yield of 18.47t/ha has been reported from integrated application of full dose of Farm Yard Manure and vermin composting at 75% recommended NPK dose (Verma *et al.*, 2012). Orji *et al.* (2019) also reported significant increase in corm girth, yield, cormel yield and total yield from an integrated use of NPK and Poultry manure.

NxS 003, NCe 002 and Local cultivars which responded best to 6 t/ha of poultry Manure fertilization for Number of corms/plant, Average yield/corm and total yield as evident by Cultivar x PM fertilization is an indication of differences in varietal inheritance. This has been reported by some researchers Sibyala (2013); Dwivedi and Sen (2001). Das *et al.*, (2018) obtained highest cormel weight with 4bags of NPK from a landrace "Kadma Local" closely followed by the Jhankri cultivar from Jharkhand with no significant NPK increase.

Cultivars were more responsive to yield under the application of poultry manure and responses were higher due to low nutrient content. This is in line with the findings of Shiyam *et al.*, (2007); Mare & Modi (2009) who reported higher responses of crop varieties in low to marginal soils nutrients than soils with higher nutrients. These may have also resulted from maximum ecological factors which triggered higher photosynthetic activities to accumulate more photosynthates deposited in the sink (Ahmed and Badr 2009; Orji *et al.*, 2016). However, lesser variations in this situation has been reported by Sibyala (2013) and this has been attributed to inherent diversification in cultivars (Tewodros *et al.*, 2013).

### Effect of Cultivar, Poultry Manure and C x PM Interaction on Corm quality of Taro crop

Our result on corm quality corroborates with the findings of Melese (2017) who reported variation in nutrient composition of cocoyam varieties. He found that Boloso had 10.49 - 12.13% crude protein, 2.11 - 2.80 % crude fiber, 72.53 - 75.49 % carbohydrate and 3.29 - 3.88% ash. He concluded that peeling and pre-gelatinization method may have influenced the changes in the nutrient composition (Ahmed *et al.*, 2010). Other authors Monte *et al.*, 2005; Ogunlakin, *et al.*, 2012, Ologhobo and Adejumo, 2011 and Jirarart *et al.* (2006) also revealed inconsistent changes in the chemical composition of cocoyam cormels in Thailand. The variation in fat content of varieties in this study may result from the varietal differences and processing methods. Similarly, Mbofung *et al.*, 2006 and Ndabikunze *et al.*, 2011 reported that varietal inheritance and pre-gelatinization methods may result to drop in fat content of taro. Bradbury and Holloway, 2002 and Shanthakumari *et al.*, 2008 did not dispute this assertion.

Variation observed with cultivars in response to poultry manure fertilization in terms of moisture content and carbohydrate content of corms may be indirectly influence by the shape and size of corms and cormels. Ezeocha *et al.* (2014) reported that increased levels of poultry manure result in an increase in dry matter, starch, fibre and protein contents and a decrease in fat content of D. bulbifera. He obtained an optimum mineral content with 2 t/ha level of poultry manure application. Starch, dry matter, fibre and protein were highest at 4 t/ha level of application. Significant interaction of cultivar and poultry manures on corm quality observed in this study aligned with with the works of El-Sirafy *et al.* (2008). Huang *et al.*, (2007) reported that cocoyam varieties cultivated on hills retains higher moisture and seldom contains higher mineral level than paddy cocoyam cultivars. Response of Akirimgbawa to PM fertilization in our study also conforms with the report of McPharlin & Lancaster (2005) who found that dry matter content decreases with increasing protein, specific gravity, nitrogen, phosphorus, potassium content in potato tubers as a result of interactions of farm yard manure and soil potassium. Interaction of farm yard manure and cultivar has significantly increased starch content amongst varieties planted two months late at Umbumbulu (Mare 2009) Significant interaction but non-response of NxS 003 to 6 t/ha PM fertilization corroborates with the work Melese, (2017) who insinuated that local cocoyam cultivars are better source of ash. This finding was consistent with the work of Adane *et al.* (2013) who conducted a research on the mineral contents of taro and yam corm. Similar findings by Jirarart *et al.* (2006) also revealed inconsistent changes in the chemical composition of taro cornels in Thailand. This also justifies the non-response of NxS 003 to 6 tha$^{-1}$ poultry manure fertilization. Significant interaction of cultivar x poultry manure fertilization on fat and crude fiber has been reported by Ivonyi *et al.*, (1997) who reported that additional nutrients are applied to the soil to produce optimum yields and quality of crops.

