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Effect of phosphorus on the fruit yield and food value of two landraces of *Trichosanthes cucumerina* L.- Cucurbitaceae

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Abstract

Studies were conducted in the early season of 2002 and 2003 at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria to evaluate the effect of phosphorus (P) on fruit yield and chemical composition of two landraces of *Trichosanthes cucumerina* L. For the purpose of the study, two landraces of *T. cucumerina* named Landrace I and Landrace II were used. The five levels of phosphorus evaluated were 0, 30, 60, 90 and 120 kg P_2O_5 ha^{-1} using single super phosphate fertilizer (8% P). Statistical analysis showed that 90 kg P_2O_5 ha^{-1} gave statistically significant higher fruit yield (16.4 tons ha^{-1}) compared to other P levels. The fruit yield of the two Landraces did not differ significantly. Except for crude protein content, the 90 kg P_2O_5 ha^{-1} produced significantly higher ether extract (1.22 g 100 g^{-1}), crude fibre (1.93 g 100 g^{-1}), moisture content (90.5 g 100 g^{-1}), ash (0.90 g 100 g^{-1}), total sugars (0.81 g 100 g^{-1}) and ascorbic acid (28.7 mg 100 g^{-1}) than other P levels. The essential amino acids compositions were also significantly higher at 90 g 100 g^{-1} compared to other lower P levels. Landrace I had significantly higher ether extract (0.90 g 100 g^{-1}) content than Landrace II (0.62 g 100 g^{-1}) while Landrace II in turn had significantly higher total sugar (0.76 g 100 g^{-1}) compared to Landrace I (0.61 g 100 g^{-1}). The essential amino acids composition is high and the oxalate composition is low. The high ascorbic acid and amino acid content together with a low oxalate composition suggested a strong basis for encouraging the cultivation of this indigenous fruit vegetable to augment nutrient requirement, improve diet and consequently alleviate poverty, preserve the biodiversity and increase the gene bank of neglected wild species of high quality nutrient sources.

Keywords: *Trichosanthes cucumerina* L.; Phosphorus; Fruit yield; Nutrient quality

1. Introduction

The suitability of snake tomato (*Trichosanthes cucumerina* L.) for use as a substitute to the regular tomato (*Lycopersicon esculentum* (L.) Mil) is due to its sweet tasting, aromatic and blood red pasty endocarp pulp when it is fully ripe. It is known that the paste of *T. cucumerina* does not go sour as fast as the paste of *L. esculentum*. Survey conducted in Southwest Nigeria also showed that *T. cucumerina* fruit is used as substitute to the regular tomato by the poor rural people especially, only during the off-season when prices of regular tomato are very high; suggesting that its consumption is directly related to the level of poverty (Onagoruwa Pers. Com). Yadava and Yasmeen (1994) reported that *T. cucumerina* is used as a tonic and in curing coughs and that the seeds are used as purgative, anthelmintic and in the treatment of syphilis.

There is dearth of information in the literature on cultivation practices for *T. cucumerina* while the literature is replete with information on the general cultivation packages for *L. esculentum*. Despite all the attention concentrated on *L. esculentum*, reports showed that it is not exceedingly rich in any nutrient (Stevens, 1974). For example, Adebooye (2001) reported that the vitamin C content of tomato is about 15.0 mg 100 g^{-1} fruit, which is only about 50% of that of sweet orange (*Citrus sinensis* (L.) Osb.) 10% that of pepper (*Capsicum frutescens* L.), and 8% that of carrot (*Daucus carota* L.). Studies by Adebooye,

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Oloyede, Opabode, and Onagoruwa (2005) on the chemical composition of three landrace morphotypes of *T. cucumerina* showed that the seeds of *T. cucumerina* are good sources of crude protein (26.2–26.6 g 100 g^{-1}), fat (44.6–57.2 g 100 g^{-1}), phosphorus (78.0–81.5 mg 100 g^{-1}) and calcium (41.0–46.7 mg 100 g^{-1}) while the pulp is a good source of ascorbic acid (23.1–23.3 mg 100 g^{-1}) and the anti-nutritional oxalate content was low (1.20–2.62 g 100 g^{-1}) suggesting that mineral nutrients (calcium and magnesium) will not be held in unavailable form.

