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Research Article

Effect of Tillage Methods on the Growth and Yield of Fluted Pumpkin (*Telfairia occidentalis*) On the Jos Plateau

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Abstract: *Telfaira occidentalis* is tropical vine grown for its edible leaves, stem and seeds. This experiment was conducted to determine the effect of zero and manual tillage methods on the growth and yield of *Telfaira occidentalis*. The study was carried out for a period of 16 weeks using a Randomized Complete Block Design. The treatments were zero and manual tillage (involving plowing into raised beds) methods with six replicates. Data were collected on leaf count, plant height, collar girth, weight of harvested foliage, fresh leaves and length of vines of *Telfaira occidentalis*. Analysis of variance indicated that there was no significant difference ($p > 0.05$) in yield of harvested foliage from the two tillage methods. This implies that the beneficial effect of zero tillage on growth and yield of *Telfaira occidentalis* may not be obvious on a short term basis. In addition the non-significance difference in yield characteristics between the two tillage methods shows that it may not be necessary to spend extra time and resources in conventional tillage activities when growing *Telfaira occidentalis* on similar soil and climatic conditions of the study area.
Keywords: Conservation, tillage, *Telfaria occidentalis.*

Introduction

Telfairia occidentalis (fluted pumpkin) is a leafy vegetable native to the tropical rain forest of West Africa with the largest diversity in south eastern Nigeria. *Telfairia* of different species are also grown as leafy vegetable in other tropical regions of the world including India, Bangladesh, Sirilanka and the Caribbean. It is also grown to some extent in south east Africa and Latin America (Aletor, Oshodi and Ipinmoroti, 2002).

Fluted pumpkin grows well in fertile well drained loamy soil with a high water holding capacity when grown under rain-fed conditions. The plant dies back during the dry season in Nigeria (November-March). The plants are tolerant to elevation up to 1000 m and a wide range of soil condition. Although fertile soils with good moisture retaining capacity are preferable, it is partially drought resistant, growing in shade or full sun. The low land humid tropics normally provide suitable condition for growth (Tindall, 1968 as cited by Kayode and Kayode, 2011). The plant is diecious perennial and normally grown trellised.

The seedling of fluted pumpkin is very tender, and as such it is usually grown on soils cultivated into raised bed, ridges or mounds to ensure good soil tilth for easy root penetration, aeration and infiltration of water. However, a lot of concerns have been raised on the negative effect of excessive tillage and conventional tillage practices on soil productivity in the long term (Brady and Weil, 1999). For example, Hoffman (2012) noted that the disadvantages of conventional tillage include increased: loss of soil organic matter, soil compaction and

vulnerability of soil to erosion. Hence various conservation tillage practices have been proposed as an alternative to conventional tillage methods. Conservation tillage practices such as zero tillage may present some difficulties in managing the soil for crop production. Challenges posed by zero tillage especially in poorly drained fine textured soils may include poor root development (Busari *et al.,* 2015) and additional efforts required in weed control and planting of seeds or seedlings, just to mention a few. On the other hand, beneficial effects of conservation tillage have been reported and these include increased soil: organic matter content, structure development, and productivity. Consequently, the objectives of this study was to evaluate the effect of zero and manual tillage methods on the growth and yield of *Telfairia occidentalis.*

Material and Method

Study Area

A suitable site that had not been cultivated before or used for agricultural purpose within the Federal College of Forestry, Jos; was chosen for the study. The Federal College of Forestry Jos, is situated between latitudes $9^0$56.843'N, longitude $8^0$53.493'E and latitudes $9^0$56.822'N, longitude $8^0$53.753'E. It is situated 1173 meters above sea level on the Jos Plateau, within the northern guinea savannah ecological zone of Nigeria (Kowal and Knabe, 1972). The climate is characterized by distinct dry and wet seasons with a mean annual rainfall of 1,260 mm (1050-1403 mm) which peaks between July and August and a mean annual temperature of about 22°C (Olowolafe, 2002). Weather condition during period of study is presented in Table 1.