## CONCLUSION

From the analyzed results, we have deduced and concluded that; Taro varied in forms, yield and yield characters. Poultry manure application significantly ($P<0.05$) yield, yield attributing characters and quality (Crude protein, Fat content, Ash, Crude fiber, and Carbohydrate content) of cocoyam crop. A significant PM x C interaction obtained during the period of the trial is an indication that, after all, cultivars do not behave alike under poultry manure fertilization. The best cultivar with respect to corm weight/ha (i.e. total yield/ha) is Local (7.0 $tha^{-1}$) but however did not technically differ with Akirimgbawa (6.96 $tha^{-1}$), and NCe 003 (6.53 $tha^{-1}$). Based on the Proximate Analysis for Nutrient content conducted for the different taro cultivars, NCe 003 with the high crude protein content of 13.41%, Crude fibre (0.69%) and Ash (0.97%) appeared to be of higher value nutritionally than others as application of 6 $tha^{-1}$ of poultry manure has contributed 48.8% increase in crude protein, 34.1% increase in total corm yield, 20.9% increase in total crude fibre, 10.1% increase in total number of corns/plant and 2.4% decrease in total carbohydrates. Given the relatively low but strong coefficient of variability observed in all but one (corm diameter) of the measurements/analysis, is an indication that the outcomes of this study can be used to make some empirical decisions/recommendation for Agricultural development in Anyigba environment and Nigeria as whole.

## RECOMMENDATIONS

Given the response of this crop to applied poultry manure, further study involving graded level of the organic fertilizer (Poultry manure) with few cultivars (NCe 003; NCe 002 and Local) should be experimented for identification of optimum levels of the manure for maximum yield. Poor quality food (especially those deficient in protein) is a major cause of malnutrition related diseases in the rural areas and by extension, Nigeria as a whole, improved cultivar especially NCe 003 and application of poultry manure that has shown high potential for improving crude protein yield in cocoyam, should be encouraged. This could be one simple means by which malnutrition problems may be reduced in rural areas of Nigeria, and in areas where cocoyam is consumed in particular. The euphoria of absolute crop yield should be jettisoned, and emphasis should be to marry the two characters Quality and Quantity without one, taking absolute preference over the other.

## REFERENCES


Adane, T., Shimelis, A., Negussie, R., Tilahun, B., Gulilat, D. (2013). Effect of processing method on the proximate composition, mineral content and ant-nutritional factors of taro (Colocasia esculenta, L.) grown in Ethiopia. *Africa Journal of Food, Agriculture, Nutrition and Development, 34,* 1411–1488.

Adekiya, A. O & Agbede, T. M. (2016). The Influence of Three Years of Tillage and Poultry Manure Application on Soil and Leaf Nutrient Status, Growth and Yield of Cocoyam. *Journal of Advanced Agricultural Technologies 3*(2), 104 – 109.

Ahmed, M. A. & Badr, E. A. (2009). Effect of Bio- and mineral Phosphorus fertilizer on the growth, productivity and nutritional value of some chickpea cultivars [Cicer arietinum L.] in newly cultivated land. *Australian Journal of Basic and Applied Sciences, 3*(4), 4656 – 4664.

Ahmed, M., M. S. Akter, & J. B. Eun. (2010). Peeling, drying temperatures, and sulphite-treatment affect physicochemical properties and nutritional quality of sweet potato flour, Food Chemistry, 121(1), 112–118.

