

1 **Green Manure Source Affects Growth and Vegetative Yield of Fluted** 2 **Pumpkin**

3 **ABSTRACT**

4 Application of green manure to the soil can improve soil quality and increase crop yields,
5 especially in organic farming. An experiment was conducted between April and October
6 2014 to determine nutritional potential of the soil amendments: Aleshinloye grade B organic
7 manure; Mexican sunflower manure [*Tithonia diversifolia* (Hemsl.) A. Gray]; Neem
8 (*Azadirachta indica* A. Juss) manure; *Moringa* (*Moringa oleifera* Lam.) manure, compared to
9 a non-manure control. on growth and vegetative yield of Fluted pumpkin (*Telfaira*
10 *occidentalis* Hook.F). At 2 week intervals, from 2 to 12 weeks after transplanting, number of
11 leaves per plant, vine length per plant and number of branches per plant were determined. At
12 harvest, fresh and dry leaf, stem and root weights were determined. Growth of Fluted
13 pumpkin was generally enhanced by manures compared with untreated plants. *Moringa*,
14 Mexican sunflower and Neem manures produced similar numbers of leaves, vine length and
15 numbers of branches which were higher than Aleshinloye manure and the controls. Mexican
16 sunflower manure had leaf dry weights, 38.19 g/plant, similar to *Moringa* manure, 24.76
17 g/plant, which were higher than Neem and Aleshinloye manures. Control plants had the
18 lowest yield, 15.19 g/plant. Mexican sunflower manure could be an adequate source of
19 nutrition in cultivation of Fluted pumpkin.

20 **Keywords:** *Telfaira occidentalis*, botanicals, leaf dry weight, manure

21 **INTRODUCTION**

22 Fluted pumpkin (*Telfaira occidentalis* Hook.F), a herbaceous climbing annual plant
23 (Esiaba, 1982; Christopher, 2003), is cultivated for the edible leafy shoot and immature
24 edible seed. Fluted pumpkin is rich in minerals and vitamins (Cole, 1977). It can be
25 propagated by seed or vine cuttings (Esiaba, 1982). The major challenge in production of

26 Fluted pumpkin is that indigenous production in Nigeria is rapidly decreasing due to poor soil
27 fertility, inaccessibility to fertilizer and lack of water during the cropping season (Tindal,
28 1986).

29 Besides controlling weeds and erosion, conserving moisture, sustaining soil
30 productivity by improving physical and biological soil conditions, and preventing
31 degradation of the soil, plant materials serve as nutrient sources for subsequent crops upon
32 mineralization and help to attract earthworms (Ibeawuchi et al., 2015). Green manure use can
33 increase production of vegetables under tropical conditions by maintaining soil moisture, soil
34 fertility and productivity. Apart from the economic cost, use of chemical fertilizers under
35 continuous cultivation in the tropics is not adequate to sustain crop yield (Sullivan, 2004).
36 Most plant products are non-polluting, less toxic and biodegradable with no hazardous
37 residues in soil, water and air. They are environmentally safe and generally do not leave
38 residues in stored food products (Prakash and Rao, 1997). Plant materials can be used as soil
39 amendments (Taiwo and Makinde, 2005) and can improve soil fertility (Atta et al., 2004).
40 Fabunmi et al. (2014) reported that *Moringa* leaves has potential to furnish nitrogen,
41 phosphorus and potassium in production of vegetable amaranth (*Amaranthus hybridus* L.).
42 *Tithonia* can increase yield of crops (Jama et. al., 2000). Usually, most small holder farmers
43 cannot afford to apply fertilizer, making it necessary to identify cheap and accessible means
44 of replenishing nutrients in the soil. Farmers rely on native fertility and leave the land fallow
45 over time to be restored. According to Sanchez et al. (1996), soil fertility depletion in small
46 holder production systems is the fundamental cause of declining per capita food production.
47 The shortage and high cost of inorganic fertilizers have limited their use for crop production
48 among small holder farmers in Nigeria (Tanimu et al., 2007). With increasing demand and
49 consumption of fluted pumpkin, it is necessary to identify potential plant materials as

alternatives to synthetic fertilizer. This project was undertaken to assess effects of green manures on growth and vegetative yield of fluted pumpkin.

