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COMPARATIVE EVALUATION OF NPK AND CHICKEN DROPPING ON THE GROWTH AND PROXIMATE COMPOSITION *AMARANTHUS HYBRIDUS* L.

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ABSTRACT

This experiment was carried out to compare the effects of NPK 15:15:15 and chicken droppings on growth and proximate composition of *Amaranthus hybridus*. In each fertilizer, four application rates (0, 2, 4 and 6 g/kg of soil) were considered. There were twenty four pots arranged in completely randomized design with three replications. Plant height, number of leaves, stem girth, leaf area, and above-ground fresh and dry weight increased with increase in the rates of application compared with the control. The enhancements of these characters were in higher in NPK fertilizer than chicken dropping at all rates studied. Significant differences ($p \leq 0.05$) were recorded in the chemical parameters. In both fertilizers, the percentage moisture, ash, crude fibre, crude protein, crude fat and total carbohydrate ranged from 16.34-18.80, 9.75-11.54, 13.50-16.84, 2.42-3.09 and 34.14-40.33% respectively. The percentage crude protein was enhanced in NPK treated plants compared to those of chicken dropping. Conversely, carbohydrate and fat were on the increase in chicken dropping than NPK. In both fertilizers, percentage moisture, ash and crude fibre increased with increase in application rates.

Key words: NPK 15:15:15, chicken droppings, *Amaranthus hybridus*, proximate composition, growth characters.

INTRODUCTION

The increasing awareness on the value of leafy vegetable in contributing to a balanced diet, particularly in areas where animal protein is deficient, lead to the cultivation of leafy vegetables on a very large quantity around the world. This is due to its contribution to the amount of carotene, ascorbic acid (Vitamin C) protein, minerals, (particularly Calcium) and carbohydrate in the diet (Faruq *et al.*, 2002).

Amaranthus, like other vegetables requires high soil organic matter and availability of nitrogen (N) as well as other nutrients such as phosphorus (P), potassium (K), and magnesium (Mg) which are essential for its proper growth and development. However, soil often lacks these elements, either naturally or as a result of over cultivation, hence the needs to have them put back in to the soil. Fertilizers are sources of plant nutrients that can be added to the soil to supply some nutrients. They are intended to supply plant needs directly rather than indirectly through modification of such properties as soil pH and structure. There is usually noticeable improvement in both quantity and quality of plant when appropriate amount is added. Inorganic fertilizer has over the years been the source of nutrient addition to the soil. They are needed to supply sufficient amount of nutrient to crops. Most inorganic fertilizers dissolve readily in water, thereby making them available to plant for uptake (Brady and Weil, 2000).

A typical example of inorganic fertilizer is the NPK which consists of nitrogen, phosphorus and potassium all of which are essential plants nutrients necessary for healthy growth and development. NPK fertilizer plays a major role in the soil's ability to provide macro nutrient to crops thus increasing the production of seed and fruit and enhancing the quality of leaves. However, most vegetable farmers in tropical countries such as India, Malaysia, Indonesia, Philippines, south pacific and tropical Africa are small holders who cannot afford the high cost of inorganic fertilizers, although they are aware that poor soil fertility limit the yield of vegetables especially in urban centres. Hence farmers depend largely on locally sourced organic fertilizers.

In Nigeria organic fertilizers have been developed from farm and city wastes, also organomineral fertilizer in which organic wastes are fortified with inorganic NPK fertilizer. Organic and organomineral fertilizers were found to increase the yield of maize significantly and vegetables such as pepper, tomato, okra, melon and *Amaranthus* (Olowokere, 2004; Makinde, 2007; Akanni and Ojieniyi, 2008). Wood ash, goat and poultry manures increased fat, protein and reduced carbohydrate in *Amaranthus* (Adekayode, 2004). It is therefore the attention of this experiment is to compare the effect of organic (chicken droppings) and inorganic (NPK) fertilizer on the growth attribute and proximate composition of *A. hybridus* with a view to determining the optimum rate for proper growth which will also enhance the nutritive content of the plant.