Amhakhian, S. O, Isitekhate, H. H. & Ezeaku, P. I. (2012). Influence of Land Uses on Structural Stability of Some Guinea Savanna Soils in Anyigba, Kogi State Proceedings. *Soil Science Society of Nigeria. 30,* 308 – 314.

Amsalu, N. 2003. Characterization and divergence analysis in cassava (Manihot esculenta Cranz) Genotypes at Jimma. MSc thesis, Alemaya University, Ethiopia.

Angami T, Jha A.K, Juri B. B, Deka C, Verma V. K & Amit N. (2015). Evaluation of taro (Colocasia esculentaL.) cultivars for growth, yield and quality attributes. *J. Hortl. Sci. 10*(2), 183-189.

Ayeni, L. S. (2011). Integrated application of cocoa pod ash and NPK fertilizer on soil chemical properties and yield of tomato. *American-Eurasian Journal of Sustainable Agriculture, 2*(3), 333 – 337.

Bradbury, J. H. & W. D. Holloway. (2002). Chemistry of Tropical Root Crops: Significance for Nutrition and Agriculture in the Pacific. Australian Centre for International Agricultural Research, Canberra.

Das, L. K., Dwivedi, A. K. & Singh, S. K. (2018). Interactive Effects of Cultivars and NPK Fertilizer on the Growth and Yield of Taro [Colocasia esculenta (L.) Schott] under Agro-Climatic Condition of Zone IV Prevailing in Palamu District of Jharkhand, India. *Int. J. Curr. Microbiol. App. Sci. 7,* 600-606.

Del Rosario, A. G., Sengebau, F. & Taro, T. (2014). Salt tolerant taro varieties in the Republic of Palau. Acta Horticulturae. In Press

Dwivedi, A. K. & Sen, H. (2001). Comparative studies of some local taro (Colocasia esculenta var. antiquorum) cultivars of West Bengal. *The Hort. J., 14*(2), 149-153.

El-Sirafy, Z. M., Abbady, K. A., El-Ghamry, A. M & El-Dissoky, R. A. (2008). Potato yield quality, quantity and profitability as affected by soil and foliar potassium application. *Research Journal of Agriculture and Biological Sciences 4*(6), 912-922.

Ezeocha, V. C., Nwogha, J. S., Ohuoba, A. N. & Chukwu, L. I. (2014). Evaluation of Poultry Manure Application Rates on the Nutrient Composition of Dioscorea bulbifera. *Nigerian Food Journal, 32*(2), 92 – 96.

FAO. (1999). Taro Cultivation in Asia and the Pacific, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

FAO. (2001). FAO Statistical (FAOSTAT), https://apps1.fao.org

FAO. (2008). Importance of Taro. Retrieved from; http: www.fao.org/docrep/005/AC450e

Hartemink, A. E., Poloma, S., Maino, M., Powell, K. S., Egenae, J. & O'Sullivan, J. N. (2000). Yield decline of sweet potato in the humid lowlands of Papua New Guinea. Agric. Ecosyst. *Environ. 79,* 259–269.

Hota, R., Jena, A. K. & Narayana, K. L. (2014). Effects of inorganic and organic amendments on yield of cocoyam (Colocasia esculenta) and on soil properties. *World Journal Agricultural Research. 2*(2), 70-81.

Huang, C. C., Chen, W. C., & Wang, C. C. (2007). Comparison of Taiwan paddy-and upland-cultivated taro (Colocasia esculenta L.) cultivars for nutritive values. *Food Chemistry, 102*(1), 250-256.

IPGRI/IITA. (1999). Descriptors for taro (Collocasia spp.). International Institute for Tropical Agriculture, Ibadan, Nigeria. International Plant Genetic Resources Institute, Rome, Italy.

Ivonyi, I., Izsoki, Z., & Van der Werf, H. M. (1997). Influence of nitrogen supply and p and k levels of the soil on dry matter and nutrient accumulation of. *Journal of the International Hemp Association, 4*(2), 84-89.