With respect to mineral nutrition of *T. cucumerina*, there is dearth of information in the literature. A mineral element that has been reported to be important for fruit growth and development is phosphorus (P). Studies by the International Institute of Tropical Agriculture (IITA), Ibadan Nigeria in 1989–1998 showed that phosphorus deficiency is a major yield-limiting factor in several locations in southwest Nigeria. As reported by Aduayi, Chude, Adebusuyi, and Olayiwola (2002), P is the mineral nutrient needed by tomato plant in largest quantity in Southwest Nigeria compared to other macronutrients. Widespread P deficiency in Nigerian soils results from the low organic matter content and high P-fixation capacity of the soils (Mokwunye, 1979, 1999). Based on our understanding of the fertility status and P requirement of farmlands at the Obafemi Awolowo University, Ile-Ife, Nigeria, this study was designed to investigate the effect of five levels of phosphorus fertilizer on fruit yield and nutrient composition of two landraces of *T. cucumerina*.

2. Materials and methods

The studies were conducted at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria, during the early season of 2002 and repeated during the early season of 2003. The site is located on latitude 07°28′N and longitude 04°33′E and about 244 m above sea level. Ile-Ife lies in the rainforest vegetation characterized by bimodal rainfall pattern with peaks in June and September. The average rainfalls were 1300 mm and 1365 mm while the average daily temperatures were 28.5 °C and 29 °C at the study location during 2002 and 2003, respectively.

From the experimental site, 10 core soil samples were taken. The samples were mixed together to form a composite sample. Thereafter the soil sample was air-dried, and passed through a 2 mm sieve. Soil total N and organic carbon in soil were determined by the Kjeldahl method and Walkley and Black (1934) method, respectively. Available phosphorus was determined by Bray 1-P method (Bray & Kurtz, 1945) while K, Ca and Mg were first extracted using neutral normal NH_4OA_c (Knusden, Petereson, & Prat, 1984) thereafter, K was determined by flame photometry while Ca and Mg were determined by using atomic absorption spectrophotometer model BUCK Scientific 200 A.

The experiment was a split plot design in a factorial arrangement with four replications. The factors were two landraces of *T. cucumerina*: Landrace I has long fruit with deep green background and white stripes when unripe while Landrace II has light green long fruit when unripe; and four levels of phosphorus with one control (0, 30, 60, 90 and 120 kg P_2O_5 ha^{-1}). The landraces served as main plots while the P levels served as the sub plots. The P levels were calculated based on the results of soil analyses which showed that available P (Bray-P) was 5.80 mg/kg and was considered inadequate when compared with the critical value of 10–16 mg/kg for southwest Nigeria, (Sobulo, Fayemi, & Agboola, 1975; Agbede & Aduayi, 1978; Aduayi et al., 2002). Other macro and micronutrients were found to be present at adequate levels in the soil used for this study.

The plot size was 9 m × 4 m. Paths between the plots and the replicates were 2 m each. The plants were raised directly from seeds and there were 2 plants per stand. The plants were spaced 1.0 m × 1.0 m to give a total of 5 rows and 100 plants per plot. Plantings were done on April 16th 2002 and April 21st 2003, when rainfall had stabilized. The P was applied 15 days after planting using single super-phosphate fertilizer (8% P). Basal application of Nitrogen and Potassium was done at the rates of 40 and 30 kg ha^{-1}, respectively at 15 days after planting. Data were collected from the three middle rows while the first and fifth rows served as guard rows. Data were collected on number of marketable fruits harvested, number of flowers aborted and the fruit yield of the two variants.

At full ripening, fifty fruits of each landrace per phosphorus level were harvested separately from the four middle rows in each plot. The fruits were taken to the laboratory and weighed. Thereafter, the fruits were split open; the seeds were extracted and then depulped. The pulp for each morphotype and phosphorus level was dried in a Gallenkamp oven at 80 °C for 48 h. The dried pulp samples were ground into powder separately using a Wiley micro hammer stainless mill. The pulp samples at the different P levels were subjected to chemical analyses separately. To ensure quality control, the ground samples were stored separately in screw-capped bottles and stored in a refrigerator at −5 °C until they were needed for analyses. Fresh samples were used for determination of total sugar immediately after harvest.

All the chemical analyses described below were carried out in triplicate using the routine chemical analytical methods of Association of Official Agricultural Chemists (AOAC) (1995). To 5 g fresh pulp sample was added water at 80 °C for 1 h to ensure that denaturation of enzyme occurred thus avoiding enzyme-mediated changes during extraction. The extract was heated with anthrone reagent in a boiling water bath for 1 h. The sample was filtered and the absorbance of the filtrate was read at 620 nm with a spectrophotometer. The essential amino acids were read directly using the Beckman 126AA amino acid analyzer following the methods of Spitz (1973); and Moore (1963). The ether extract content was determined by Soxhlet extraction method (Association of Official Agricultural Chemists (AOAC) (1995)). About 2 g of the ground sample