NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 53 Number 3, December 2022 Pg. 52-59
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Effect of Integrated Plant Nutrient Management on Some Mineral Composition of Taro (*Colocasia esculenta*) and tannia (*Xanthosoma sagittifolium*) in Umudike

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Abstract
A three year experiment was carried out at the Forestry Research Institute of Nigeria, Eastern Research Station, Umuahia in Abia State with the aim of comparing the percent concentrations of some mineral contents of plant fractions of tannia and taro species as well as their raw and cooked forms as influenced by integrated plant nutrient management. At the end of third year cropping season, one cocoyam plant was uprooted from fertilized (plot treated with 600 kg NPK + 10 t PM/ha) and unfertilized plots (control plot) and partitioned into leaf, stem and corm fractions. They were washed and divided into two parts. One part was cooked and the other was not. They were sliced into pieces and dried under direct sunlight for one week. The dried samples were ground in a mill, until a consistent powder was obtained and replicated thrice. The ground samples were analyzed for chemical composition using 3 x 2 factorial arrangements fitted in randomized complete block design in which plant part samples formed Factor A with 3 levels (leaf, petiole and corm), while integrated plant nutrition (IPN) formed Factor B comprising two levels (600 kg NPK fertilizer + 10 t poultry manure and 0 tha^{-1}). F-LSD was applied to determine significant difference between two sample means at 0.05 % probability level after mean separation. The results showed that the integrated plant nutrient management was statistically the same with N contents of both raw/cooked species of cocoyam, but significantly ($p \leq 0.05$) increased the percent concentration of phosphorus in both raw and cooked tannia, but non-significant for that of taro. There were also significant increments in potassium and calcium contents in cooked and raw taro, respectively. Similar results were also observed in calcium content in both cooked tannia and taro, whereas percentage concentration of magnesium of raw tannia/taro was also improved by application of integrated nutrient management. It was also observed that taro contained higher percent concentrations of N, P, K and Mg than tannia in both raw and cooked states. Again, the highest percent concentrations of the minerals under study were found in the leaves of both cocoyam species relative to other plant fractions.

Keywords: Tannia, taro, cocoyam, integrated plant nutrient management

Introduction

Cocoyam species (taro and tannia) are herbaceous, perennial plants treated as annual crop plants. They belong to the family of *Araceae* and are grown primarily for their edible corms and cormels. Cocoyam species that are cultivated as food crops belong to either the genus *Colocasia* or the genus *Xanthosoma* and generally consist of a large spherical swollen underground storage stem (corm) from which a few large leaves emerge (Anon, 2018). *Colocasia* species may also be referred to as old cocoyam, arrow root, eddoe, macabo or dasheem and originates from South East or Central Asia, while *Xanthosoma* species may be called new cocoyam, yautia or Chinese taro and originated from Central and South America (FAO, 2018). Taro grows best in fertile well-drained sandy loam soil with a pH between 4.2 –7.5. It can be grown in a wide variety of conditions including paddies in wetland areas using a system similar to that of rice (Wilson, 1987). *Xanthosoma* species require temperature above 21% to grow properly, unlike *Colocasia* species, they will not tolerate water logging and grow best in deep, well-drained loamy soils with a pH between 5.5 and 6.5 in partial shade (CABI, 2008). Cocoyam species will thrive when planted in full sunlight or partial shade. They can survive for short periods at temperature of 10^0C but will be damaged or killed by lower temperatures (CABI, 2008).

Nutritionally, cocoyam is superior to cassava and yam because of its high protein content, minerals and vitamins in addition to more digestible starch

(Onyenweaku and Okoye, 2007). The main nutrient provided by cocoyam as with many other root and tuber crops is the dietary energy supplied by carbohydrates (O'Hair, 1990). The protein fraction content of corms and cormels is low (1-3%) and like other tuber crops protein, sulphur containing amino acids are limiting (Mwenye *et al*., 2011). The mature corms are mostly boiled in Zimbabwe, while in West African countries they can be roasted, baked and fried. They can be eaten alone or with stew and they are boiled and mashed like Irish potatoes and used as a weaning diet for babies. In West Africa, the mature corms are also processed into flour which is used for preparing *fuf*u eaten with stew or soup. The leaves are also nutritionally rich, containing about 23% protein on a dry-weight basis (Onwueme, 1994). Cocoyam can be used as an industrial raw material in the manufacture of alcohol and drugs (Okwuowulu *et al*., 2000).