Lebot, V. (2009). Bio molecular evidence for plant domestication in Sahul. *II Genetic Resources and Crop Evolution. 46,* 619–628.

Lebot V. (1999). Biomolecular evidence for plant domestication in Sahul. *Genetic Resources and Crop Evolution. 46,* 619–628.

Liu, Q., Donner, E., Yin, Y., Huang, R. L., & Fan, M. Z. (2006). The physicochemical properties and in vitro digestibility of selected cereals, tubers and legumes grown in China. *Food Chemistry, 99*(3), 470-477.

Mare, R. & Modi, A. T. (2009). Influence of planting date and organic fertilization on growth and yield of Taro landraces. *African Crop Sci. Conf. Proc. 9,* 179 – 189.

Mare, R. (2009). Taro (Colocasia esculenta l. Schott) yield and quality response to planting date and organic fertilization. An MSc. Thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy (Crop Science) (University of KwaZulu-Natal) Pietermaritzburg. 1 – 205.

Mbofung, C. M. F., Njintang, A. Y. N., Bouba, A. A., & Balaam, F. (2006). Physicochemical and functional properties of six varieties of taro (Colocasia esculenta L. Schott) flour.

McPharlin, I. R. & Lancaster, R. A. (2005). Applied nitrogen effects on yield and crisping quality of 'Atlantic', 'Bliss 'and 'Dawmor' potatoes. *Acta Horticulturae 684,* 119-126.

Melese, T. Y. (2017). Nutrient Constituents of Taro (Colocasia esculenta) Corm and Leaf for Infant Food Development and Chicken Feed Formulation. A Ph.D. Dissertation in Food Science and Nutrition Addis Ababa University. 8 – 220.

Monte N., D. C., Rocha, T. L., Guimaraes, R. C., Santana, E. F., Loureiro, M. E., Valle, M. & de Sa, M. F. G. (2005). Characterization and spatial localization of the major globulin families of taro (Colocasia esculenta L Schott) tuber. *International Journal of Plant Sciences, 112,* 149 – 159.

Ndabikunze, B. K., H. A. L. Talwana, R. J. Mongi, A. Issa-Zacharia, A.K. Serem, V. Palapala, & J.O.M. Nandi. (2011). Proximate and mineral composition of cocoyam (Colocasia esculenta L. and Xanthosoma sagittifolium L.) grown along the Lake Victoria Basin in Tanzania and Uganda. *African Journal of Food Science, 5*(4), 248–254.

Njintang, N. Y., Mbofung, C. M. F., & Kesteloot, R. (2007). Multivariate analysis of the effect of drying method and particle size of flour on the instrumental texture characteristics of paste made from two varieties of taro (Colocasia esculenta L. Schott) flour. *Journal of food engineering, 81*(1), 250-256.

Ogbonna, P. E. & Nweze, N. J. (2012). Evaluation of growth and yield responses of cocoyam (Colocasia esculenta) cultivars to rates of 15:15:15 NPK fertilizer. *African Journal of Agricultural Research, 7*(49), 6553 – 6561.

Ogunlakin, G. O. Mooke, G. O. Babarinde, & DG. Olatunbosun, (2012). Effect of drying methods on proximate composition and physicochemical properties of cocoyam flour. *Am. J. Food Technol. 7,* 245-250.

Ojeniyi, S. O., Amusan, O. A., Adekiya, A. O. (2013). Effect of poultry manure on soil physical properties, nutrient uptake and yield of cocoyam (Xanthosoma sagittifolium) in South west Nigeria. *American-Eurasian J. Agric. Environ. Sci. 13*(1), 121-125.

Ojeniyi, S. O, Amusan, O. A., Adekiya, A. O. (2013). Effect of poultry manure on soil physicalproperties, nutrient uptake and yield of cocoyam (Xanthosomas agittifolium) in South west Nigeria. *American-Eurasian J.Agric. Environ. Sci.; 13*(1), 121-125.

