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Short Communication

INFLUENCE OF ORGANIC NUTRIENT SOURCES ON FRUIT YIELD AND ANTIOXIDANT PROPERTIES OF NIGERIAN PUMPKIN (*Cucurbita pepo* L.) MORPHOTYPES

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ABSTRACT

A field experiment was carried out during the early cropping season of 2015 at the Teaching and Research Farm, Osun State University, Ejigbo campus, Nigeria. The study evaluated the effects of organic manures on fruit yield and antioxidant properties of green and orange morphotypes of Nigerian pumpkin. Pumpkin, locally called Elegede in the South-West Nigeria is used as an indigenous vegetable. Cattle and poultry manures were applied as treatments at the rates of 10 t ha^{-1} each, there was a control (plants that were treated with neither cattle nor poultry manure). The experiment was a factorial experiment, set out in a randomized complete block design with three replicates. At maturity, the fruits were harvested, yield data were taken and selected fruits across treatments were analyzed for antioxidant activities, phenol, flavonoids, anthocyanin and proanthocyanidin. Results showed that the orange morphotype out-yielded the green morphotype. Also, the yields of the plants that received cattle and poultry manures did not differ statistically. The antioxidant activities and parameters studied across the morphotypes were highest in the control and cattle manure but lowest in plants treated with poultry manure. For optimal yield and bioaccumulation of antioxidants in pumpkin fruits, cattle manure is preferred in the study area.

Key words: agronomic practices, antioxidants, protein, manure, vegetable

INTRODUCTION

Few decades ago, chemical fertilizers have been widely used globally to improve the yields of a number of crops. However, it is now realized that fields under intensive monoculture receiving heavy applications of chemical fertilizers alone show a gradual decline in soil productivity (FFTC, 1998). Applications of nitrogen fertilizers are responsible for emissions of greenhouse gases like nitrous oxide (N_2O) and ammonia (NH_3). Besides, supplying of nitrogen and NH_3, nitrogen fertilizers can also increase soil acidity. Excessive application of such fertilizers leads to pest problems by increasing the birth rate, longevity and overall fitness of certain pests (Jhan, 2004; Jhan *et al*., 2005). Conversely, applications of organic materials such as livestock dung and crop residues as manures can improve soil productivity and crop performance over time. A study carried out on five vegetables in Japan showed that applications of organic matter enhanced root growth and nutrient uptake, resulting in higher yields (FFTC, 1998). Also in Nigeria, there have been studies supporting this practice for vegetables such as *Cucurbita pepo, Corchorus olitorus* and *Celosia argentina* (Makinde *et al*., 2011; Oloyede *et al*., 2019). Another benefit from the increased use of organic materials is that it can help to solve pollution problems caused by agro-industrial wastes. If too much nitrogen fertilizer is applied, whether in the form of organic matter or chemical fertilizer, some of the excess nitrogen is converted to nitrates, which are harmful to human health (Preap *et al*., 2002). Improper use of inorganic fertilizers can cause nitrates to accumulate in groundwater as well as in crops if they are taken up by the roots. They also have bearing on the nutrients and antioxidants concentrations in fruits and vegetables (Oloyede, 2012; Nwite *et al*., 2012).

Pumpkin is a vegetable in Nigeria that almost all its parts are edible and utilized at different developmental periods. The parts, including, shoot, immature fruits, mature fruits and seeds have been found to be very high in bioactive compounds and nutritional properties, especially at minimal input of inorganic fertilizers (Oloyede *et al*., 2014). Source of nutrients influence not only pumpkin yield but also its nutrients (Nwite *et al*., 2013).

MATERIALS AND METHODS

Field experiment was carried out during the early cropping season (Apr.-Aug.) 2015 at the Teaching and Research Farm, Osun State University, College of Agriculture (COA), Ejigbo campus, Nigeria, after soil analysis had been carried out using standard methods. All planting materials (seeds and organic manures namely poultry and cattle dung) were obtained from the same COA farm. The organic manures were analyzed for their chemical compositions. Standard agronomic practices were observed for the cultivation operations. Cattle and poultry manures were applied as treatments at the rates of 10 t ha^{-1} each two weeks before sowing. The

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plot size was 4 m × 4 m, while planting spacing was 2 m × 2 m. The experiment was a factorial experiment, set out in a randomized complete block design with three replicates.

