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Effect of Application of Sole Organic, Inorganic Fertilizers and their Combinations on the Growth and Biological Yield of Fluted Pumpkin (Telfairia occidentalis)

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Abstract

The effect of application of sole organic, inorganic fertilizers and their combinations was investigated on the growth and biological yield of Fluted pumpkin (*Telfairia occidentalis*) at the Teaching and Research Farm, Babcock University, Ilishan Remo, Ogun state, Nigeria. Ten treatments were involved namely: No fertilizer (control), 100kgN/ha as Sulphate of Ammonia, SA (21%N), 100kgN/ha as Composted Maize Cob, CMC (0.97%N), 100kgN/ha as Composted Saw Dust, CSD (1.01%N), 50:50 CMC/SA combination, 50:50 CSD/SA combination, 50:50 CMC/CSD combination, 75:25 CMC/SA combination, 75:25 CSD/SA combination, 75:25 CMC/CSD combination, the treatments were replicated four times using Randomized Complete Block Design (RCBD). Seedling emergence, Leaf area, Leaf number, Plant height and dry matter weight of the crops were assessed. On the Plant height and Leaf number, application of 75:25 CMC/SA combination resulted in taller plants and more leafiness at 3 WAP compared to 75:25 CMC/CSD combination. The application of 100kgN/ha as sole Sulphate of Ammonia, gave the least leaf number and the shortest plant at 4WAP. The sole application of any of the organic fertilizers 100kgN/ha has proven to be superior in terms of (vegetative yield) of *Telfairia occidentalis* (ugu-elu) than its combination of each of the organic fertilizer with sulphate of ammonia.

Keywords: Organic fertilizer; Inorganic fertilizer; Fluted pumpkin; Yield.

Introduction

Fluted pumpkin *(Telfairia occidentalis)* belongs to the curcurbitaceae family. It is a perennial climber grown for its leaves and seeds, which are very nutritious (Schippers, 2000). It has been stressed that it originated in south-east Nigeria and was distributed by the Igbos, who have cultivated this crop since time immemorial. It is however, equally possible that fluted pumpkin was initially wild all through its present varieties, but that wild plants have been harvested to local extinction and are now replaced by cultivated forms. Fluted pumpkin is the most important and extensively cultivated food and income generating crops in various parts of Africa (Adebisi-Adelani *et al*., 2011). The crop does best at medium to high rainfall and will do well on sandier soil provided fertilizer is applied but has a more robust growth in rich well drained soil. When planting for leaves, the usual spacing is 50 x 50cm in a mono-cropping system (Nwauwa and Omona, 2010). Fluted pumpkin plays an important role in the population diet because it is affordable and offers quite a number of nutrients. Fluted pumpkin is often cultivated and consumed in rural, urban and peri-urban areas in Nigeria. Kayode *et al*. (2010), in a comprehensive review of some medicinal values of *Telfairia occidentalis*, cited Nwangwa *et al*. (2007), who showed that *T. occidentalis* has the potential to be used in testicular regeneration therapy and for the increase of spermogenesis.

Fertilization as a cultural operation is essential and important for vegetable production and yield. The two broad types of fertilizers namely inorganic and organic can be used as sources of nutrient. The scarcity and high cost of inorganic fertilizers have restricted their use for crop production among the peasant farmers in Nigeria. Use of chemical fertilizers alone generate several lethal effects to the environment and human health and they should be replenished with every cultivation. This is because; the synthetic fertilizer is rapidly lost by either volatilization or by leaching in drainage water and it causes dangerous environmental pollution (Aisha *et al.,* 2007). Organic fertilizers come from different sources which makes them heterogeneous in quantity and quality. Organic fertilizers are required in large amounts to have desired effects but the bulkiness of the organic fertilizer can be reduced through composting. Organic compounds contain growth hormones which have been found to play a significant role in crop production such as rapid vegetative growth and initiation of flowering and fruiting (reproduction) of many crops (Onofeghara, 1981).