MATERIALS AND METHODS

Sample Collection and Soil Preparation

Seeds of *Amaranthus hybridus* used for the study were obtained from an agrochemical shop in Ilorin, Kwara state. The experiment was conducted at the back of the plant biology department, University of Ilorin, Ilorin, Kwara state. Thirty-four polythene bags of size 13 by 22 cm were filled with sandy-loam soil to a depth of 20 cm, holes were drilled at the sides and bottom to facilitate drainage. Ten bags were used for the nursery preparation while twenty-four bags were prepared for the experiment to accommodate the different application rates of fertilizer under investigation.

Seed sowing, germination and transplanting

Seeds of *Amaranthus hybridus* were broadcast in each of the ten polythene bags prepared for the nursery. The bags were watered twice daily for three weeks until the seeds germinated. The seedlings were transplanted when they were three weeks old into the permanent pots with each pot containing three seedlings. This was done late in the evening in order to enable the seedling to withstand the shock of transplanting and get established. Watering was undertaken twice daily for two weeks before application of the fertilizers.

Experimental Design

Chicken droppings and NPK fertilizer (15:15:15) were applied to the soil on the 2nd week after transplanting. In each fertilizer, four levels of treatment were used - 0, 2, 4 and 6 g with each having three replicates. The 0 g represents the control treatment (no NPK; no chicken dropping). The pots were arranged in a completely randomized design.

Data Collection

A simple non-destructive technique was employed to collect growth characters such as plant height, number of leaves, and stem girth. The plant height was determined by measuring the plant from the soil level up to the shoot apex using 150cm tape. The number of leaves was manually counted. Stem girth was determined using thread to encircle the circumference of the stem 2cm above soil level, the cut thread obtained was then measured on 30cm ruler and length covered was recorded as the stem girth.

The foregoing growth characters were assessed at weekly interval for a period of seven weeks after transplanting (WAT) when the plant has attained maturity. At the harvest, the plants were carefully uprooted and separated into leaves and

The stem girth showed an increasing trend at all growth stages, various levels of treatments had higher stem girth than the control. However, both

stem, the roots were discarded. Both fresh and dry weight were taken using an electronic weighing balance MP 101 with 0.001g precision. The plants were oven dried to a constant weight at 75°C for 12 hours to obtain the dry weight.

Proximate Analysis

Proximate composition of air dried leaves of *A. hybridus* was determined using the standard methods of Association of Official Analytical Chemists (AOAC, 2000). Moisture content was estimated by drying 2 g of air dried leaves in an oven at 105°C for 5 hours. Ash determination was obtained by the incineration of 2 g samples in a Yorco muffle furnace at 600°C for 3 hours. Crude fibre percentage was determined by dilute acid and alkali hydrolysis. Crude protein percentage (%CP) was determined by Kjeldhal method using 2 g of the samples. The crude protein was calculated by multiplying with protein factor (%N x 6.25). The crude fat was determined by extraction procedure using 2 g of the samples in a Soxhlet apparatus using petroleum as the solvent. Carbohydrate was calculated by difference. This was achieved by subtracting the sum of percentage moisture, ash, fibre, protein and fat and hundred.

Data Analysis

Data were subjected to One Way Analysis of Variance using Statistical Package for Social Science (SPSS) software version 17.0, the level of significance used in F-ratio was $p \leq 0.05$. Where F is significant, means were separated using Duncan Multiple Range Test. Bar charts were plotted using Origin 7.0 for windows.

RESULTS

Growth characters.

Generally, NPK fertilizer regardless of the treatment levels increased plant height of *A. hybridus* over the chicken dropping as shown in Fig. 1. Plant heights of *A. hybridus* showed an increasing trend till final date of sampling (7 weeks after transplanting), different levels of NPK and chicken dropping increased the height of *A. hybridus* at all the stages of growth compared to the control Fig. 1 with tallest plants in bags receiving 4 and 6 g of the treatments. *A. hybridus* grown in soil treated with 6 g and 4 g of NPK recorded the highest number of leaves compared to other concentrations and the effect became more pronounced with increase in the age of the crop. In chicken dropping, 6 g recorded the highest number of leaves compared to other treatments studied. Regardless of the treatment levels, NPK fertilizer showed better increase in the number of leaves compared to chicken dropping as shown in Fig. 2.

However, both NPK and chicken dropping treatment showed highest stem girth development at 6 g followed by 4 and 2 g in the aforementioned order.