Table 1. Weather condition* during period of study

Month	Mean monthly Rainfall (mm)	Mean monthly atmospheric Temperature (^{0}C)	Mean monthly Relative humidity (%)	Evapotranspiration (mm)
January	0.0	23.5	24.73	5.84
February	0.0	27.82	29.68	6.71
march	0.69	30.49	31.84	5.94
April	11.40	29.9	62.6	5.40
May	9.1	28.13	62.84	5.68
June	12.91	25.50	69.63	5.38
*daily weather data sourced from Federal College of Forestry, Jos Metrological station				

Field Work and Statistical Analysis

Two treatments replicated six (6) times were used for this study. Details of the treatments are:
T1-Manual tillage
T2-Zero tillage

The size of each plot was 2.0m x 2.0m with 1.0m discard area between the plots. The gross plot (total area) of the experimental site was 11m x 8m (88m).

For manual tillage, the soil was cultivated with a hoe, pulverized before forming into raised beds. No cultivation or tillage activity was performed on plots with zero tillage treatments. Seeds were extracted from the fruit pod, cleaned in water and shade dried for 2 days to reduce the moisture content. The seeds were planted directly in the plot. For the zero tillage plot a

tiny hole just enough to accommodate the width of the seed was drilled into the soil. Planting spacing was 1m x 1m. Irrigation and hand weeding was carried out frequently. The crop was staked at the fourth week after planting.

Data was collected on leaf count, collar girth, plant height, length of vine (sum of length of vine in each branch and the main stem), weight of harvested foliage and fresh leaves. The harvesting process commenced at 10 weeks of growth. The data collected from the experiment was subjected to analysis of variance.

Three soil samples were collected at random from the study site from a depth of 0 - 15cm and bulked to form a composite sample. The following analyses of the soil were carried out as described by Ibitoye (2008): nitrogen (Walkley-Black oxidation method), organic matter (Potassium dichromate method), phosphorus (spectrophotometric method), pH (using pH meter), potassium (flame photometer method) and particle size analysis (hydrometer method).

Results

Soil Characteristics of the Study Area

Table 2 shows result of physical and chemical analysis of the soil of the area. Consequently, the analysis shows that the soils are extremely acidic (pH = 4.18) with medium Nitrogen level (N = 0.16%). This indicates that the soil has some fertility constraints for crop production. The texture of the soil is sandy loam with high organic matter (4.21%).

Growth and Yield Characteristics

There was a progressive increase in leaf count, plant height and collar girth from the onset of growth as shown in Figure 1 to 3. There was no significant difference ($p > 0.05$) between the effect of manual tillage and zero tillage on leaf count and plant height. However, there was significant difference ($P<0.05$) in mean collar girth between zero and manual tillage at 10 weeks of growth. This indicated that at 10 weeks of growth of *Telfairia occidentalis*, zero tillage produced higher collar girth than for manual tillage. *Telfairia occidentalis* was harvested after 16 weeks of growth and data was obtained on mean vine length, total mean weight of harvested foliage and total mean weight of fresh leaves as presented in Table 3.

The mean weight of harvested foliage was 795.6317 and 1311.8317 (kg/ha) for zero and manual tillage respectively. However, there was no significant difference ($P > 0.05$) in harvest data between zero and manual tillage.

Table 2. Soil properties of the study area

Soil properties	Data	Rating*
pH	4.18	Extremely acidic
Nitrogen %	0.16%	Medium
Organic matter %	4.21%	High
Potassium cmol/kg	2.1cmol/kg	Very high
Bulk density	1.50 mg/m^3	Medium
Clay %	14.88%	Sandy loam
Silt %	18.0%	
Sand	67.84%	
*Soil ratings sourced from Owonubi (2017)		

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Table 3. Harvest data after 16 Weeks of growth

			95% Confidence Interval for Mean	
		Mean	Lower Bound	Upper Bound
Harvested Foliage[a]	Zero tillage	795.6317	286.6389	1304.6244
	Manual tillage	1311.8317	845.8149	1777.8484
Leaves[a]	Zero tillage	505.7683	187.3709	824.1658
	Manual tillage	819.8367	583.6322	1056.0411
Length of vine[b]	Zero tillage	177.4667	82.9252	272.0081
	Manual tillage	230.0500	201.1241	258.9759
a = kg/ha, b = cm				