Generally, the conventional method of soil nutrient replenishment is by application of mineral fertilizers. But mineral fertilizers are very costly, so resource-poor farmers can hardly afford them (McGuiness, 1993). Mineral fertilizers are rarely available at the time needed for crop production to farmers in Nigeria (Adedoyin, 1995). Mineral fertilizers also create residue problem in soils, the residue are known to be absorbed by plants thereby getting into the food web thus prompting human health-related problems. In contrast organic manures exhibit residual beneficial effect evidenced as gradual but long-lasting nutrients release to crop. Incessant use of the inorganic fertilizers especially the acid- former, N-fertilizers are known to increase soil acidity. Apparently for these reasons greater research attention is now been paid to exploitation of organic fertilizer in the crop production. Aside from supply of macro and micro nutrient, organic fertilizers are soil physical property improvers, they help to promote a stable soil structure (Naeem *et al*., 2006), and also enhance biodiversity. Organic fertilizer increases nutrient retentivity, enhances aggregation and is responsible for a slow but ready release of fixed P (Onweremadu *et al.,* 2003). Organic fertilizer such as compost, animal manure, crop residues and municipal wastes when used as primary source of plant nutrients constitute part of crop production system referred to as organic farming an environmental and human health friendly option of producing residue-free organic food (Adenowoola *et al.,* 2005). Constant application of organic manures exhibit residual beneficial effect evidenced by gradual but long-lasting

nutrients release to crop. Mineral fertilizers are known for fast nutrient release pattern than organic manures which has slow but extended supply pattern of nutrient. A combined application of a low and higher C/N ratio, inorganic and organic fertilizers may also prove to be a beneficial option in crop production as well.

Arising from the growing acceptability of Fluted pumpkin as a good source of nutrients for healthy growth of humans and the medicinal potential attribute of the leaf vegetable and its weed control ability, many farmers have adopted it for cultivation a preferred leaf vegetable in Ogun and Lagos States, which constitute an effective demand market centres for it. There is paucity of empirical finding on the nutrition of the crop. This being so, there is a pertinent need to assess the growth and leaf yield to sole application of mineral and organic fertilizers, their combination and the combined application of organic fertilizers. Therefore, this research was designed to assess the application of sole organic and mineral fertilizers and their combinations when applied at 50:50 and 75:25 ratios on the growth and yield of *Telfairia Occidentalis* ugu-elu.

Materials and Method

Location of the Experiment and Soil Analysis

The field experiment was carried out at the Teaching and Research Farm of the School of Agriculture and Industrial Technology, Babcock University, Ilishan Remo, Ogun State, Nigeria in the rain forest of south western Nigeria, with a mean rainfall of 2400 mm. A number of core samples (15 cm deep) were collected randomly from the field and were bulked, mixed, air-dried and pass through a 2-mm sieve to remove non-soil particles of roots, stones etc. A composite sample was later obtained. Physical and chemical characteristics of the soil sample were as follows: 850 g/kg Sand, 48 g/kg Silt, 102 g/kg clay, pH in H_2O 3.82, 1.3 g/kg organic carbon, 20.40 mg/kg Extractable P (Bray 1) soils, 0.77 g/kg total N, and Exchangeable K was 73.00 Cmol/kg .

Mineral and Organic Manure

The inorganic manure {Sulphate of Ammonia (21%N)} and organic manure used {the composted maize cob (CMC) and composted sawdust (CSD)} were obtained from the teaching and research Farm of the School of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo. The two organic manures were analysed for certain chemical properties at ROTAS soil laboratory services, Ibadan (Table 1) using standard methods (Bray and Kurtz, 1945; Brady and Weil, 1999; Bouyocous, 1962; Bremmer and Malvincy, 1982; Walkey and Black, 1934).

Basal fertilizer application

Phosphorus, 40 kgP/ha as Single Super Phosphate (20 $\%P_2O_5$) and Potassium, 30 kgK/ha as Muriate of potash (60 $\%K_2O$) were applied (broadcast) to the experimental field.

Treatments and application

Ten treatments were involved, consisting of Sulphate of Ammonia (SA), composted sawdust (CSD), composted maize cob (CMC) and their combinations in varying proportions of the organic and mineral fertilizers as shown below.

Letter notation	Treatment Description
A	No fertilizer (control)
B	100 kgN/ha as Sulphate of Ammonia, SA (21 %N)
C	100 kgN/ha as Composted Maize cob, CMC (0.97 %N)
D	100 kgN/ha as Composted Saw dust, CSD (1.01%N)
E	50:50 CMC/SA combination
F	50:50 CSD/SA combination
G	50:50 CMC/CSD combination
H	75:25 CMC/SA combination
I	75:25 CSD/SA combination
J	75:25 CMC/CSD combination

The experiment was a randomized complete block (RCBD) design, which was replicated four times.