Generally, NPK showed better increase in stem girth than chicken dropping at all stages of crop growth (Fig. 3). The above ground fresh and dry weights of *A. hybridus* in different concentrations of both fertilizers did not differ significantly from one another (Fig. 4). However, *A. hybridus* grown in the pots treated with 6 g of NPK and chicken dropping showed the highest accumulation of above-ground fresh and dry weights and followed in decreasing order by 4 g and 2 g (Fig. 4). Comparatively, NPK at all concentrations studied showed higher accumulation of both above ground fresh and dry weights of *A. hybridus* than chicken dropping (Fig. 4.).

Proximate composition

Moisture

Percentage moisture content of *A. hybridus* on dry weight basis was significantly ($p \leq 0.05$) different in all the treatment levels of NPK and Chicken dropping. It ranged from 16.34-18.08% and 16.53-18.06 in NPK and Chicken dropping respectively. In NPK treated bags significantly highest moisture content was recorded in crop grown to 6 g followed by 2 and 4 g respectively. Significantly lowest moisture content was recorded in the control over all other treatments. In Chicken dropping, crop grown to 2 and 6 g had moisture contents that were statistically similar but significantly higher than that of 4 g. As observed in NPK, significantly lowest moisture content was recorded in the control over all other treatments studied.

Ash

Ash content was significantly affected ($p \leq 0.05$) across all treatment levels of NPK and chicken dropping (Table 1). Pots that received 6 g of NPK showed significantly higher percentage ash content over all other treatment levels (Table 1). The ash content of the control was comparable to those of 4 g but significantly higher than those recorded in crop grown to 2 g of NPK. In chicken dropping, ash contents at all the treatments were at par with the control except in those that received 2 g (Table 1).

Crude Fibre

Percentage crude fibre also differed significantly ($p < 0.001$) in all levels of NPK and chicken dropping studied (Table 1). It ranged from 10.08-11.52% and 9.75-11.54% in NPK and chicken dropping respectively (Table 1). Crop grown to 6 g of

NPK had significantly higher crude fibre than 4g and the control bags (Table 1). Crude fibre was lowest in 2 g NPK treated pots (Table 1).

Crude protein

Various treatment levels of NPK and chicken dropping significantly affected ($p \leq 0.05$) percentage crude protein (Table 1). The crude protein values ranged from 14.18-16.8% and 13.50-16.07% in NPK and chicken dropping respectively. Crop grown to 6 g NPK was the only treatment that significantly enhanced percentage crude protein over the control. All other treatments showed significantly lower percentage crude protein than the control treatment (Table 1). Conversely, in chicken dropping, significantly higher crude protein was recorded in the control compared to various treatment levels of chicken dropping (Table 1). It is interesting to note that higher concentration (6 g) of chicken dropping tend to lower crude protein content of *A. hybridus* compared to low concentrations (2 and 4 g) (Table 1).

Crude fat

Significant differences ($p < 0.05$) were observed in crude fat under different treatment levels of NPK and chicken dropping (Table 1). Crude fat was lower than other proximate parameters and it ranged from 2.54-3.09% and 2.42-2.93% in NPK and chicken dropping respectively (Table 1). In NPK treated pots, the control had significantly lower crude fat over all other treatments. Among the treatment levels, crude fat was significantly higher in crop receiving 2 g, this was followed in decreasing order by 4 g and 6 g in both NPK and chicken dropping (Table 1).

Carbohydrate

Different treatment levels of NPK and chicken dropping significantly affected ($p \leq 0.05$) percentage carbohydrate contents (Table 1). As observed in this study, carbohydrate forms the bulk of the leaves of *A. hybridus*. It ranged from 34.14-40.33% and 37.84-39.48% (Table 1). In both NPK and chicken dropping, significantly higher percentage carbohydrate was recorded in crop grown to 2 g over all other treatments. Crop grown to 6 g NPK had significantly lowest percentage carbohydrate and followed in increasing order by control and those in 4 g. In chicken dropping, all the treatments significantly enhanced percentage carbohydrate content over the control except pots treated to 4 g (Table 1).



Table 1: Proximate composition of air dried leaves of *A. hybridus* as influenced by different concentrations of NPK and chicken dropping.
Means within the column followed by the same letters are not significantly different at $p \leq 0.05$.