MATERIALS AND METHODS

A rain fed experiment was conducted at the Federal College of Agriculture, Ibadan, Nigeria, latitude 7°22N and longitude 3°50E, from April to October in 2014. Fluted pumpkin seed were sown into a degraded loamy sand soil in polythene bags and the soil moistened to allow plant establishment. Weeding was at 3 and 6 weeks after transplanting. One week after sowing, 10 kg of degraded soil was weighed into 20 polythene bags, 20 by 20 cm, into which were added either Mexican sunflower leaves [*Tithonia diversifolia* (Hemsl.) A. Gray]: 17.1 g/pot; Neem leaves (*Azadirachta indica* A. Juss): 26.9 g/pot, or Moringa leaves (*Moringa oleifera* Lam.): 14.4 g/pot, all of which were collected during vegetative growth of plants. Two weeks after application of green manures, 3 week-old seedlings were transplanted into the polythene bags. Soil around the seedling collar was firmed to stabilize seedlings. The control was no soil amendment, as usually practiced by farmers.

Tissues of green manures were air dried for 4 weeks and ground into a powder for analysis. Soil samples were air-dried for 72 hrs, ground and passed through 2 and 0.5 mm sieves. The 2 mm sieved soil was used to determine pH and the 0.5 mm sieved soil used for nitrogen and organic carbon determination. Phosphorus was determined by the Bray 1 method (Bray and Kurt, 1945); nitrogen by the Kjeldahl method (Bremner, 1996), and potassium and sodium by flame photometry. A completely randomized design was used with treatments replicated 4 times. Data collected included: number of leaves per plant, vine length, and number of branches per plant. At harvest: fresh and dry weights of leaves, roots and stems were determined. The data were subjected to analysis of variance, and where appropriate, means separated using Duncan multiple range test. Data that were quantitative and continuous were analyzed with linear regression.

75 RESULTS AND DISCUSSION

76 Results of plant analysis showed that Mexican sunflower had 2.61%N, 0.47%P,
77 2.89%K and 0.63%Na; Neem had 1.66%N, 0.12%P, 1.49%K and 0.50%Na and Moringa had
78 3.11%N, 0.38%P, 2.04%K and 0.52%Na. The Alesinloye grade B organic manure had
79 1.52%N, 3.00%P, 2.00%K and 3.50%Na.

80 The available phosphorus, total nitrogen, and organic matter content in the soil were low;
81 soil pH was slightly acidic (Table 1). This qualifies the soil for nutrient study as it mimics the
82 usual practice of small-holder farmers in Nigeria, which should not be encouraged in a
83 sustainable farming system. Vine length, number of leaves and number of branches per
84 plant was affected by fertilizer type and sampling time but not by the interaction (Table 2).

85 Growth of Fluted pumpkin was generally enhanced by the green manures compared
86 with untreated plants. *Moringa*, Mexican sunflower and Neem manures produced similar
87 numbers of leaves, vine length and numbers of branches which were higher than Aleshinloye
88 manure and the controls (Table 3). Treated plants produced more leaves than controls,
89 indicating the green manures can enhance growth of fluted pumpkin. Treatment with
90 Mexican sunflower manure and Moringa manure were similar and greater than the Neem, the
91 Aleshinloye and the control. The green manures produced more leaves than the Aleshinloye
92 and the control which had the least leaves compared with highest leaf production from
93 Moringa manure. Taiwo and Makinde (2005) reported that weed residues increased crop
94 yield than the conventional manure. This may be due to higher soil moisture, improved soil
95 fertility and reduced weed competition (Ibeawuchi et al., 2015). Organic poultry manure
96 enhanced growth of fluted pumpkin (Dauda et al., 2008) where there were increases in
97 numbers of leaves, vine length and number of branches while green manures gave better
98 yield than conventional manure which could be beneficial due to nutrients available being
99 released slowly (Aruleba and Fasina, 2004).

Vine length due to treatment with Moringa was greater than the control; the remaining treatments were intermediate and similar to either the Moringa treatment or the control as reported by Foidle et al. (2001) where application of Moringa increased crop production even though this was achieved under a different environment. Green manures produced longer vines than the control and the Aleshinloye manure which are similar in vine length extension. Crop residues have been used to supplement inorganic fertilizer for vegetable crops (FDA, 1980). This probably occurred because of earlier mineralization than the other nutrient sources (Ibeawuchi et al., 2015).

Application of manures encouraged production of more branches than on unfertilized plants. All green manures produced the same number of branches. Treatment with Moringa was greater than the control; the remaining treatments were intermediate and similar to either the Moringa treatment or the control. However, all green manures were similar and greater than the Aleshinloye manure and the control which produced the lowest number of branches. Liasu and Achakzai (2007) reported that *Tithonia* leaf mulch produced higher biomass and increased crop yield than other organic manure sources (Jama et. al., 2000).