At maturity (14 weeks after planting), fruits were harvested and yield data were taken and recorded. Five fruits were randomly selected across the treatments and analyzed for the antioxidants using standard assays. Antioxidant activities (AA) which is the radical scavenging ability of the fruit was determined using the stable radical DPPH (2,2-diphenyl-1-picrylhydrazyl hydrate) as described by Brand-Williams *et al.* (1995). The reaction of DPPH with an antioxidant compound which can donate hydrogen, leads to its reduction. The change in colour from deep violet to light yellow was measured spectrophotometrically at 517.00 nm. Total phenolic content was analyzed using the method of Singleton and Rossi (1965) as described by Gulcin *et al.* (2003) using the Folinciocalteu's phenol reagent which is an oxidizing reagent. Total flavonoid content was determined using standard quercetin with varying concentration 0.10, 0.20, 0.30, 0.40, and 0.50 mg ml^{-1} as standard in comparison to the sample extract. This was carried out based on the aluminum chloride colorimetric assay method according to Zhilen *et al.* (1999) as described by Miliauskas *et al.* (2004). Total proanthocyanidin content was determined using the modified acid/butanol assay of Porter *et al*. (1986). Total anthocyanin content of the extract was determined by the pH differential method of Fuleki and Francis (1968) and Wrolstad (1993).

RESULTS

Table 1 shows the soil properties of the study area. Total N and K were 1.58% and 4.25 cmol kg^{-1}, respectively; while P value evaluated in ppm was 19. These values are above the critical levels (0.11, 0.20, and 10.00 respectively for N, P and K) according to Adepetu *et al*. (2014).

Figure 1 shows the effect of organic manures on the yield of green and orange morphotypes of pumpkin fruits. Orange morphotype out-yielded green morphotype across the treatments ($p \leq 0.05$). However, fruit yields in poultry manure and cattle dung treatments were similar ($p \leq 0.05$) but higher compared to control. The orange morphotype yielded 17.23, 17.08, and 4.94 t ha^{-1} for plants treated with poultry manure, cattle manure and control respectively, while it was 14.13, 13.65, and 4.04 t ha^{-1} for the green morphotypes respectively.

Table 1: Soil chemical properties of the study area

pH (H_2O) 1:1	7.00	Exch. cations (cmol kg^{-1})	
pH ($CaCl_2$) 1:2	6.80	K^+	4.25
Total N (%)	1.58	Mg^{++}	0.48
Total P (ppm)	19.00	Ca^{++}	2.89

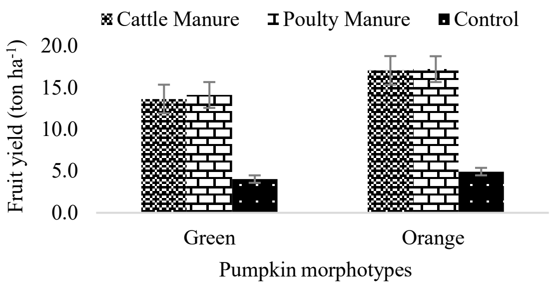

Figure 1: Effect of treatment of manure type on the yield of green and orange morphotypes of pumpkin fruit (t ha^{-1})

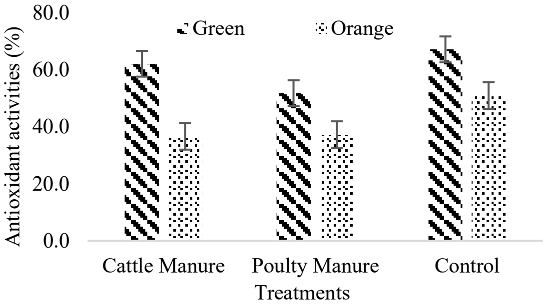

Figure 2: Treatment effect on antioxidant activities of green and orange morphotypes of Nigerian pumpkin