Parameters	Moisture	Ash	Fibre	Crude Protein %	Crude fat	Carbohydrate
NPK (g)						
0	16.34 ^d	16.13 ^b	10.75 ^c	16.14 ^b	2.42 ^c	36.68 ^c
2	17.83 ^b	14.60 ^c	10.08 ^d	14.18 ^d	2.93 ^a	40.33 ^a
4	17.57 ^c	15.92 ^b	11.23 ^b	15.27 ^c	2.82 ^{ab}	37.08 ^b
6	18.08 ^a	16.73 ^a	11.52 ^a	16.84 ^a	2.67 ^b	34.14 ^d
Mean	17.47	15.85	10.89	15.61	2.72	37.06
P-value	<0.001	<0.001	<0.001	<0.001	0.004	<0.001
SE	0.19	0.24	0.17	0.30	0.06	0.66
Chicken dropping (g)						
0	16.53 ^c	16.19 ^a	10.67 ^c	16.07 ^a	2.60 ^{bc}	37.84 ^c
2	18.46 ^a	13.88 ^b	9.75 ^d	15.34 ^b	3.09 ^a	39.48 ^a
4	17.17 ^b	16.04 ^a	11.07 ^b	14.84 ^c	2.78 ^b	38.10 ^b
6	18.06 ^a	16.17 ^a	11.54 ^a	13.50 ^d	2.54 ^c	38.44 ^a
Mean	17.56	15.57	10.75	14.82	2.75	37.46
p-value	<0.001	<0.001	0.001	<0.001	0.00	<0.001
SE	0.23	0.29	0.20	0.34	0.07	2.41

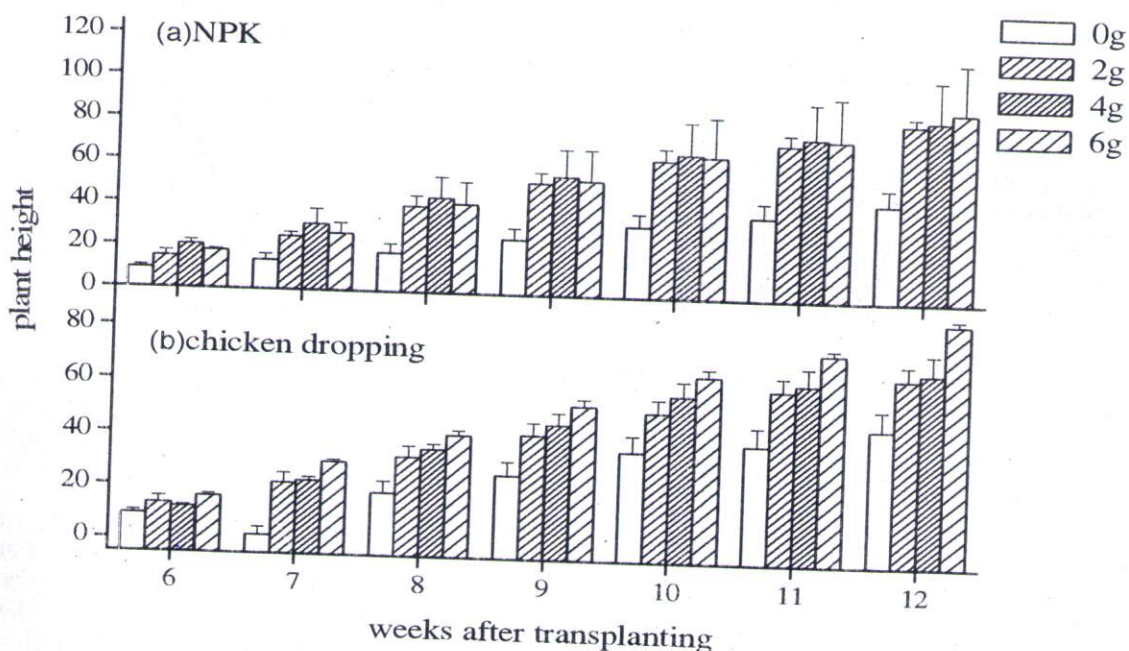


Fig.1: Plant height as affected by different concentration of (a) NPK and (b) Chicken dropping. Vertical bars represent standard error (SE±) of treated mean.