Roy *et al*. (1992) defined integrated nutrient management as the maintenance of the soil fertility for sustaining increased crop productivity through optimizing all possible sources of organic and inorganic of plant nutrients required for crop growth and quality in an integrated manner, appropriate to each cropping system and farming situation in its ecological, social and economic possibilities. The application of integrated plant nutrient management in cocoyam production is not yet common among the poor resource farmers. Integrated plant nutrient management is the best approach for application of resources and to produce crops with less expenditure. Poor resource farmers mainly depend more on farmyard manure and household wastes found at their sites. Matikiti *et al.* (2017) reported highly significant interaction between varieties of *Colocasia esculenta* and fertilization with respect to all the nutritional composition measured. Since the chemical composition of crop plants depend on genotype and environment, the objective of this research was to determine the effect of integrated plant nutrient management on mineral composition of taro (NCe 003 cultivar) and tannia (NXs 001 cultivar) in Umudike, Southeastern Nigeria.

Materials and Methods

A field experiment was carried out in 2015, 2016 and 2017 cropping seasons at the Forestry Research Institute of Nigeria, Eastern Research Station, Okwuta in Umuahia South Local Government Area of Abia State to determine the effect of integrated nutrient management on some mineral composition of raw and cooked tannia and taro cocoyam species in Umudike, Southeastern Nigeria. The site lies on a longitude 07° 31´ E and latitude 05° 31´ N with altitude 149 m above sea level (GPS). At the end of 2017 harvest, one cocoyam plant was uprooted from fertilized (plot treated with 600kgNPK + 10tPM/ha) and unfertilized plots (control plot) and partitioned into leaf, stem and corm fractions. They were washed and divided into two parts. One part was cooked and the other was not. They were sliced into pieces and dried under direct sunlight for one week. The dried samples were ground in a mill, until a consistent powder was obtained and replicated thrice. The ground samples were analyzed for chemical composition using 3 x 2 factorial arrangements fitted in randomized complete block design in which plant part samples formed Factor A with 3 levels (leaf, petiole and corm) while integrated plant nutrition (IPN) formed Factor B comprising two levels (600kg NPK fertilizer + 10t poultry manure and 0 tha^{-1}). F-LSD was applied to determine significant difference between two sample means at 0.05 % probability level after mean separation.

The minerals (Ca, Mg, N and P) were determined by the use of Atomic Absorption Spectrophotometer (AAS) while K was determined by using flame photometer. 2.5ml of each sample solution were measured out of 7.5ml and poured into a 100ml volumetric flask and diluted into the 100ml mark with water. Adjust the meter to zero, maximum readings are obtained with all the working standard solutions containing 0 and 50µg/ml of the mineral as described in AAS. Nebulize each diluted solution and note the galvanometer readings (Umeh and Ogbuagu, 2010).

Results and Discussion

The concentration of N in the cocoyam species was not significantly influenced by fertilizer, probably due to the high nitrogen content of the soils (Tables 1 and 2). In soils of low fertility, nitrogen concentrations in plants have been shown to increase with increase in fertilization, especially with nitrogen nutrition (Rhoads and Stanley, 1984; Okpara, 1985). Also, the fact that the availability of nitrogen can be greatly reduced due to leaching under conditions of high rainfall as was the case in this study, or under irrigation (Woodmansee, 1978), are other possible explanations the lack of effect on percent N following fertilizer application. However, concentration of N in the cocoyam species was consistently and significantly higher in the leaf than in the petiole and corm. Interaction effects were significant. Highest N was obtained in the leaf regardless of fertilizer sources or rates (Table 2). Percent N in cooked tannia and taro cocoyam plant fractions was not significantly affected ($p \geq 0.05$) by fertilizer (Table 3). This could be attributed to N stability in these crops as there was no significant variation in the values of both the raw and cooked plant fractions. This observation was similar to the result of Ricardo *et al.* (1987) who reported that application of fertilizer did not significantly affect protein content either in raw or cooked grain of *Amaranthus cruentus* and *Amaranthus candatus.*

