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EFFECTS OF NPK FERTILIZER ON NUTRIENT UPTAKE OF *Cucurbita moschata* (Duch. *ex* Lam.) Duch. *ex* Poir.

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ABSTRACT
The effects of NPK (15:15:15) fertilizer on nutrient uptake of Cucurbita moschata (Duch. ex Lam.) Duch. ex Poir. were conducted at the University of Port Harcourt Botanical Garden. Eight treatments viz; 0, 200, 250, 300, 350, 400, 450 and 500 kilogram of NPK per hectare (kg/ha) were used in a randomized complete block design (RCBD) with four replicates. These treatments were applied once to two weeks old seedlings of C. moschata using ring method. The effects of these treatments on leaf N, P, K, Ca, Na and Mg concentrations were studied. Soil mineral levels were also monitored for 0 and 6 weeks. The crude protein and chlorophyll contents were also studied. The study showed that NPK fertilizer increased the nutrient contents (N, P, K, Ca, Na and Mg) of C. moschata. The highest uptake of N, P, K, Ca, Na and Mg concentrations were obtained from fertilizer at 250 kg/ha. Crude protein content was also higher with 250 kg/ha treatment. In all cases the lowest nutrient uptake was recorded in the control (0 kg/ha). However, 350 kg/ha showed high chlorophyll a while the control gave the highest chlorophyll b and total chlorophyll content respectively. At $P<0.05$, there were significant difference among treatments. The NPK (15:15:15) fertilizer increased the soil nutrient. The study recommends an application rate of 250 kg/ha for the cultivation of C. moschata.

Key words: *NPK fertilizer, Nutrient uptake, Cucurbita moschata*

INTRODUCTION
Cucurbita moschata commonly known as musk pumpkin belongs to the family Cucurbitaceae. With regard to the sources of variation of *C. moschata* cultivars developed outside its area of origin, the best example is that of a cultivar, native to Nigeria, which represents the only source of resistance to certain viral diseases (Grubben *et al.,* 2004). The 'musk', *C. moschata,* is cultivated in northern Nigeria for the fruits and in southern Nigeria, in a largely unimproved form (ugboguru), for both the leaves and fruits (Okoli, 1984; Ndukwu and Okoli, 1992). While the leaves are important vegetables, the pulp of the fruit is eaten when cooked (Okoli, 1984). In Africa, cultural practices are still extensive and yield levels are low and with the introduction of improved cultivars, native species are in danger of disappearing.

The use of inorganic fertilizers is one of the ways of increasing nutrient status of both the soil and plants (Dauda *et al.*, 2005). They are intended to supply plant needs directly rather the indirectly through modification of such properties as soil pH and structure. Again, there is usually a dramatic improvement in both quantity and quality of plant growth when appropriate fertilizers are added (Nahed, 2007). Although the problem with the use of inorganic fertilizer on Nigerian soils is that, the fertilizers are not obtained at the right time in addition to the huge cost of procurement (Awodun, 2007), however, inorganic fertilizers are the important sources of artificial nitrogen. Adequate supply of N is associated with high photosynthetic

activity, vigorous vegetative growth and a dark green colour of the leaves (John *et al*., 2004). Thus the processes like protein synthesis, role of nucleic acids and chlorophyll synthesis are related to nitrogen (Pandey and Sinha, 2006). IFDC (2005) reported that improper chemical fertilizer application has ruined tropical soils through its abuse. The study, therefore, seeks to determine some effects of rates of NPK fertilizer application on the nutrient uptake of *C. moschata* and scientifically deduce the potential of as a dietary source and thus promote its awareness.