Seed sowing

Telfairia Occidentalis crop variety (ugu-elu) seeds were obtained from the Teaching and Research Farm of the School of Agriculture and Industrial Technology, Babcock University, Ilishan Remo, Ogun State, Nigeria. The seeds were sown at two seeds per spacing of 30cm apart.

Data collection

Data were collected on the following variables: Seedling emergence, Plant height (cm) at 3 and 4 weeks after planting, Leaf number/plant at 3 and 4 weeks after planting, Leaf area (cm^2) at 3 and 4 weeks after planting and Dry matter weight of shoot (g).

Statistical analysis

The variables were subjected to analysis of variance as described by Steel and Torie (1980) and the means were separated using Duncan Multiple Range Test (DMRT) at 5% level of significance.

Results and Discussion

Based on the result of the soil properties, particle size analysis carried out showed that the soil was sandy loam (textural triangle) which must have prompted the nutrient loss through leaching evidenced by the low %N concentration (Table 1). Soil was Acidic pH (3.82) thus containing a medium concentration of available phoshorus (20.40 mg/kg). The % C of 0.76 is an equivalent of 1.3% organic matter. Oluwatosin *et al.* (2008) have identified low organic matter and microbial population as indices of poor soil quality.

For Organic fertilizers used for the trial namely; composted maize cob (CMC) and composted Sawdust: composted Sawdust contains higher %C compared to the composted maize cob (Table 1). Based on this attribute of CSD, it may appropriately provide more organic colloids for a better soil structure development and has more potential and support a higher biodiversity as a manure item. The alkaline nature of the manure (CSD) (Table 1) may enable it supply the postulated higher biodiversity in a soil, thus prompting a higher biotransformation activity as a manure than CMC with rather low carbon used for the trial.

Seedling emergence was similar irrespective of the treatments at 3 Weeks After Planting (Table 2). However, application of CMC has resulted in a slightly higher seedling emergence than its combined application with SA. The reverse is the case with application of CSD and its combined application with SA in respect of seedling emergence. The application of 100 kgN/ha as Sulphate of Ammonia resulted in the least seedling emergence which may be attributed to the fact that the soil is a sandy loam according to the textural class thus, permits N loss through leaching or the impact of treatments may not have become effective on seedling emergence 3 WAP.

Plant growth on height increased with age, irrespective of treatments for 3 and 4 weeks (Table 3). Significantly taller plants ($P \leq 0.05$) was observed with applications of CMC compared to either the control or applications of sole Sulphate of Ammonia at 4 WAP. Conversely, though by only 15%, combined application of CSD and SA resulted in taller plants compared to sole CSD application an indication that combined use of organic and inorganic fertilizer has some positive effect on the variable and may lead to reduced expenses on mineral fertilizers by farmers. The 50:50 CMC/SA, CSD/SA and CMC/CSD the combination involving CSD and SA resulted in tallest plants. Shortest plants were recorded with CSD/CMC . Similarly 75:25 ratio of CSD/SA gave the tallest plants among the other 75:25 combinations. The shortest plants were recorded at 75:25 CSD /CMC. The tallest plant height observed when both organic fertilizer (CMC AND CSD) were combined with sulphate of Ammonia (inorganic fertilizer) were in line with the findings of Idem *et al*., 2012**.**

Leaf production is very crucial to the process of photosynthesis in crops. Like in height, increased plant foliage was observed with age, irrespective of treatments (ie at 3 and 4) weeks after planting (Table 4). Combined application of either of the two organic fertilizers as seen at 50:50 in this trial with inorganic fertilizers resulted in more leafy plants than when each type of fertilizer was separately applied (4WAP) implying a kind of superiority in a combined use of the fertilizers. Combining CSD and SA at a ratio of 75:25 for application resulted in a somewhat higher leaf number of the crop than CSD/SA at 50:50 ratio signifying a replacement of the SA rate by up to 75% to obtain comparable leaf number than a 50% replacement .This is an option the resources poor farmers may exploit in growing the vegetable. Result from this study demonstrated that 50:50 and 75:25 CMC/CSD combination ratios produced similar leaf number with application of sole CMC or sole CSD suggesting the feasibility of combined application of the two types of organic fertilizer for the production of the vegetable, taking advantage of their subsisting nutrient release.