There was a positive correlation between plant age and number of leaves produced. The number of leaves increased with increase in weeks after transplanting through week 12 (Fig. 1). According to Adeniji and Aremu (2007), as plants aged and plant growth and development factors were adequate, photosynthetic activity is enhanced leading to production of more leaves/plant. The vine length of the Fluted pumpkin increased for every week increase in age of the Fluted pumpkin (Fig. 2). Vines increased in length more quickly from 2 to 6 weeks after planting than from 6 to 12 weeks after transplanting indicating the plant has transitioned to production of reproductive structures. This agreed with Makinde (2015) where plant height, stem diameter and number of leaves of *Amaranthus* increased with time as the

plant had more time to grow. Number of branches of Fluted pumpkin increased with age for every week after transplanting (Fig. 3).

Fresh yield of fluted pumpkin was not affected by green manure type (Table 4). Fresh yield of treated and untreated plants were similar at harvest which may be due to the slow release of green manure (Aruleba and Fasina, 2004), or as a result of morphological characteristics of the fluted pumpkin (Ndor et al., 2013).

Except for leaf dry weight, root, stem and total plant dry weights were not affected by green manures (Table 4). Mexican sunflower and Aleshinloye manures produced the greatest dry leaf weight (Table 5). According to Olaniyi and Oyelere (2012) yield, and yield components, of *Telfairia* were increased by application of green manure; Neem manure, *Tithonia* manure; than organic manures. The highest yield and yield components of *Telfairia* were from Neem manure followed by Mexican sunflower manure.

CONCLUSION

Fluted pumpkin growth was generally enhanced by the green manures. Mexican sunflower leaves appear to be better replacements for highly expensive Moringa leaves in cultivation of Fluted pumpkin. The green manures can be used to support growth where soil nutrition is marginal. It is necessary to determine if the green manures can be used if soil nutrition is adequate to support the crop. Inorganic fertilizers and health issues can result from agro-chemical residues and plant materials can be used as an alternative to synthetic fertilizer.

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209 **Table 1:** Physical and chemical properties of the soil

210 Parameter	Value
211 pH	6.4
212 Organic carbon	11.5 g·kg ⁻¹
213 Total N	1.1 g·kg ⁻¹
214 Available P (Bray-1)	8.18 mg·kg ⁻¹
215 Exchangeable Ca ⁺⁺	6.0cmol·kg ⁻¹
216 Exchangeable Mg ⁺⁺	0.8cmol·kg ⁻¹
217 Exchangeable K ⁺	0.3 cmol·kg ⁻¹
218 Exchangeable Na ⁺	0.3 cmol·kg ⁻¹
219 Sand	856 g·kg ⁻¹
220 Silt	52 g·kg ⁻¹
221 Clay	92 g·kg ⁻¹
222 Textural class	Loamy sand

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Table 2: Results of ANOVA for vine length, and numbers of leaves and branches for Fluted pumpkin.

Source of variation	Df	Vine length	Number leaves	Number branches
Fertilizer type (F)	4	10382.9**	23499.7**	4.8**
Sampling time (S)	5	49349.2**	70537.7**	28.8**
F × S	20	463.5NS	779.8NS	0.43NS

NS, ** = not significant or significant at $P \leq 0.05$ or $P \leq 0.01$, ANOVA.

Table 3: Effects of fertilizers on the growth of Fluted pumpkin.

Fertilizer type	No. of leaves	Vine length (cm)	No. of branches
Control	90.08d ^a	99.13c	2.33c
Mexican sunflower manure	133.00a	162.00a	3.21ab
Neem manure	120.71b	133.94b	3.21ab
Moringa manure	140.21a	164.41a	3.50a
Aleshinloye manure	102.92c	102.29c	2.88b

^a values in columns followed by the same letter(s) are not significantly different, 5% level of probability Duncan's Multiple Range Test.

Table 4: Results of ANOVA on yield and yield components of Fluted pumpkin (g/plant).