MATERIALS AND METHODS

The mature fruits of pumpkin, *C. moschata* used for this study were harvested from a subsistent farm in Abiriba, Abia State. The seeds were removed from the fruits, air dried and stored at room temperature. The field experiment was laid out in a Randomized Complete Block Design at the University of Port Harcourt Botanical Garden. Soil samples were obtained from the upper soil surface layer (0 - 15 cm) using a 5 cm diameter soil auger. The soil samples were air dried for analysis to establish the initial soil chemical properties used for the experiment. About 5 gram of the air-dry soil was taken in a glass beaker and 10 ml of distilled water was added. The contents were mixed thoroughly with a glass rod and allowed to stand for 30 minutes. The soil pH was measured using EQUIP-TRONICS Digital pH meter model EQ-610. The soil samples were digested on a labcon digester at 300°C in a mixture of hydrogen peroxide, sulphuric acid, selenium and salicyclic acid (Okalebo *et al*., 2002). The digests were analysed for total N, P, K, Na, Ca, and Mg. The total N content in the digests were determined by Kjeldahl method, 10 ml of the digest solution was taken in the distillation flask, 20 ml of 40 % NaOH was added and the NH_3 evolved was collected in a flask containing 4 % H_3BO_3. Finally, the distillate was titrated against 0.1 N H_2SO_4. Total phosphorous was determined using the ascorbic acid blue colour procedure and the absorbance measured at 880 nm wavelength UV-spectrophotometer. The Ca, K and Mg contents in 1/20 dilution (sample /distilled water) soil digests were measured by reading their absorbance on a UNICAM 969 Atomic Absorption Spectrophotometer at 766.5, 422.7 and 285.2 nm, respectively. The sodium content in 1/20 diluted sample were determined by reading their absorbance at 248.3 nm (Okalebo *et al.*, 2002). The total organic carbon was determined by ash method at 560^{o}C. The organic matter was obtained by multiplying total organic carbon values by a conversion factor of 1.27 (AOAC, 1990). The planting of *C. moschata* seeds were done during the rainy season in the month of May. NPK (15:15:15) fertilizer was used as treatment. The treatments were 0, 200, 250, 300, 350, 400, 450 and 500 kg/ha. The treatments were applied in a single dose at two weeks old seedlings of *C. moschata* using ring method. Each treatment was replicated four times. The plants were staked to avoid creeping on the ground.

Measurement of plant material:

At 6 weeks after planting (WAP), leaf samples were collected, oven-dried at 80 ^{o}C for 48 hours and grounded. The mineral constituents of the plant were determined by digesting the samples on a labcon digester at 300°C in a mixture of hydrogen peroxide, sulphuric acid, selenium and salicyclic acid (Okalebo *et al.*, 2002). The digests were analysed for total N, P, K, Na, Ca, and Mg. The total N content in the digests were determined by Kjeltec method using FOSS instrument as described in the ASN3201 as total Kjeldahl nitrogen (TKN). The crude percentage protein was obtained by multiplying TKN values by a conversion factor of 6.25 (AOAC, 1990). Total phosphorous was determined using the ascorbic acid blue colour procedure and the absorbance measured at 880 nm wavelength UV-spectrophotometer. The Ca, K and Mg contents in 1/20 dilution (sample /distilled water) plant digests were measured by reading

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their absorbance on a UNICAM 969 Atomic Absorption Spectrophotometer at 766.5, 422.7 and 285.2 nm, respectively. The sodium content in 1/20 diluted sample were determined by reading their absorbance at 248.3 nm (Okalebo *et al*., 2002). Nutrient uptake (N, P, K, Ca, Na, and Mg) of *C. moschata* was then calculated by multiplying the leaf dry matter with the composition of the nutrients in the leaves. The chlorophyll content was measured according to the method described by AOAC (1990).

Statistical analysis:

Statistical analyses of data obtained from plant material and soil samples were by Analysis of Variance (ANOVA) using 5 % level of significance. The statistical package used was SPSS 17.3. Means were compared using Duncan's Multiple Range Tests (DMRT).