Percent P in tannia was significantly ($p \leq 0.05$) higher with application of NPK fertilizer and manure than with the no fertilizer control (Table 4). However, in taro, combining NPK fertilizer and poultry manure did not influence the concentration of P in the plant, although values tended to be slightly higher in the control. Gregory (1979) and Okpara (1985) had reported that the concentration of phosphorus in millet plant decreased rapidly, because carbon assimilation increased more rapidly than the uptake of nutrients, thus resulting in a dilution effect. In both cocoyam species, the concentration of P was consistently and significantly higher in the petiole than in the leaf and corm fractions. Similarly, interaction effects showed that the highest concentration of P was obtained from the petiole regardless of fertilization regime. Percent P in cooked tannia was significantly higher ($p \leq 0.05$) in plants that received NPK fertilizer and poultry manure than in the control (Table 5). There were no differences in % P in taro among the fertilizer treatments. Wierzbieke and Trawezynski (2011) had reported that phosphorus content in tubers depends on cultivar and weather conditions. In both cocoyam species, % P in the petiole (1.01) was significantly higher than the values in other plant parts. In taro, interactions were significant, with the highest % P obtained from the petiole (1.00) regardless of fertilizer combination or rate.

The concentration of K in both tannia and taro were not significantly affected by fertilizer treatment, probably because of the high level of K in the soil (Tables 1 and 6). This result is contrary to the observation of Widirowska *et al.* (2014) who indicated that farmyard manure application increased the content of potassium in potato tuber. In both cocoyam species, the concentration of K in the leaf was higher than that of the petiole in tannia and corm in taro. Interaction effects showed that concentration of K in tannia was significantly higher in the leaf regardless of the fertilizer combination than in the petiole with a mixture of fertilizer and manure. In taro, concentration of K was higher in the leaf than corm, irrespective of fertilizer combination. Percent K in cooked plant fractions of the cocoyam species are shown in (Table 7). A combination of fertilizer and manure gave similar % K concentrations as the control in tannia, but in taro, a mixture of fertilizer and manure produced significantly high % K than the no fertilizer control, indicating variability among the species in potassium uptake or nutrition. In both cocoyam species, % K was consistently and significantly higher in the leaf than in the petiole and corm. The corm and petiole fractions have similar results in % K. There was also the possibility of antagonism following the application of K in fertilizer and manure, since K depresses Mg uptake (Yan and Hou, 2018).

Percent Ca in tannia was not affected ($p \geq 0.05$) by fertilizer combination (integrated plant nutrition), but in taro, a combination of NPK fertilizer and manure gave significantly ($p \leq 0.05$) higher % Ca than the control (Table 8). This result indicated differences in the uptake of Ca by the species. Percent Ca in the leaf of tannia was significantly higher than that of the petiole, while in taro, % Ca was higher in the leaf than in the corm. This agrees with the report of Ezeocha *et al.* (2014) who obtained the highest content of Ca in aerial yam, with application of 2 t/ha poultry manure. In both cooked cocoyam species (taro and tannia), percent calcium was significantly higher (3.52) ($p \leq 0.05$) with application of fertilizer and manure than with the control (2.96) (Table 9). Across the plant fractions, percent calcium following fertilizer and manure application in tannia and taro species were higher than those of the no fertilizer control by 15.1% and 3.5%, respectively. This result agrees with findings of Reddy and Mark (2016) who reported that the nutritional quality of minerals in food depends on their quality as well as their bioavailability, and that the concentrations of elements such as Fe, Zn and Ca are altered by various processing methods including milling, fermentation, sprouting and the thermal processing. In tannia species, percent calcium was higher in the leaf and petiole than in the corm, while in taro, percent calcium in the leaf was higher than in the corm but not the petiole.