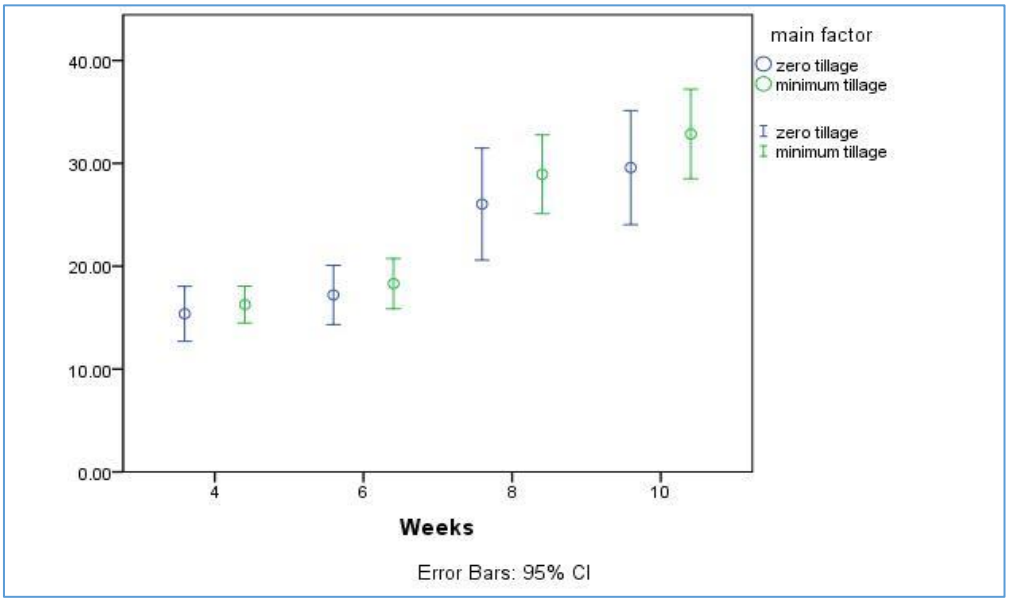

Figure 1. Trends in Mean Leaf Count of *Telfairia occidentalis*

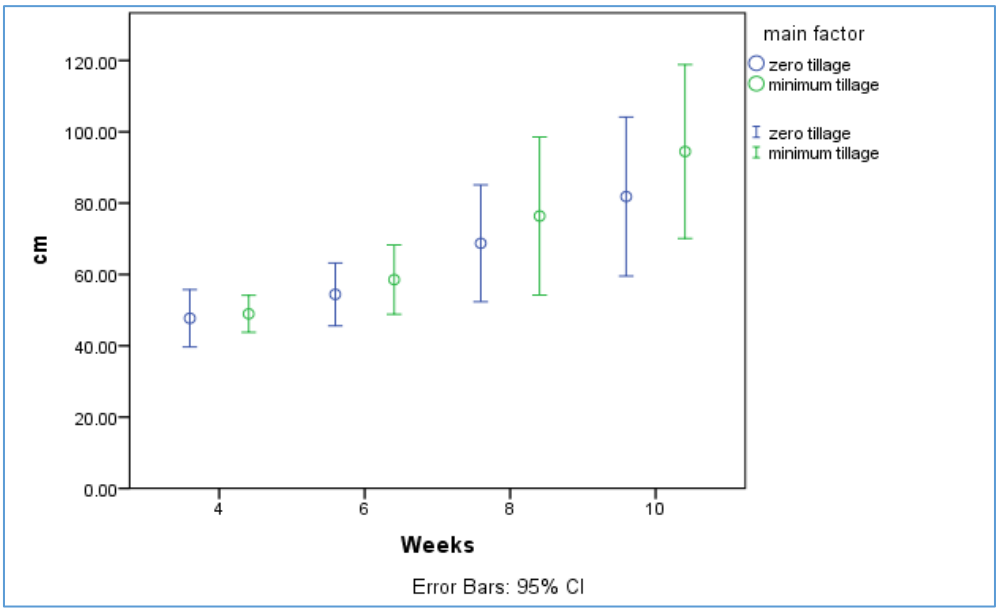

Figure 2. Trends in Mean Plant height of *Telfairia occidentalis*

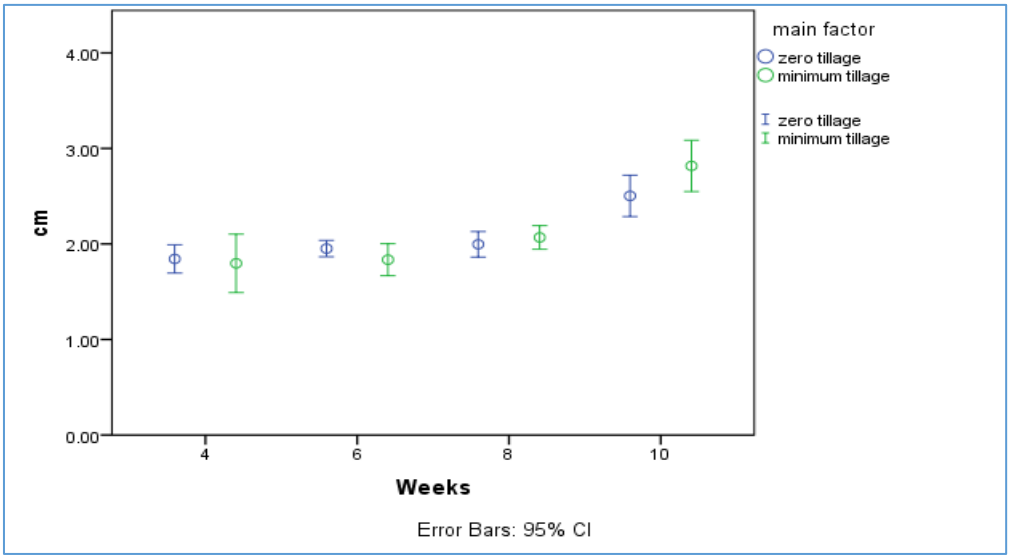

Figure 3. Trends in Mean Collar Girth of *Telfairia occidentalis*

Discussion

The land area used for this study had no evidence of cultivation or tillage activities at least in the recent past. It is probable that no cultivation has ever been performed on the land area. This is more so as stable, coarse, porous granular soil structure made by earthworms were observed in considerable quantities on the soil surface. In addition, nitrogen and organic matter were at favorable levels in the soils. Brady and Weil (1999) have noted that soil not under cultivation generally have more organic matter than soil put into cultivation. They also noted the role of organic matter in soil aggregate stability and water holding capacity.

The physical analysis also indicated that the soil has medium bulk density (1.50 mg/m^3) which will allow for water infiltration and root penetration. High soil bulk densities, most especially below the plough layer have been usually reported in soil under prolonged intensive mechanized cultivation (Brady and Weil, 1999). Manual and zero tillage in general did not did not have significant effect on growth and yield characteristics of *Tefaria Occidentalis*.

However, in a similar study carried out by Odjugo (2009); it was reported that ridging and mounding produced higher yield than zero tillage. This difference in result may be due to the varying climatic and soil characteristics of the study areas. The range in mean harvested foliage (796 to 1312 kg/ha) for this study was slightly higher than that reported by Ndor, Dauda and Garba (2013). They reported a range of 689.45 to 1234.42 kg/ha for yield of *Telfairia occidentalis* cultivated using conventional tillage.

Conclusion

This study shows that the beneficial effect of zero tillage on growth and yield of *Telfairia occidentalis* may not be observed on a short term basis. In addition, the non-significant difference in yield characteristics between zero and manual tillage shows that there may be no need spending extra resources (such as time and labor costs) to cultivate the land before planting *Telfairia occidentalis*.

It is therefore recommended that further research on a larger scale and with a longer time frame be conducted to fully comprehend the effects of tillage on growth and yield of *Telfairia occidentalis.*

Conflicts of interest: There is no conflict of interest of any kind.

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