RESULTS

Effect of NPK fertilizer on the soil chemical properties:

The initial chemical composition of the soil used in this study is presented in Table 1. The soil was loamy. The organic carbon, total nitrogen and available phosphorus contents of the soil were high. Four weeks after NPK application, the chemical properties of the soil treated with NPK increased total N, P, K, Na, Ca, OM and OC contents (Table 2) with respect to initial chemical composition of the soil (Table 1) except Mg which showed reduction in the nutrient level. Among, treatments, 450 kg/ha gave the highest K and Ca concentrations while available P and Na concentrations were high at 500 kg/ha. Organic matter, organic carbon and N concentration were high at 350 kg/ha. However, the control (0 kg/ha) showed a reduction in all the nutrient level assessed.

Table 1: Soil chemical properties used for the experiment

Chemical properties	Soil
Na (mg/kg)	206 .00
K (mg/kg)	219.20
Ca (mg/kg)	13.20
Mg (mg/kg)	95.75
Total phosphate (mg/kg)	4.95
Total nitrogen (%)	0.22
Organic carbon (%)	4.77
Organic matter (%)	8.20
Ash content (%)	91.80
pH ($_{1:2}$ soil to water)	5.94

Table 2: Effect of NPK fertilizer on soil nutrient composition 4 weeks after application

Treatment (kg NPK/ha)	N (%)	P (mg/kg)	K (mg/kg)	Na (mg/kg)	Mg (mg/kg)	Ca (mg/kg)	OM (g/100g)	OC (g/100g)
0	0.15	4.13	181.95	158.05	84.25	17.15	16.20	9.42
200	0.15	12.38	250.40	160.30	64.05	-4.25	6.40	3.72
250	0.21	12.79	433.40	208.95	66.90	17.55	7.20	4.19
300	0.18	16.50	303.25	147.15	70.80	35.60	11.70	6.80
350	0.18	10.73	409.55	144.45	78.45	10.05	19.00	11.05
400	0.15	12.38	448.15	334.98	75.10	-11.65	5.70	3.31
450	0.17	16.09	487.00	317.65	79.45	65.70	5.10	2.97
500	0.15	17.74	482.15	357.75	73.25	-0.70	4.80	2.79
SE	0.008	1.517	40.514	32.643	2.375	8.810	1.940	1.128
SD	0.022	4.289	114.592	92.327	6.719	24.919	5.487	3.191
LSD (0.05)	0.015	3.038	81.150	65.383	4.758	17.647	3.886	2.260

SE represents standard error, SD - standard deviation, LSD - least significant different ($p<0.05$)

Effect of NPK fertilizer on the nutrient uptake of *C. moschata*

The uptakes of N, P, K, Ca, Mg and Na by C. moschata were significantly influenced by doses of NPK treatments when compared with the control (Table III). At $P < 0.05$, there were significant differences among these treatments. The result showed that *C. moschata* treated with 250 kg/ha consistently gave the highest uptake of N, P, K, Ca, Mg and Na concentrations while control (0 kg/ha) gave the least uptake of the nutrient.

Table 3: Effect of NPK treatments on some mineral nutrient content of *C. moschata* 4 weeks after application

Treatment (kg NPK/ha)	Dry weight (g)	Nutrient uptake (mg/plant)					
		N	P	K	Ca	Mg	Na
0	1.635	65.44	0.06	36.40	14.30	1.30	1.30
200	6.988	347.30	0.17	243.61	51.85	5.82	5.97
250	32.133	899.72	1.13	1093.99	233.96	27.66	39.42
300	23.438	492.20	0.78	828.87	133.18	19.68	25.84
350	10.948	352.53	0.54	391.43	33.62	8.58	11.33
400	3.838	120.90	0.20	131.64	12.41	2.93	3.17
450	7.460	234.99	0.45	258.35	29.61	5.84	6.93
500	12.688	488.49	0.87	455.08	90.09	7.73	6.98
SE	1.140	92.892	0.134	127.493	26.989	3.199	4.668
SD	10.394	262.739	0.379	360.603	76.336	9.049	13.204
LSD (0.05)	2.371	187.457	0.270	257.280	54.464	6.456	9.420

SE represents standard error, SD - standard deviation, LSD - least significant different ($p<0.05$)

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Crude protein and chlorophyll content:

The results of the treatments indicated that 250 kg/ha treatment gave the highest mean level for crude protein. Table IV revealed that the photosynthetic pigments increased gradually during plant age in both control and treated plants. However, total chlorophyll, chlorophyll 'a' and 'b' in *C. moschata* leaves were quite high with the control (0 kg/ha).

