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Abstract

This experiment was carried out on the Teaching and Research Farm of the University of Agriculture, Abeokuta to determine the effects of phosphorus application rates on yield and chemical composition of snake tomato (*Trichosanthes cucumerina* L). The treatments were four levels of phosphorus application (15, 30, 45 and 60 kg/ha), and the control plot at zero level. The experiment was laid out in randomized complete block design with three replications. Phosphorus application significantly ($p<0.05$) increased the fruit yield at 15 kg/ha up to 30 kg P ha^{-1}, beyond which there was a decline. Chemical composition of the harvested fruits showed that the plots that received 45 and 60 kg P/ha had significantly ($p<0.05$) higher Na content than the other levels. Similarly, Mg content of the fruits increased significantly ($p<0.05$) with increasing levels of phosphorus application. The vitamin C and β carotene content of the fruits were higher at 15 kg/ha P than the other treatments. Vitamin A was significantly ($p<0.05$) higher in fruits harvested from the fertilized plots than those of the control. The acidity and Brix content of fruit tissue were highest at 15 and 30 kg/ha P, but not statistical significance.

Keywords: Snake Tomato, Phosphorus Fertilizer, Fruit Yield, Nutrient Composition.

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Introduction

Snake tomato, *Trichosanthes cucumerina,* is used as a substitute to the regular tomato (*Lycopersicon lycopersicum* (Karst) in Nigeria. Information is scarce in the literature on the fruit characteristics and food value of this plant. The edible part of the immature fruit is 86 – 98 % per 100 g edible portions, it contains 94 g moisture, protein (0.6 g), fat (0.3 g), carbohydrate (4 g), fiber (0.8 g), Ca (26 mg), Fe (0.3 mg), P (20 mg), Vitamin B1 (0.02 mg), Vitamin B2 0.03 ng, Niacin 0.3 mg, Vitamin C (12 mg), energy value 70 kJ (Siemonsma and Piluck, 1993). The fruits become inedible upon ripen, they taste bitter and develop hardened fibro vascular bundles. Fruits of the wild forms are very bitter and inedible. They are used in traditional medicine as a purgative. The use of the pulp of ripe fruits as a substitute for tomato paste is the known major use of snake gourd. There are limited reports on the chemical composition and nutritive value of snake gourd seed. Yusuf, *et al.,*(2007) reported that snake tomato has a good food potential and used as flour with high protein value and solubility, water and oil absorption capacities, gelation foaming as well as good emulsion capacity. Nutrient composition analyses indicated that seed of the snake tomato are good sources of crude protein (26.2-26.6 g/100 g), fat (44.6-57.2 g/100 g), phosphorus (78.0-81.5 mg/100 g) and calcium (41.0-46.7 mg/100 g). These good qualities have made this plant a substitute to the solanaceous tomato especially during the off-season when prices of solanaceous tomato are very high. The pulp is a good source of ascorbic acid (23.1-23.3 mg/100 g) which is far higher than that of the popular solanaceous tomato varieties in Nigeria, suggesting its possible use for paste and puree. The anti-nutritional oxalate content is low (1.20-2.62 mg/100 g) suggesting that mineral nutrients will not be held in an unavailable form (Adebooye *et al.,* 2006). Essential amino acids compositions increased with increasing P treatment level.

The high nutrient level and low oxalate composition indicates that this vegetable can be used in the human diet (Adebooye and Oloyede, 2006). In Nigeria, the common tomato is largely cultivated in the northern parts of the country where environmental conditions and irrigation facilities for cultivation abound. Improved cultivars are cultivated on a large scale in the northern part of Nigeria, while unimproved cultivars of the crop are cultivated on a relatively smaller scale in the southern parts of the country (Denton and Swarup, 1983). Supply of fresh tomato fruits of improved cultivars in the southern part of Nigeria is fraught with irregularities and characterized by exorbitant prices. Among the information required for the successful cultivation of the crop is nutrient requirement, particularly those that promote good growth and fruiting. Phosphorus is one of such macro nutrients. Information on cultivation of this substitute, snake tomato may encourage the cultivation on a large scale to reduce dependence on solanaceous tomato. Phosphorus (P) as phospholipids is a constituent of cell membrane. It is usually concentrated in the fast growing parts of the plants particularly in the root tips. P speeds up the maturation of crops and is found in large quantities in seeds and fruits. It also stimulates good root development. Plant absorbs P largely in the form of phosphates as primary orthophosphates ion (HPO_4^{2-}). Phosphorus does not occur as abundantly in soils as nitrogen (N) and potassium (K). Total concentrations in surface soils vary between 0.02 and 0.01%. The importance of P as a yield limiting factor in many Nigerian soils is well established (Udo, 1981; Adetunji, 1994b; Adepetu, 1983). Fruits and vegetables of snake tomato are good sources of natural antioxidants for the human diet, containing many different antioxidant components which provide protection against harmful free radicals and have been strongly associated with reduced risk of chronic diseases, such as cardiovascular disease, cancer, diabetes, Alzheimer's disease, cataracts and age-related functional decline in addition to other health benefits (Cao *et al.*, 1996; knekt *et al*., 2002).. These positive effects are believed to be attributable to the antioxidants, particularly the carotenoids, flavonoids, lycopene, phenolics and ß-carotene (Lavelli *et al*., 2000). The juice of the leaves and fruits are useful in decongesting of the liver and bilious headache (Chakravarty, 1982). The fruit is also used as a laxative (Vashista, 1974). The fruit is considered to be anthelmintic, emetic and purgative (Kanchana and Raymond, 2005).