Figure 2 shows the effect of organic nutrient sources on the antioxidant activity or the radical scavenging ability of the pumpkin morphotypes. Green morphotypes showed higher concentration of antioxidant activity across all treatments compared to the orange morphotype. The plants that received no treatment had the highest antioxidant activity in green and orange morphotypes with respective values of 67.25 and 51.05%. The antioxidant activity in the plants that received cattle dung was next in concentration to control containing 62.17% and 36.71% for the green and orange respectively ($p \leq 0.05$), while the antioxidant activity in plants treated with poultry manure had respective values of 51.86 and 37.27% in green and orange morphotypes ($p \leq 0.05$).

Figure 3 shows the effects of organic nutrient sources on total flavonoid concentration of green and orange morphotypes of pumpkin. Green morpho-type had significant ($p \leq 0.05$) higher level of flavonoid compared to the orange across treatments,

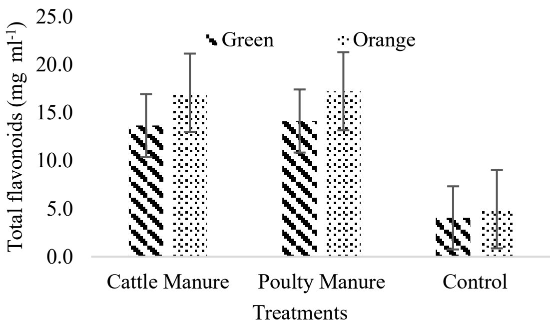

Figure 3: Treatment effect on total flavonoid contents of green and orange morphotypes of Nigerian pumpkin

while poultry manure gave significantly ($p \leq 0.05$) higher concentration of flavonoid in the green and orange morphotypes with respective values of 20.43 and 13.37 mg ml^{-1}. Cattle dung and control seemed not to be different significantly in flavonoid concentration ($p \leq 0.05$).

Figure 4 shows the effect of organic nutrient sources on total phenol content of green and orange morphotypes of pumpkin. Total phenol concentration was significantly ($p \leq 0.05$) higher in the green morphotype than in the orange. Control had highest value (7.96 mg ml^{-1}) in the green morphotype compared to other treatments. Plants treated with cattle dung had 6.15 and 3.93 mg ml^{-1} phenol in the green and orange morphotypes, respectively. Plants treated with poultry manure had the least concentrations with respective values of 5.72 and 2.33 mg ml^{-1} for the green and orange morphotypes.

Figure 5 reveals the effect of organic nutrient sources on anthocyanin concentration of green and orange morphotypes of pumpkin. Highest values of 594.90 and 321.45 mg ml^{-1} were observed ($p \leq 0.05$) in green and orange morphotypes, respectively. The green morphotype had significantly ($p \leq 0.05$) higher concentration of anthocyanin across the treatments.

Figure 6 shows the effect of organic nutrient sources on proanthocyandin concentration of green and orange morphotypes of pumpkin. Plants that received cattle manure had respective values of 10.75 and 4.22 mg ml^{-1} proanthocyandin concentration in green and orange morphotypes. Poultry manure gave 3.39 and 5.46 mg ml^{-1} proanthocyandin concentration in green and orange morphotypes, respectively. Control had the least concentration of proanthocyandin with 2.31 and 2.15 mg ml^{-1} in green and orange morphotypes, respectively.