The data on leaf area is presented in Leaf area is a morphological attribute of plants crucial for photosynthesis. At 3 weeks after planting, the combined applications of organic manures and inorganic manure at a 50:50 ratio (CMC/SA and CSD/SA) performed better, in terms of foliage size (Fig 1). At 4 weeks after planting, 100kgN/ha as CSD and 75:25 CMC/CSD combination gave a significantly broader leaf area compared to any of the other treatments, suggesting that the CSD sole and in combination with CMC (another organic fertilizer) can be used as an alternative to the SA, inorganic fertilizer was used as a standard in this study especially on sandy soil texture of the experimental plot. The fertilization options expressed above for the production of fluted pumpkin should be further evaluated in the face of erratic availability of mineral fertilizers (Adedoyin, 1995).

Application of sole organic fertilizers or its combinations with inorganic fertilizers also resulted in the highest dry matter weight of shoot, while the application of 100 kgN/ha as Sulphate of Ammonia resulted in the least dry matter weight of shoot 4 weeks after planting (Table 5).

Conclusion

Generally in this study, application of sole organic fertilizers and their combinations with inorganic fertilizers promoted growth in *Telfairia occidentalis* crop variety (ugu-elu) indexed by seedling emergence, leaf area, plant height, leaf number, leaf area and dry matter weight. Results obtained from their study showed that applications of organic/inorganic and organic/organic combinations hold a lot of promises in contrast to application of sole fertilizers which pumpkin producers can exploit. It is apparent that the application of the combinations may generate residual effects on desirable soil properties for enhanced growth performance of crops. The organic/inorganic fertilizer combination in this study resulted in a synergy somewhat in terms of Fluted pumpkin seedling emergence, leaf area and plant height. The findings above have demonstrated a more profitable mobilization of organic wastes causing environmental pollution in many communities in Ogun and other states of Nigeria in general as possible alternatives or for replacing in part the quantum of mineral fertilizers now in use in agricultural business. Further studies should be carried out to evaluate the effects of applications of sole organic fertilizers, their combinations on one hand as well as organic/inorganic fertilizer ratios in the production of other varieties of *Telfairia*, other vegetables and on soil quality.

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Table 1. Chemical properties of Organic manures

Properties	CMC	CSD
pH 1:1 Solid/ H_2O ratio	6.50	8.30
Available P (mg/kg)	1.02	0.43
Nitrogen (%)	0.97	1.01
Carbon (%)	3.51	5.00
Potassium (%)	0.57	0.26
Calcium (%)	1.43	0.26
Magnesium (%)	0.46	0.13
Sodium (%)	0.50	0.42
C/N Ratio	3.61	4.95

CMC- Composted Maize

CSD- Composted Saw dust

Table 2. Effect of sole organic, inorganic fertilizers and their combinations on Seedling emergence.

TREATMENTS	Seedling emergence
No fertilizer (control)	3.2a
100kgN/ha as SA	2.7a
100kgN/ha as CMC	3.7a
100kgN/ha as CSD	3.0a
50:50 CMC/SA combination	3.2a
50:50 CSD/SA combination	3.7a
50:50 CMC/CSD combination	3.0a
75:25 CMC/SA combination	3.7a
75:25 CSD/SA combination	3.5a

75:25 CMC/CSD combination	3.0a

Means followed by the same letters within a column are not significantly different according to the DMRT at 5% probability level

Table 3. Effect of sole organic, inorganic fertilizer and their combinations on Plant height

	Plant height (cm)	Plant height (cm)
Treatments	**3WAP**	**4WAP**
No fertilizer (control)	16.5a	29.4b
100kgN/ha as SA	15.2a	28.3b
100kgN/ha as CMC	17.5a	40.8a
100kgN/ha as CSD	16.8a	32.9ab
50:50 CMC/SA combination	18.8a	35.1ab
50:50 CSD/SA combination	16.0a	37.5ab
50:50 CMC/CSD combination	16.7a	31.0ab
75:25 CMC/SA combination	20.0a	34.8ab
75:25 CSD/SA combination	16.2a	35.0a
75:25 CMC/CSD combination	15.8a	27.0ab

Means followed by the same letters within a column are not significantly different according to the DMRT at 5% probability level

