

Rate and Frequency of Poultry Manure on Growth and Yield of Fluted Pumpkin (*Telfairia Occidentalis* Hook. F.)

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Abstract

Fluted pumpkin (*Telfairia occidentalis* Hook. F.) cultivation is predominantly done by smallholder farmers but scarcity and high cost of inorganic fertilizers have limited its usage and shifted to viable alternative. Field experiments were carried out in the Crop Research Farm, Federal University of Agriculture, Abeokuta, Ogun State Nigeria from November 2018 to August 2019 and from August 2019 to August 2020 cropping seasons to determine the effects of poultry manure (PM) rate and frequency of application on agronomic performance of fresh shoot, pod and seed yields of *Telfairia occidentalis*. The study involved three rates: 5, 10 and 15 t ha⁻¹ of PM as main plot and four frequency of PM application: once, twice, thrice and at every harvest and a control plot laid out in split-plot arrangement and fitted into a Randomized Complete Block Design, replicated three times. In 2018, Poultry manure at 15 t ha⁻¹ increased fresh shoot weight at 6 to 14 weeks after planting (WAP) relative to 5 t ha⁻¹ and 10 t ha⁻¹ PM rate. In 2019, interaction of PM at 5 t ha⁻¹ applied thrice significantly increased fresh shoot weight by 85.4% at 14 WAP relative to 15 t ha⁻¹ PM applied once. Interaction of PM at 10 and 15 t ha⁻¹ applied thrice and at every harvest respectively gave similar results on cumulative fresh shoot weight while the plants in control plots produced significantly lower fresh shoot weight in 2018. There were no significant differences observed in weight of pod and seed weight/plant with PM rate, frequency and interaction in 2018 and 2019 cropping. The study concluded that 10 t ha⁻¹ PM rate applied thrice enhanced cumulative fresh shoot yield in fluted pumpkin in the study area.

Introduction

The genus *Telfairia*, is a nutritionally important but scientifically less popular member of the family Cucurbitaceae, order Telfaireae (The Complete Botanica 2004). *Telfairia occidentalis* originated from South Eastern Nigeria, where it is predominantly cultivated to date (Uwa *et al.* 2016). It must be provided with support (stakes); it has a creeping growth habit that spreads across the ground to produce an efficient cover to the ground against erosion (Horsfall and Spiff 2005). Vine size at 64 days after planting could be used as a sex indicator, because female plants are more vigorous than the male plants (Benadine 2021). Fluted pumpkin is a rich source of protein, oil, vitamins and minerals (Nwite *et al.* 2013). Application of 10 t ha⁻¹ and 15 t ha⁻¹ poultry manure rates has been shown to influence growth and yield parameters of *Telfairia* (Achebe *et al.* 2014). This implies that the use of organic soil amendments could be means of improving the growth of *Telfairia occidentalis*. Increased demand for crops and continuous cultivation on the same land for a long time requires the soil to be adequately fertilized. This has become the norm of cultivation. Most farmers who apply fertilizers do so indiscriminately (Beatrice *et al.* 2016). Application of manure has benefits other than delivery of nutrients. Poultry manure application improves the physical properties of the soil. There have been reports on the increase in the vegetative development of crops with fertilization application (Akanbi *et al.* 2007). Poultry manure contains more plant nutrients than all other organic manures for the healthy growth of plants (Oyedeki *et al.* 2014). Timing of poultry manure application should be scheduled in order to meet crop needs while minimizing runoff susceptibility. The maximum rate of poultry manure that can be applied at one application

depends on the salinity threshold the crop can tolerate. Split fertilizer applications help to avoid salt damages to the crop and improve germination rate. Growers get improved return from fertilizer investments and fertilizer losses can be reduced (Yang et al. 2011). For *Telfairia* plant to complete its life cycle, more than one application of manure may be needed. So, there is need to investigate the response to manure rate and frequency of manure application on growth and yield of *Telfairia occidentalis*.