Mg concentration was significantly higher in plants that received a combination of NPK fertilizer and poultry manure than in unfertilized plants in both cocoyam species (Tables 1 and 10). Okpara (1985) obtained similar results, in which the concentration of Mg in maize and millet increased with increased nitrogen fertilization. Ezeocha *et al.* (2014) however, reported that highest content of Mg in aerial yam in unfertilized plants. In the study, the higher concentrations of Mg obtained from integrated nutrient management indicates the higher level of the element in the soil and greater availability to plants. Percentage concentration of Mg varied among the cocoyam species. In tannia, Mg concentration was significantly higher in the petiole than in the leaf or corm. Conversely, in taro, % Mg was higher in the leaf than in the petiole and corm. Interaction effects were significant, such that the highest concentration of Mg was from integrated nutrient management and petiole in tannia or leaf in taro. In both cocoyam species, combined application of NPK fertilizer and manure did not affect ($p \geq 0.05$) percent magnesium in cooked plant fractions (Table 11). This observation agrees with the result of Ezeocha *et al.* (2014) who reported non-significant effect of poultry manure rates on % Mg of aerial yam. However, percent magnesium was significantly higher ($p \leq 0.05$) in the leaf and petiole of tannia than in the corm, while in taro, % Mg in the leaf was higher than that of petiole and corm. Interactions were significant. In tannia, % Mg was higher in the petiole than corm regardless of fertilizer combination, while in taro, the highest % Mg was obtained in the leaf and a combination of NPK and manure.

Conclusion

These results showed that a combination of NPK fertilizer and poultry manure significantly increased percent concentration of mineral elements (N, P, K, Ca and Mg) under study in relation to the control. Integrated plant nutrient management did not significantly influence percent concentration of N in both raw and cooked tannia and taro. However, fertilizer treatment x plant fractions interaction effect was significantly different on % N in both species of cocoyam. Percent P concentration in both raw and cooked tannia differed significantly by the application of combined fertilizer treatment while it was statistically the same with those of taro. Also, percent K concentration in the cooked taro was significantly different by the combined treatment application whereas it was non-significantly different on % K concentration in the raw taro as well as both the raw and cooked tannia. It was also observed that integrated plant nutrient management was non-significantly different on % Ca concentration in raw tannia while % Ca concentration in cooked taro and raw or cooked tannia was significantly increased by the combined treatment application. Percent Mg concentration in both raw tannia and taro was significantly increased by combined treatment application whereas it did not differ significantly on % Mg concentration in cooked tannia and taro. It was also observed that integrated nutrient management showed a balanced influence on the minerals of both raw and cooked plant fractions of both species of cocoyam under study. However, it was also observed that taro species contained higher percent concentrations of N, P, K, and Mg than tannia. Again, the highest percent concentration of the mineral elements was found in the leaf fraction of both cocoyam species compared to other plant fractions. Therefore, people are encouraged to eat every part of cocoyam as it contains the vital nutrient elements required by our body for proper anatomical and physiological functions.

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Table 1: Physico-chemical properties of the experimental site before planting

Parameters	2015	2016	2017
Sand (%)	67.80	64.80	60.20
Silt (%)	11.40	11.80	12.30
Clay (%)	20.80	23.40	24.60
Texture	SL	SL	SL
pH (H_2O)	5.90	5.80	5.60
Organic carbon (g/kg)	10.20	15.60	16.00
Organic matter (g/kg)	17.60	26.80	26.00
Available phosphorus (mg/kg)	39.60	68.20	60.80
Total nitrogen (g/kg)	0.90	2.50	2.00
Exchangeable calcium (cmolkg)	4.00	4.40	4.20
Exchangeable magnesium (cmol/kg)	1.60	1.20	1.25
Exchangeable potassium (cmol/kg)	0.12	0.19	0.20
Exchangeable sodium (cmol/kg)	0.35	0.21	0.18
Exchangeable acidity (cmol/kg)	1.12	1.20	1.18
Exchangeable CEC (cmol/kg	7.19	7.20	7.22
Base saturation (%)	84.42	83.33	80.15