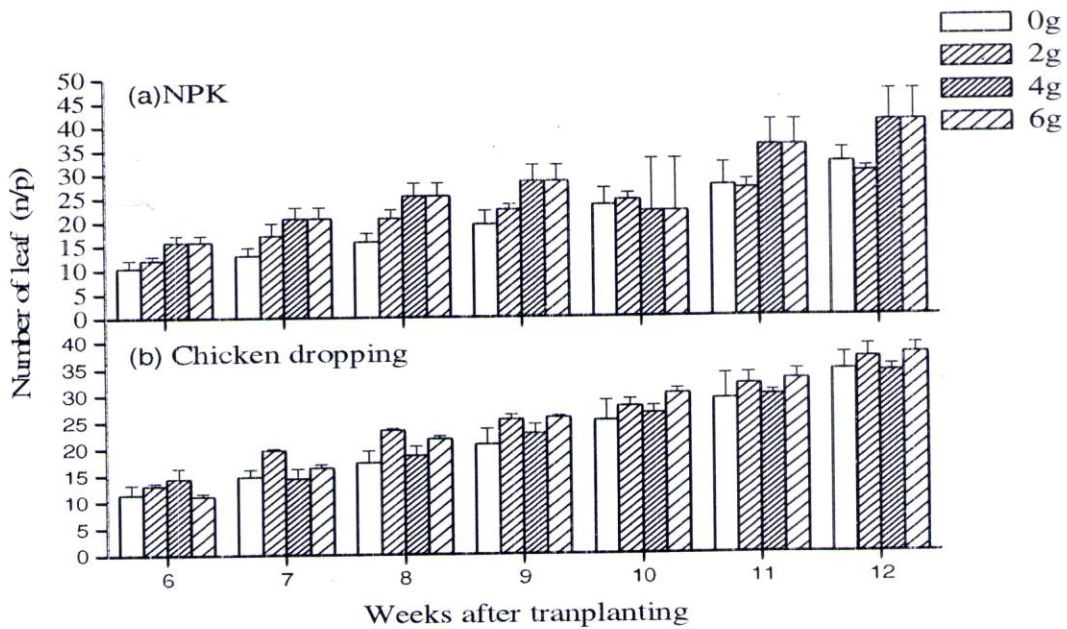


Fig. 2: Number of leaves as affected by different concentrations of (a) NPK and (b) Chicken dropping. Vertical bars represent standard errors (SE±) of treatment mean.

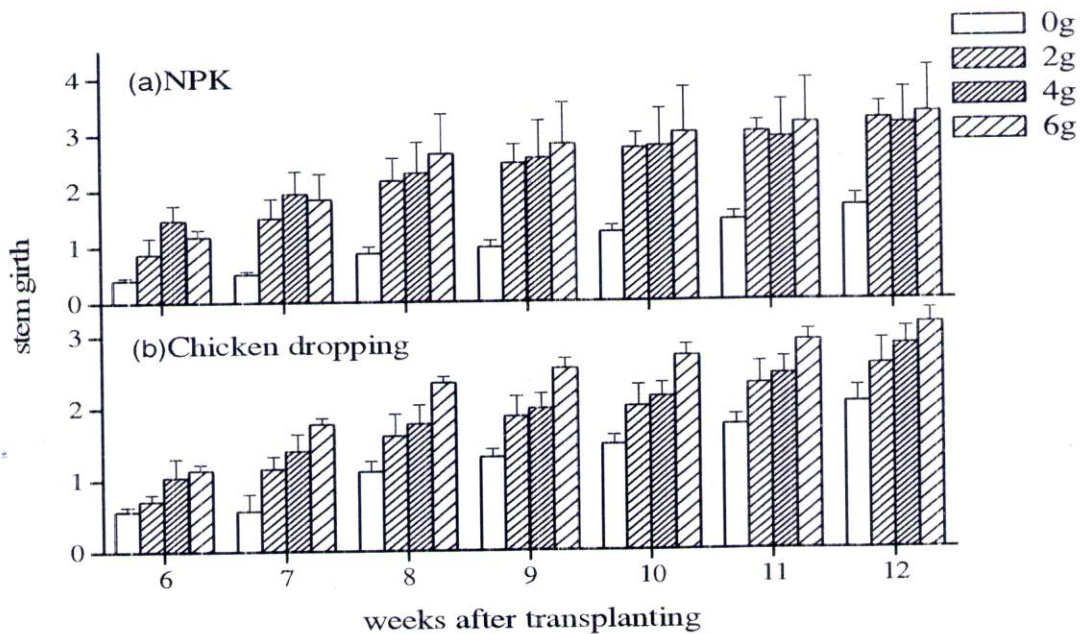


Fig. 3 Stem girth as affected by different concentrations of (a) NPK and (b) chicken dropping. Vertical bars represent standard error (SE±) treatment mean.