Materials And Methods

The trial was conducted in lowland in the Crop Research Farm of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria from November, 2018 to August, 2020. Weather data for the experimental period was obtained from the Meteorological Station of the Department of Water Management and Agrometeorology, Federal University of Agriculture, Abeokuta. The factors included three Poultry manure (PM) rates: 5, 10 and 15 t ha⁻¹ as main plot. Frequency of PM application: once, twice, thrice and at every harvest as sub-plot, with a control. The trial was a split plot arrangement in randomized complete block design (RCBD), replicated three times. Soil samples were taken twice (pre and post sampling) using the soil auger at the depth of 20 cm. The pre-cropping samples were taken randomly in "W" pattern while the post-cropping samples were taken per plot. After the random collection, the samples were thoroughly mixed in a bucket and a representative sample was taken for the soil analysis. The post sampling analysis which was randomly taken per plot, was mixed and bulked per plot. These were analysed to determine the physico-chemical composition of the soil. A sample of the PM was taken for chemical analysis prior to each application time. At each harvest, portion of the PM used as treatment was taken for analysis because the PM gradually decompose due to how long it has been stored before usage. Seeds were extracted from the pods and planted. Planting of one seed/hole at a spacing of 1m x 1m was done by laying the seeds flat on the prepared beds on 29th November 2018 for the first trial. The second trial was sown on August 26th 2019 on same plots. 'Telfairia' plants that survived at the end of the first trial were counted and missing stands were supplied to meet plant population per plot in 2019. Mulching was done to conserve soil moisture during the dry season. The plants were staked at 6 Weeks After Planting (WAP) to assist the plant to climb for flowering and fruiting. First PM application was done at 3 WAP and subsequently at 2 weeks interval, after every harvest of leafy shoot to assist the germinated *Telfairia* plants get the nutrients needed. Hand weeding was done around the base of the plants at 6 and 14 WAP. Harvesting of leafy shoot was done five times at intervals of 2 weeks from 6 to 14 WAP. Data were collected on: Number of branches/plant; Fresh shoot weight; Weight of pods/plant and Seed weight/pod. Number of branches/plant was done by counting the number of branches on a plant on each plant of the five tagged plant within the net plot. Fresh Shoot Weight (kg ha⁻¹) was taken by weighing the cut vines at 50 cm from the soil surface per plot. Cumulative Fresh Shoot Weight (t ha⁻¹) was extrapolated from Fresh Shoot Weight (kg ha⁻¹). Weight of pods/plant (kg ha⁻¹) was taken by weighing each pod per plant and later extrapolated to weight of pod per hectare (kg ha⁻¹). Seed weight/pod (kg) was taken by weighing the seeds extracted from the pod.

Data collected were subjected to analysis of variance (ANOVA), using GENSTAT 12th edition statistical package Copyright 2009, VSN International Limited. Significant means were separated using LSD at 5% level of probability.