Source: NRCRI Soil Laboratory, SL = Sandy loam

Table 2: Effect of integrated plant nutrition on N concentration in raw cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t pm/ha	3.51	1.05	1.83	**2.13**
Control	3.30	0.98	1.81	**2.03**
Mean	**3.41**	**1.02**	**1.82**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.28**				
F-LSD (0.05) for F x P interaction means = **0.40**				
Taro				
600 kg NPK fertilizer + 10 t pm/ha	3.75	1.37	1.95	**2.36**
Control	3.72	1.30	1.90	**2.31**
Mean	**3.74**	**1.34**	**1.93**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.43**				
F-LSD (0.05) for F x P interaction means = **0.61**				

NS = Not significant at 5percent probability level

Table 3: Effect of integrated plant nutrition on N concentration in cooked cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	3.01	1.26	1.69	**1.99**
Control	3.09	1.12	1.89	**2.03**
Mean	**3.05**	**1.19**	**1.79**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.28**				
F-LSD (0.05) for F x P interaction means = **0.40**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	3.39	1.59	2.02	**2.33**
Control	3.60	1.44	2.16	**2.40**
Mean	**3.50**	**1.52**	**2.09**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.43**				
F-LSD (0.05) for F x P interaction means = **NS**				

NS = Not significant at 5percent probability level

Table 4: Effect of integrated plant nutrition on P concentration in raw cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	0.65	0.75	0.52	**0.64**
Control	0.63	0.70	0.48	**0.60**
Mean	**0.64**	**0.73**	**0.50**	
F-LSD (0.05) for fertilizer (F) means = **0.04**				
F-LSD (0.05) for plant fraction (P) means = **0.07**				
F-LSD (0.05) for F x P interaction means = **0.10**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	0.75	0.98	0.51	**0.75**
Control	0.91	1.03	0.44	**0.79**
Mean	**0.83**	**1.01**	**0.48**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.13**				
F-LSD (0.05) for F x P interaction means = **0.19**				

NS = Not significant at 5percent probability level

Table 5: Effect of integrated plant nutrition on P concentration in cooked cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	0.46	0.75	0.40	**0.54**
Control	0.48	0.60	0.38	**0.49**
Mean	**0.47**	**0.68**	**0.39**	
F-LSD (0.05) for fertilizer (F) means = **0.04**				
F-LSD (0.05) for plant fractionr (P) means = **0.07**				
F-LSD (0.05) for F x P interaction means = **NS**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	0.68	0.91	0.47	**0.69**
Control	0.68	1.08	0.41	**0.72**
Mean	**0.68**	**1.00**	**0.44**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.13**				
F-LSD (0.05) for F x P interaction means = **0.19**				

NS = Not significant at 5percent probability level

Table 6: Effect of integrated plant nutrition on K concentration in raw cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	0.79	0.66	0.75	**0.73**
Control	0.79	0.70	0.78	**0.76**
Mean	**0.79**	**0.68**	**0.77**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.09**				
F-LSD (0.05) for F x P interaction means = **0.13**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	0.77	0.61	0.50	**0.63**
Control	0.70	0.65	0.51	**0.62**
Mean	**0.74**	**0.63**	**0.51**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.12**				
F-LSD (0.05) for F x P interaction means = **0.17**				

NS = Not significant at 5percent probability level

Table 7: Effect of integrated plant nutrition on K concentration in cooked cocoyam plant fractions