Source of variation	df	Fresh leaf weight	Fresh stem weight	Fresh root weight	Fresh plant weight	Dry leaf weight	Dry stem weight	Dry root weight	Dry plant weight
Treatment	4	12310.2ns	10550.8ns	1774.7ns	65054.4ns	7899.4*	94.5ns	204.1ns	9393.1ns

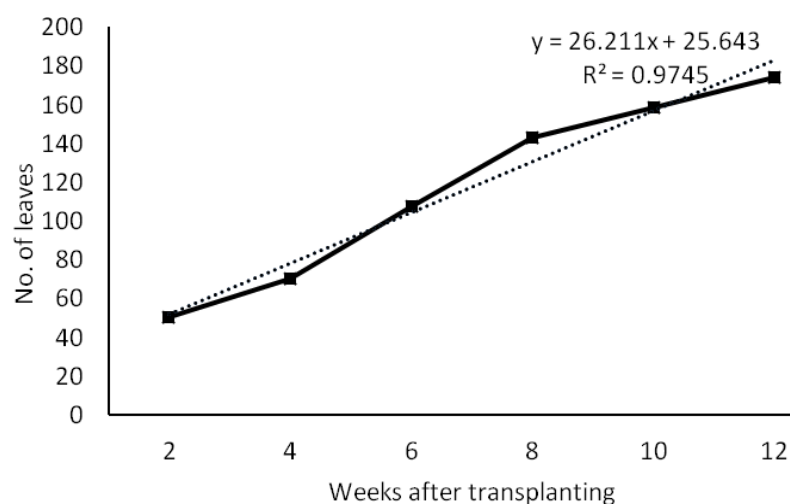
ns, * = not significant or significant at $P \leq 0.05$, ANOVA.

Table 5: Effects of fertilizers on leaf dry weight (g/plant) of Fluted pumpkin.

Treatment	Leaf dry weight
Control	15.19b
Mexican sunflower manure	38.19a
Neem manure	15.56b
Moringa manure	24.75a
Aleshinloye manure	16.81b

^a Values followed by the same letter in a column are not significantly different, 5% level, Duncan's Multiple Range Test.

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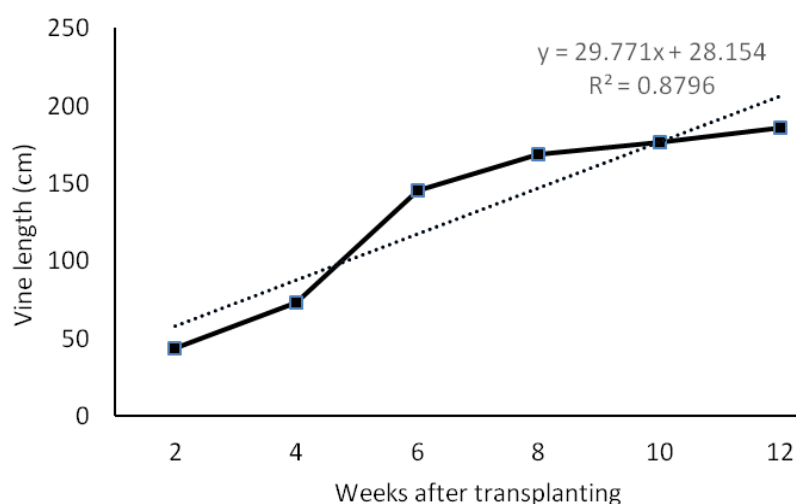
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Figure 1: Number of leaves of Fluted pumpkin across weeks after transplanting, dotted line is the regression line.



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Figure 2: Vine length of Fluted pumpkin across weeks after transplanting, dotted line is the regression line.

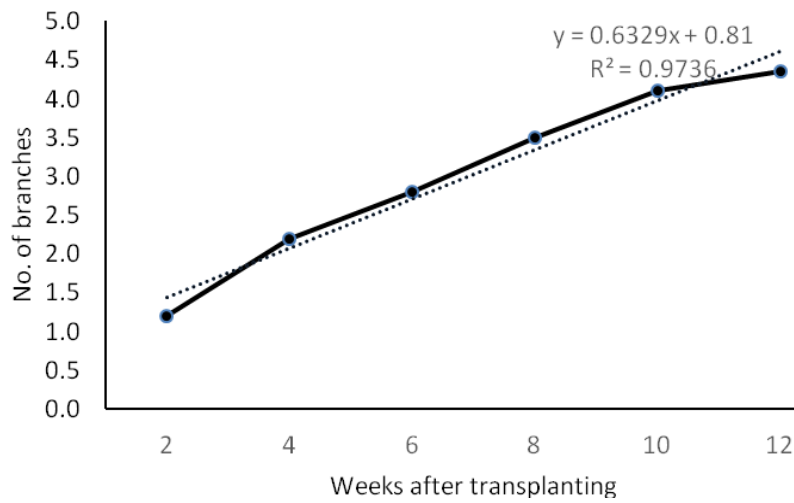


Figure 3: Number of branches of Fluted pumpkin over time number of leaves of Fluted pumpkin across weeks after transplanting, dotted line is the regression line.