Ologhobo, A. D., and I. O. Adejumo, (2011). Effects of differently processed taro (Colocasia esculenta on growth performance and carcass characteristics of broiler finishers. *International Journal of Agri Science, 1*(4), 444–448.

Onwudike, S. U, Asawalam, D. O, Ano, A. O. (2015). Comparative evaluation of burnt andunburnt agro-wastes on soil properties and growth performance of cocoyam in a humid environment. *Asian J. Agric. Res.; 9,* 276-292.

Orji K. O., Mbah, E. U., Muoneke C. O. and Okpara, D. A. (2019). Effect of integrated plant nutrient management on the growth and yield of taro [Colocasia esculenta (L.) Schott] in Umudike, Nigeria. *Nigerian Agricultural Journal, 50*(2), 112 – 122. Available online at: http://www.ajol.info/index.php/naj

Orji, K. O., Ogbonna, P. E. & Chukwa, L. A. (2016).

Studies on the interactive effects of cultivars, NPK fertilizer and seasons on the growth and yield of taro [Colocasia esculenta (L.) Schott] on plains of Nsukka, Nigeria. *J. Global Biosciences, 5*(3), 3699-3710.

Reddy, T. Y. & Reddi, G. H. (1995). *Principles of Agronomy.* 2nd Edition, Kalyani Publishers. New Delhi, 110002. p. 223.

Roy, R. N., Finck, A. Blair, G. J. & Tandon, H. L. S. (2006). Plant nutrition for food security. A guide for integrated nutrient management. *FAO Fertilizer and Plant Nutrition Bulletin 1,* 25 –43.

Shanthakumari, S., Mohan, V. & J. De Britto. (2008). Nutritional and anti-nutritional evaluation of wild yam (Dioscorea spp.). *Tropical and Subtropical Agroecosystems 8,* 313-319.

Shiyam J. O, Obiefuna J. C, Ofoh, M. C., Oko B. F. D., Uko, A. E. (2007). Growth and corm yield response of upland cocoyam (Xanthosoma sagittifolium L.) to sawdust mulch and NPK 20:10:10 fertilizer rates in the humid forest zone of Nigeria. *Cont. J. Agron. 1,* 5-10.

Sibyala, S. (2013). Studies on performance of certain taro [Colocasia esculenta (L.) Schott] cultivars for growth, yield and quality parameters. M. Sc. (Hort.) Veg. Sci. thesis submitted to Dr. Y. S. R. Horticultural University, Venkataraman nagudem, India.

Sridhar, M. K. C. & Adeoye, G. O. (2003). Organo mineral fertilizers from urban wastes: Developments in Nigeria, *The Nigerian Field. 68,* 91-111.

Tattiyakul, J., Asavasaksakul, S., & Pradipasena, P. (2006). Chemical and physical properties of flour extracted from taro Colocasia esculenta (L.) Schott grown in different regions of Thailand. *Science Asia, 32*(3), 279-284..

Tattiyakul J, Asavasaksakul S, P. Pradipasena. (2006). Chemical and physical properties of flour extracted from taro Colocasia esculenta (L.) Schott grown in different regions in Thailand. *Sci Asia.; 32,* 279–284. https://doi.org/10.2306/scienceasia1513-1874.32.279.

Tewodros M. B. (2013). Morpho-Agronomical Characterization of Taro (Colocasia esculenta) Accessions in Ethiopia, Plant. 1(1), 1-9. https://doi.org/10.11648/j.plant.20130101.11.

Uwah, D. F., Udoh, A. U., & Iwo, G. A. (2011). Effect of organic and mineral fertilizers on growth and yield of cocoyam (Colocasia esculenta (L.) Schott). *Int. J. Agric. Sci. 3*(1), 1-6.

Verma V. K., Jha, A. K., Wanshnong, K. K., Swer, T. L. (2012). Effect of integrated nutrient management modules on growth, Yield and quality attributes in taro (Colocasia esculenta). Schott). *Indian Journal of Hill Farming 25*(1), 21-25. Available online at www.kiran.nic.in