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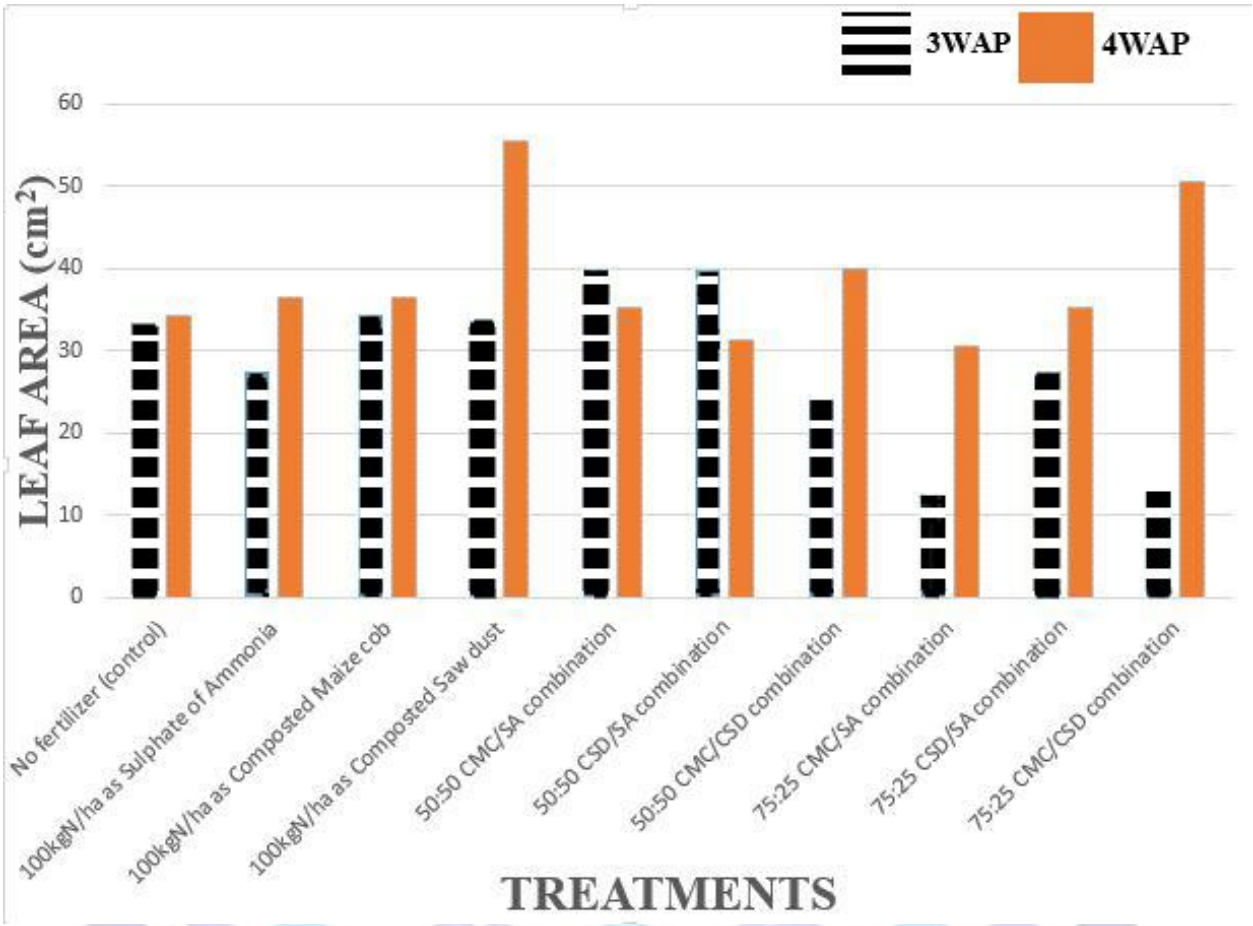

Fig 1. Effect of sole organic, inorganic fertilizer and their combinations on Leaf area at two sampling periods

Table 5. Effect of sole organic, inorganic fertilizer and their combinations on Dry matter weight of shoot

Treatment	Dry matter weight of shoot (4WAP)
No fertilizer (control)	2.26a
100kgN/ha as Sulphate of Ammonia	1.20b
100kgN/ha as Composted Maize cob	2.46a
100kgN/ha as Composted Saw dust	3.40ab
50:50 CMC/SA combination	2.95a
50:50 CSD/SA combination	2.70a
50:50 CMC/CSD combination	3.76a

75:25 CMC/SA combination	3.18ab
75:25 CSD/SA combination	2.22a
75:25 CMC/CSD combination	3.56a

Means followed by the same letters within a column are not significantly different according to the DMRT at 5% probability level