Table 4: Effect of NPK on the crude protein and chlorophyll content of *C. moschata* 4 weeks after Application

Treatments (kg NPK/ha)	Crude protein (g/plant)	Chlorophyll a (mg/l)	Chlorophyll b (mg/l)	Total Chlorophyll (mg/l)
0	0.41	8.39	3.70	17.86
200	2.17	7.83	2.83	16.44
250	5.62	2.75	0.77	6.05
300	3.08	2.77	1.01	5.64
350	2.20	8.92	3.50	17.61
400	0.76	4.27	1.13	8.49
450	1.47	5.80	1.85	12.63
500	3.05	8.05	2.37	16.70
SE	0.581	0.904	0.402	1.854
SD	1.642	2.556	1.138	5.244
LSD (0.05)	1.189	1.851	0.824	3.797

SE represents standard error, SD - standard deviation, LSD - least significant different ($p<0.05$)

DISCUSSION

The organic carbon, total nitrogen and available phosphorus contents of the soil were quite high when compared with the work of Pagel *et al* (1982). The later reported that total nitrogen and available phosphorus contents of the soil were low when poultry manure was used the growth and yield of maize. The increase obtained in the N, P, K, Na, Ca, OM and OC contents of the soil treated with NPK could be due to rapid mineralization of NPK treatments applied. This is consistent with the report of Awodun *et al* (2007) and Agbede *et al* (2008). Among, treatments, 450 kg/ha gave the highest K and Ca concentrations while available P and Na concentrations were high at 500 kg/ha. Organic matter, organic carbon and N concentration were high at 350 kg/ha. However, the control (0 kg/ha) showed a reduction in all the nutrient level assessed and this may suggest the nutrient utilization by the plant.

Cucurbita moschata treated with 250 kg/ha consistently gave the highest uptake of N, P, K, Ca, Mg and Na concentrations while control (0 kg/ha) gave the least uptake of the nutrient. These results might be attributed to quicker release of N, P and K from chemical fertilizer. This is in conformity with the earlier report by Awodun *et al* (2007). Katalin and Katalin (2002) reported also that the application of NPK doses proved to be beneficial since it contained balanced nutrient. Ibeawuchi *et al* (2007) reported that maize treated with NPK (0.4 t/ha) increased the plant height, leaf area and dry matter.

The results of the treatments indicated that 250 kg/ha treatment gave the highest mean level for crude protein. This result is in line with the N uptake by *C. moschata*. The total chlorophyll, chlorophyll a and b in *C. moschata* leaves were quite high with the control (0 kg/ha). This could be due to fast immobilization

of NPK treatments and consequent yellowing of leaves. Amujoyegbe *et al* (2007) reported that inorganic fertilizer increased the chlorophyll content of maize and sorghum.

The study indicates that NPK fertilizer is a valuable material in the production of *C. moschata* and its use needs to be encouraged. An application rate of 250 kg/ha was capable of increasing nutrient content by more than 100% over the control. The 250 kg/ha may be recommended for now since it produced high crude protein contents which is a function of nitrogen. Early harvesting of the plant is encouraged to avoid yellowing of leaves after immobilization of NPK treatment. It may be worthwhile considering point application of NPK fertilizer in order to minimize fertilizer wastage since its availability and huge cost of procurement have been a problem to average farmer. The use of NPK fertilizer (15:15:15) at 250 kg/ha is therefore recommended for the cultivation of *C. moschata*. This work also indicates and suggests that analysis of the leaves of *C. moschata* could be an index for understanding the soil status of these elements.

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