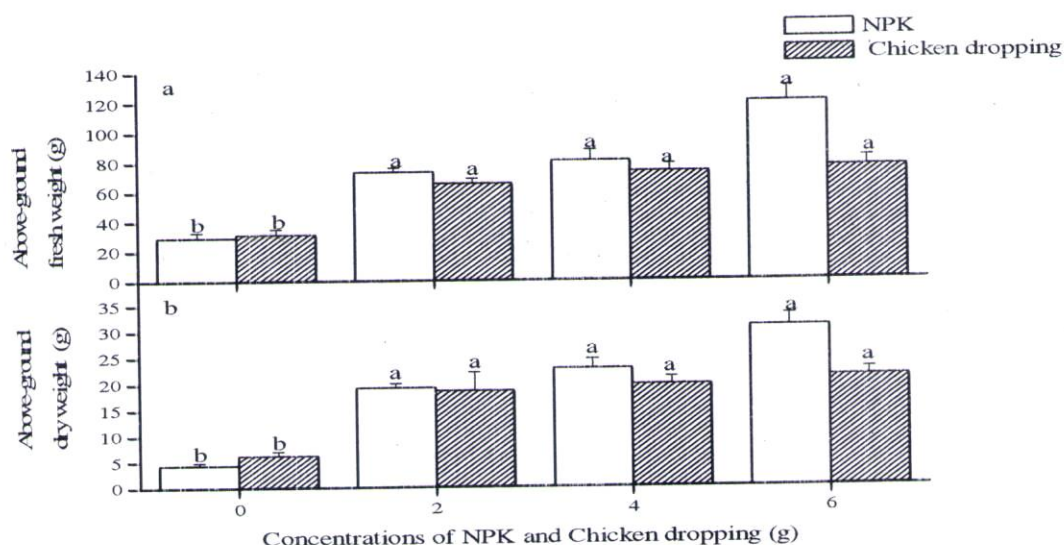


Fig.4: Above- ground fresh weight and above-ground dry weight of *A. hybridus* as affected by different concentrations of NPK and chicken dropping. Vertical bars represent $\pm$ standard error of means of three replicates. Means within the same fertilizer followed by the same letter are not significantly different at $p < 0.05$.

DISCUSSION

Growth characters

Generally, it can be deduced from this experiment that on the basis of growth, NPK 15:15:15 fertilizer is the best treatment for better performance of *A. hybridus* at all application rates studied. Similar results had been observed by Nahed (2007) where the author reported stimulatory effect of NPK at 4 and 8 g, benzyladenine at 20 and 40 ppm and their combinations on the growth and chemical constituent of *Codiaeum variegatum*. Furthermore, better growth enhancement observed in NPK treated pots compared to chicken droppings could be linked to the faster dissolution of NPK than chicken dropping where nutrients are not made available in time for faster growth (Nyankanga *et al.*, 2012).

Proximate composition

Moisture content.

The higher moisture content in plant grown to chicken droppings than NPK could be due to increase soil water retention capacity due to accumulation of organic matter. The result was lower than the moisture reported for *A. cruentus* and *A. deflexus* Oyedeleji *et al.*, (2014; Shela *et al.*, 2004).

Ash content

Ash content, which is an index of mineral contents in biota, is low (13.91-16.83) in *A. hybridus* compared to the values reported in leaves of *Talinum triangulare* (20.05%) (Ifon *et al.*, 1980; Ladan *et al.*, 1996), but compared favourably with the value reported for *Ipomea batatas* (11.10%), *Vernonia*

colorate (15.86%), and *Moringa oleifera* (15.09%) (Lockett *et al.*, 2000; Antia *et al.*, 2006). It was however, higher than those of some Nigerian leafy vegetable such as *Hibiscus esculentus* (8.00%) (Akindahunsi *et al.*, 2005).