Results

Rainfall was higher in 2019/2020 relative to 2018/2019. In 2018/2019, total rainfall was 930.6 mm, mean temperature was 31.5°C. In 2019/2020, the total rainfall was 1155.2 mm, mean temperature was 27.8°C (Table 1). Soil textural class was loamy sand (Table 2). The soil of the experimental site was low in fertility and would require amendments for sustainable agricultural yield. Across the two years of manure application, pH of the Poultry manure (PM) ranged from neutral to alkaline; the organic matter, total nitrogen and available phosphorus were moderate; the C: N ratio was moderate for the decomposition process. Over the period of PM storage, the pH decreased in 2018, ranging from moderately alkaline to neutral but increased in 2019 to slightly alkaline. The high and wide variation in the values for phosphorus and iron could be due to the poultry manure high ash content. It could also be as a result of high accumulation of iron in lowland areas (Table 3). In both croppings, there was no significant difference observed on the effect of PM rates except at 6 WAP in 2019 and frequency of PM application and interaction on number of branches. At 6 WAP, application of 5 t ha⁻¹ PM significantly increased the number of branches/plant relative to 10 t ha⁻¹ (Table 4). PM applied at 15 t ha⁻¹ significantly increased fresh shoot weight at 8, 10 and 14 WAP relative to 5 and 10 t ha⁻¹ PM rate at 8, 10 and 14 WAP in 2018 (Table 5). In 2018, at 8 WAP, PM applied thrice significantly increased fresh shoot weight (t ha⁻¹) relative to plots that received PM once, twice and at every harvest and control plot. At 10 WAP, PM applied thrice significantly increased fresh shoot weight relative to the control plot and plots that received PM once, twice and every harvest. PM applied thrice significantly increased fresh shoot weight compared to the control plot at 12 and 14 WAP. In 2019, no significant difference was observed on fresh shoot weight at 6, 8, 10, 12 and 14 WAP. Application of 5 t ha⁻¹ PM increased fresh shoot weight relative to 15 t ha⁻¹ at 6, 10 and 14 WAP. For frequency of PM application, significant differences were observed at 12 and 14 WAP. Plots that received PM thrice and at every harvest significantly increased fresh shoot weight relative to plots that received PM once and twice at 12 WAP. PM applied thrice significantly increased fresh shoot weight relative to the control plot and plots that received PM once, twice and every harvest at 14 WAP. There was significant interaction observed between PM rates and frequency of manure application on fresh shoot weight at 8 and 14 WAP in 2018 and at 14 WAP in 2019 (Table 5). In 2018 cropping, 15 t ha⁻¹ PM rate applied at every harvest significantly increased fresh shoot weight at 8 WAP compared to other PM rate and frequency of application while application of 10 t ha⁻¹ PM at control plot produced significantly lowest fresh shoot weight (Table 6). At 14 WAP, PM at the rate of 15 t ha⁻¹ applied thrice significantly increased fresh shoot weight compared to other application rate and frequency of application, while 5 t ha⁻¹ PM at control produced significantly lower fresh shoot weight (Table 6). In 2019 cropping, at 14 WAP, PM rate of 5 t ha⁻¹ applied thrice significantly increased fresh shoot weight relative to other application rates and frequency of application while 15 t ha⁻¹ PM rate

applied once produced significantly lower fresh shoot weight (Table 6). In 2018 cropping, 15 t ha⁻¹ PM rate significantly increased cumulative fresh shoot weight compared to 5 t ha⁻¹ PM rate (Table 5). PM applied thrice significantly increased cumulative fresh shoot weight relative to other frequency of application. In 2018 and 2019 cropping, there was no significant differences observed on weight of pod and seed weight/pod. Application of 15 t ha⁻¹ PM increased weight of pod/plant and seed weight/pod while 5 t ha⁻¹ produced lowest weight of pod/plant and seed weight/pod. In 2018, PM applied at every harvest increased weight of pod/plant and seed weight/pod relative to the control plot. In 2019, control plot increased weight of pod/plant relative to PM applied at every harvest while PM applied thrice increased seed weight/pod relative to PM applied at every harvest. In 2018 and 2019 cropping, there was no significant interaction observed between PM rates and frequency of application on weight of pod/plant and seed weight/pod (Table 7).

Discussion

The result revealed that the poultry manure rate and frequency of PM application influenced the shoot, pod and seed parameters. The distribution of rainfall during the growth stages favoured better growth and development of *Telfairia* especially for PM fertilized plots in both cropping seasons, which was reflected in the cumulative fresh shoot weight. Rainfall and hence soil moisture status play an important role in maximizing the yield potential of crop which is in conformity with the findings of Irmak et al. (2016) who reported that soil-water in the plant root-zone must be maintained in a balance so that plants can optimize their transpiration (biomass/yield production process) as well as water, nutrient, and micronutrient uptake. The PM had high levels of Total nitrogen, organic matter, iron and phosphorus for mineralization where organic matter decomposition releases nutrients in a plant available form. It equally indicated high moisture retentive capacity, soil aggregation and accommodation of different organisms which are agents of soil fertility (Nwosu et al. 2013). Number of branches/plant increased with increase in PM rate and frequency of manure application in 2018 and 2019. The increase observed was because the branches were able to produce its potential capacity when more soil nutrients were made available. The increased number of leaves/plant confirmed earlier report of Usman (2015) that nutrient availability is a major determinant of the crop photosynthetic capacity. The steady increase of fresh shoot weight could be attributed to the ability of PM at high rate to increase soil nutrients including organic matter which energized the activities of soil organism to liberate the chemical nutrients needed by *Telfairia occidentalis*. Oyedele et al. (2014) reported that poultry manure contains more plant nutrients than all other organic manures for the healthy growth of plants. Lower rate (5 t ha⁻¹) PM enhanced the fresh shoot weight at 6, 10 and 14 WAP in 2018. The lower manure rate resulted in higher fresh shoot weight. The residual effect of 5 t ha⁻¹ PM (from 2018 cropping) and the added 5 t ha⁻¹ PM (2019) would have been adequate for the growth of *Telfairia occidentalis* hence, leading to increase in fresh shoot weight. The luxury application of PM at 15 t ha⁻¹ (accumulated rate) from 2018 cropping thus led to nutrient loss which resulted to a decline in fresh shoot weight of *Telfairia occidentalis*. In both cropping seasons, PM applied thrice increased the fresh shoot weight while the control plot resulted in decrease in fresh shoot weight at 6 to 14 WAP. The enhanced growth was due to the fact that PM applied had medium nutrient