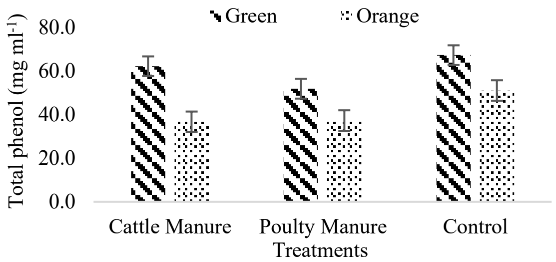

Figure 4: Effect of organic nutrient sources on total phenol in green and orange morphotypes of Nigerian pumpkin

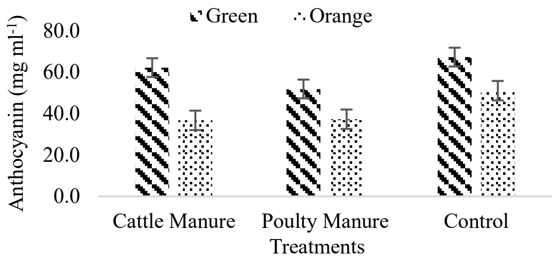

Figure 5: Effect of organic nutrient sources on anthocyanin in green and orange morphotypes of Nigerian pumpkin

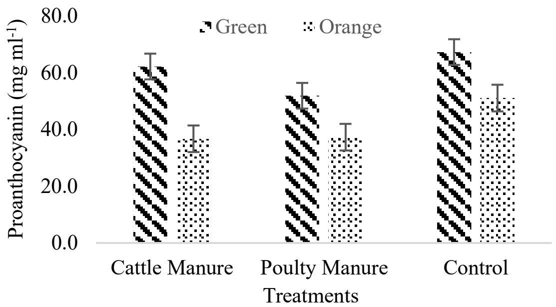

Figure 6: Treatment effect on proanthocyandin content of green and orange morphotypes of Nigerian pumpkin

DISCUSSION

Plants that received cattle dung and poultry manure had similar yield for the two pumpkin morphotypes. Similar to these results, organic nutrient sources were found to influence the fruit yield of okra (Premsekhar and Rajashree, 2009). Cattle dung has been reported to have positive effects on carrot yields (Mehedi *et al.*, 2012; Fikadu-Lebeta and Refisa-Jebessa, 2019). Specifically, Ogar and Asiegbu (2005) and Nwite *et al*. (2013) reported that manure enhanced the yield of fluted pumpkin. Oloniruha *et al*. (2021) reported a similar trend on sesame. The impressive results in the present study would be partially explained by improvements in soil structure due to cattle dung (Ezenne *et al*., 2019) and poultry manure (Obalum *et al.*, 2020). Findings of Li *et al*. (2008) were in line with our findings as well especially on the antioxidants concentrations. Their research on the effect of nitrogen and sulfur on the antioxidant activities in mustard leaf showed that increasing nitrogen supplied to the soil reduced the radical scavenging ability in mustard leaf.

Higher level of nitrogen in poultry manure that was supplied to the soil (3.12 mg kg^{-1}) compared to the cattle dung (1.83 mg kg^{-1}) might not be unconnected to the lower antioxidant capacity observed in pumpkin that was treated with poultry manure in this study. Mohd *et al.* (2013) reported that the application of organic fertilizer enhanced bioaccumulation of total phenolics, flavonoids, ascorbic acid, saponin and gluthathione contents in *L. pumila*, compared to the use of inorganic fertilizer. Similar trend was observed in tomato as reported by Oliveira *et al*. (2013), indicating that organically produced tomatoes accumulated more bioactive compounds, such as phenolics and flavonoids, compared to inorganically grown tomatoes. Other researchers have also reported a decrease in the total phenolic content of potatoes with mineral fertilizer application (Hamouz *et al.,* 2010). A lot of factors could be responsible for this according to Alyson *et al.* (2007). Findings of Crecente-Campo *et al.* (2012) on anthocyanin pigment, ascorbic acid and total phenolic compound in organic versus conventional strawberries revealed that the organic strawberries had a significantly higher level of anthocyanin than conventional ones.

CONCLUSION

Yields of green and orange morphotypes of pumpkin increased with cattle dung and poultry manure at the study location. Antioxidant levels in both pumpkin morphotypes were also positively influenced two nutrient sources. However, cattle dung had higher positive effects compared to poultry manure on the antioxidant concentration in pumpkin morphotypes. Hence, to balance yield and the health substances in pumpkin fruit, cattle dung is recommended as a local organic source of nutrients for pumpkin cultivation in the southwest Nigeria.

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