Crude fibre

Comparatively, the mean crude fibre in NPK treated pots (10.85%) was greater than those of chicken dropping with mean value of 10.75%. The crude fibre content was higher when compared to *I. batatas* (7.20%), *T. Triangulare* (6.20%) (Akindahunsi *et al.*, 2005; Antia *et al.*, 2006). This implies that consumption of *A. hybridus* especially those grown with NPK should be encouraged due to its high fibre content since adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation and breast cancer (Rao *et al.*, 1998).

Crude protein

It is interesting to note that higher concentration (6 g) of chicken dropping tend to lower crude protein content of *A. hybridus* compared to low concentrations (2 and 4 g). Similar to ash and fibre contents, crude protein was higher in crop treated with NPK than those receiving chicken dropping with mean values of 15.61 and 14.82% respectively. The crude protein content of *A. hybridus* (16.83%-16.07%) was higher than that of *Momordica balsamia* L. (11.2%) and *Momordica foetida* (4.6%) leaves consumed in Nigeria and Swaziland (Ogle *et al.*, 1985; Isong *et al.*, 1997).



According to Pearson, (1976), plant food that provides more than 12% of its calorific value from protein is considered good source of protein. Therefore *A. hybridus* leaves (16.83%-16.70%) meet this requirement.

Crude fat

Similar to moisture, crude fat content was higher in crop grown with Chicken dropping than those receiving NPK with values of 2.75 and 2.72 % respectively. *Amaranthus hybridus* leaf is a poor source of lipid. The crude fat content was low compared to reported values (8.3%-27.0%) in some vegetables consumed in West Africa (Ifon *et al.*, 1980; Sena *et al.*, 1998).

Carbohydrate

Carbohydrate forms the bulk of the leaves of *A. hybridus*. It ranged from 34.14- 40.33% and 37.84-

39.48% in NPK and chicken droppings respectively. The carbohydrate content (40.33-34.14%) was higher than 23.7% and 39.05% reported for *Amaranthus incurvatus* and *M. balsamina* leaves respectively (Faruq *et al.*, 2002; Hassan *et al.*, 2006). It was however; lower than reported values for *Corchorus tridens* (75.0%) and sweet potato leaves (82.8%) (Asibey-Berko *et al.*, 1999).

CONCLUSION

The study revealed that, *A. hybridus* growth was enhanced when treated with NPK fertilizer compared to chicken dropping. Also, application of NPK at higher rate increased the crude protein but reduced the carbohydrate and crude fat when compared to crops grown to chicken droppings. However, both fertilizers have the potential of increasing the moisture, ash and fibre content of *A. hybridus* leaves as observed in this study.

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According to Pearson, (1976), plant food that provides more than 12% of its calorific value from protein is considered good source of protein. Therefore *A. hybridus* leaves (16.83%-16.70%) meet this requirement.

Crude fat

Similar to moisture, crude fat content was higher in crop grown with Chicken dropping than those receiving NPK with values of 2.75 and 2.72 % respectively. *Amaranthus hybridus* leaf is a poor source of lipid. The crude fat content was low compared to reported values (8.3%-27.0%) in some vegetables consumed in West Africa (Ifon et al., 1980; Sena et al., 1998).

Carbohydrate

Carbohydrate forms the bulk of the leaves of *A. hybridus*. It ranged from 34.14- 40.33% and 37.84-

39.48% in NPK and chicken droppings respectively. The carbohydrate content (40.33-34.14%) was higher than 23.7% and 39.05% reported for *Amaranthus incurvatus* and *M. balsamina* leaves respectively (Faruq et al., 2002; Hassan et al., 2006). It was however; lower than reported values for *Corchorus tridens* (75.0%) and sweet potato leaves (82.8%) (Asibey-Berko et al., 1999).

CONCLUSION

The study revealed that, *A. hybridus* growth was enhanced when treated with NPK fertilizer compared to chicken dropping. Also, application of NPK at higher rate increased the crude protein but reduced the carbohydrate and crude fat when compared to crops grown to chicken droppings. However, both fertilizers have the potential of increasing the moisture, ash and fibre content of *A. hybridus* leaves as observed in this study.

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