content and the least performance exhibited by unfertilized plants (control plot) could be attributed to nutrient depletion by cropping, without replenishment. Adeniyi and Ojeniyi (2005) reported that PM made nutrients such as nitrogen and organic matter available as they are essential for plant growth which could lead to higher yields. Fresh shoot weight increased when PM was applied thrice and decreased as PM was applied every harvest at 2 weeks interval. The decrease observed maybe due to the absorptive capacity of the soil being overwhelmed with too much manure which is in conformity with Ntia et al. (2017) who reported that too much nitrogen from excess manures can reduce the yield and quality of many vegetables. Application of manures like any fertilizer, can lead to nutrient leaching and pollution of groundwater, so to maximize the economic and fertilizer value of organic manures, their application should match the nutrient needs of the crop (Ntia et al. 2017). This trend was observed in 2019 at 10 to 14 WAP. In 2019, application of 5 t ha^{-1} PM increased cumulative fresh shoot weight. The increase was as a result of residual nutrients added to the soil by carry over benefit of the application on the succeeding crop which is in conformity with Silva et al. (2006) who reported that the residual effect of organic manure applied to the soil refers to the carry over effect of the application on the subsequent crop. PM applied thrice increased the cumulative fresh shoot weight. This might be a result of high C: N ratio of the PM and nitrogen being an important nutrient in the production of leaves and shoot of plants which is in conformity with Ayeni et al. (2012) who reported that poultry manure contains useful soil nutrients that are needed for growth of plants. For interaction of PM rate and frequency of manure application in 2018, the trend showed that application of 15 t ha^{-1} PM rate applied thrice and at every harvest significantly increased cumulative fresh shoot weight. The increase was as a result of high nutrient availability for plant absorption. High organic manure application affect soil property improvement in soil quality and ability to supply beneficial nutrients to plant. This is in conformity with the research report from Micheal Okpara University of Agriculture, Umudike (2006 and 2007) that highest fresh and marketable fluted pumpkin leaf yields were associated with poultry manure application (Muoneke et al. 2011). Increasing the rate and frequency of PM application enhanced weight of pod/plant (kg ha^{-1}) and seed weight/pod (kg) in 2018 and 2019. Pod and seed yields increased with increase in rate and frequency of manure application which indicated that the higher quantity of the manure might have supplied the important nutrients and had more effect on the soil chemical and biological properties which is in conformity with Yaru *et al.* (2018) who reported increased productivity from poultry manure amended soils likely indicates that repeated application to cropland has potential to improve soil health characteristics such as soil organic matter and soil fertility. The increase observed for the pod and seed yields could be as a result of the superiority of PM especially when applied in higher quantity, hence releasing and making available adequate nutrient which might have been needed by the crop for the optimum development of the pod. Iwuagwu (2016) reported that availability of sufficient nutrients facilitates the sink function of fruit plants nourished with sufficient amount of nutrients.

Conclusion

The study concluded that interaction of 10 and 15 t ha^{-1} PM applied thrice and at every harvest gave similar result on cumulative fresh shoot weight in 2018 cropping. The study recommends that 10 t ha^{-1}

PM rate applied thrice should be used to increase cumulative fresh shoot yield in fluted pumpkin.

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Tables

Table 1 to 7 are available in the Supplementary Files section.

Supplementary Files

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- [Tables.docx](#)