Treatment	Leaf	Petiole	Corm	Mean
	Plant Fractions			
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	0.80	0.60	0.65	**0.68**
Control	0.80	0.65	0.60	**0.68**
Mean	**0.80**	**0.63**	**0.63**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fractionr (P) means = **0.09**				
F-LSD (0.05) for F x P interaction means = **NS**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	1.03	0.71	0.75	**0.83**
Control	0.77	0.72	0.67	**0.72**
Mean	**0.90**	**0.72**	**0.71**	
F-LSD (0.05) for fertilizer (F) means = **0.07**				
F-LSD (0.05) for plant fraction (P) means = **0.12**				
F-LSD (0.05) for F x P interaction means = **0.17**				

NS = Not significant at 5percent probability level

Table 8: Effect of integrated plant nutrition on Ca concentration in raw cocoyam plant fractions

Treatment	Leaf	Petiole	Corm	Mean
	Plant Fractions			
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	3.22	3.21	3.62	**3.35**
Control	4.04	2.82	3.12	**3.33**
Mean	**3.63**	**3.02**	**3.37**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.42**				
F-LSD (0.05) for F x P interaction means = **0.59**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	3.81	3.01	3.93	**3.58**
Control	3.10	3.82	2.07	**3.00**
Mean	**3.46**	**3.42**	**3.00**	
F-LSD (0.05) for fertilizer (F) means = **0.32**				
F-LSD (0.05) for plant fraction (P) means = **0.40**				
F-LSD (0.05) for F x P interaction means = **0.77**				

NS = Not significant at 5percent probability level

Table 9: Effect of integrated plant nutrition on Ca concentration in cooked cocoyam plant fractions

Treatment	Leaf	Petiole	Corm	Mean
	Plant Fractions			
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	4.12	3.42	3.01	**3.52**
Control	3.02	3.52	2.42	**2.99**
Mean	**3.57**	**3.47**	**2.72**	
F-LSD (0.05) for fertilizer (F) means = **0.24**				
F-LSD (0.05) for plant fraction (P) means = **0.42**				
F-LSD (0.05) for F x P interaction means = **0.59**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	3.50	2.84	2.88	**3.07**
Control	3.31	2.89	2.69	**2.96**
Mean	**3.41**	**2.87**	**2.79**	
F-LSD (0.05) for fertilizer (F) means = **0.32**				
F-LSD (0.05) for plant fraction (P) means = **0.55**				
F-LSD (0.05) for F x P interaction means = **0.77**				

NS = Not significant at 5percent probability level

Table 10: Effect of integrated plant nutrition on Mg concentration in raw cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	1.28	1.53	0.91	**1.24**
Control	1.03	1.18	0.73	**0.98**
Mean	**1.16**	**1.36**	**0.82**	
F-LSD (0.05) for fertilizer (F) means = **0.08**				
F-LSD (0.05) for plant fraction (P) means = **0.15**				
F-LSD (0.05) for F x P interaction means = **0.21**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	1.96	1.19	0.69	**1.28**
Control	0.75	0.75	0.63	**0.71**
Mean	**1.36**	**0.97**	**0.66**	
F-LSD (0.05) for fertilizer (F) means = **0.10**				
F-LSD (0.05) for plant fraction (P) means = **0.18**				
F-LSD (0.05) for F x P interaction means = **0.26**				

Table 11: Effect of integrated plant nutrition on Mg concentration in cooked cocoyam plant fractions

	Plant Fractions			
Treatment	**Leaf**	**Petiole**	**Corm**	**Mean**
Tannia				
600 kg NPK fertilizer + 10 t/ha PM	1.20	1.28	1.03	**1.17**
Control	1.22	1.35	0.91	**1.16**
Mean	**1.21**	**1.31**	**0.97**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fractionr (P) means = **0.15**				
F-LSD (0.05) for F x P interaction means = **0.21**				
Taro				
600 kg NPK fertilizer + 10 t/ha PM	1.38	0.63	1.00	**1.00**
Control	1.06	0.95	0.94	**0.98**
Mean	**1.22**	**0.79**	**0.97**	
F-LSD (0.05) for fertilizer (F) means = **NS**				
F-LSD (0.05) for plant fraction (P) means = **0.18**				
F-LSD (0.05) for F x P interaction means = **0.26**				

NS = Not significant at 5percent probability level