Cultivation of the common tomato is seasonal especially in the southern part of Nigeria and usually cultivated in the north particularly with irrigation. However, the cultivation of the snake tomato can be done in and out of rainy season in the southern part where the plant can be sustained by the soil moisture invariably throughout the year with little irrigation practice. Information is scanty in the literature on the agronomy of snake tomato, particularly, its nutritional requirements, it is therefore necessary to study the yield response of *T. cucumerina* to different levels of phosphorus fertilizer application.

The objectives of this study were to evaluate the rates of phosphorus application as they affect the fruit yield and chemical composition of snake tomato, *Trichosanthes cucumerina* L.

Materials and Methods

This experiment was carried out on the teaching and research farm of the University of Agriculture Abeokuta, (7^0N, 3^0 23'E), Nigeria. The soil type is sandy loam and the weather condition is 25^0C. Pre-planting soil test was done to know the nutrient status of the soil. The soil nutrient status was 0.021%P, 0.067%N and 0.879%K. The experimental design was laid out in a randomized complete block design (RCBD) with three replicates. The plot size was 6m by 4m while a path of 0.5m separated each plot and a path of 1.0m separated the replicates. At 21 days after transplanting, single super phosphate fertilizer was applied according to the treatment. Seedlings of *T. cucumerina* were raised in polythene sleeves and filled with top soils. At 24 days after sowing (4-5 leaf stage), it was transplanted to a clean manually weeded field at a spacing of 2m by 2m,four plants per row, making up 12 plants per plot. At eighteen days after transplanting (DAT), staking was done in which a bamboo was put firmly beside each seedling to project 1.6m above the ground level and vines were directed to climb round the pole. The fertilizer was applied by ring method by scooping a ring 15cm radius round each stand at a depth of 7cm. Then the weighed fertilizer was applied at the rate of 0, 15, 30, 45 and 60 kg. Basal application was also done at the rate of 20 kg N/ha in form of urea and muriate of potash. Weeding was done manually at two week interval, commencing from 2 weeks after transplanting (WAT). The treatments were application of phosphorus at five levels viz; 0, 15, 30, 45 and 60 kg P_20_5/ha, using single super phosphate (18 % P_20_5).

Data was collected on yield and yield component commencing from 5 WAT which include dry matter production and number of fruit and fruit yield, fruit diameter and fruit length as well as tissue analysis. All chemical analyses were carried out using the Agricultural Analytical methods of the Association of Official Agricultural Chemists (AOAC, 1980). Data collected were subjected to Analysis of Variance (ANOVA) and the treatment means separated using the least significant difference (LSD).Where F values were significant ($p<0.05$). (SAS, 2003)

Results and Discussion

At harvest, (Table 1, effect of phosphorus on yield of snake tomato) fruit weight of plots treated with 15 and 30 kgP_2O_5/ha were significantly higher than those of the plots with other P_2O_5 treatments. Plots treated with 30 kgP_2O_5/ha however had significantly higher fruit weight compared to those given 15 kgP_2O_5/ha. Fruit weight significantly decreased with P_2O_5 levels up to 60 kg/ha from 15 kgP_2O_5/ha and 30 kgP_2O_5/ha .Application of 15 to 45kg/ha however resulted in significantly higher fruit weight compared to no P_2O_5 (control). The regression analysis of snake tomato yield against phosphorus rates indicated quadratic and the equation thus $Y= 2.40 + 0.220 x - 0.004x^2$.Where Y refers to expected yield at a given phosphorus rate x. When computed the optimum yield was 6.2 t/ha with optimum application rate of 27.5(kgP_2O_5 ha^{-1}) and this shown in figure 1. The result on the effect of phosphorus on proximate composition of Trichosanthes is shown in Table 2. Fruits of plots given 45 kg P_2O_5/ha had higher Na content comparable to the maximum with the fruit of plots with 60 kg P_2O_5/ha while fruits of the other P_2O_5 treatments had significantly lower Na content. Mg content of fruits increased significantly with P_2O_5 application with 60kg/ha having the highest. Although not significant, Vitamin C and B carotene contents of the fruit were higher at 15 kg/ha P_2O_5 than at the other P_2O_5 rates. Vitamin A content was significantly higher in the fruits of the plots with 15, 30 and 60 kg/ha than those of no P_2O_5 (control). Brix content of fruit tissue was higher at 15 and 30 kg/ha P_2O_5 than those of the other P_2O_5 treatments. Although not significant, acidity of the fruit content was at the maximum (pH 0.54) at 30 P_2O_5 kg/ha.

The fruit yield recorded was higher than those reported by Okelana and Okeleye (1994) for all the three levels of fertilizer applied and at the three periods at which data were collected. The changes (increases and decreases) in the value of parameter compared to researchers cited above may be attributed to weather and environmental conditions of the study area. The quadratic response recorded of effects of phosphorus levels on yield of snake tomato indicated that the optimum P_2O_5 required for the crop was reached and as such the additional P_2O_5 added lead to a decrease in yield. Proximate composition of fruits showed that plots in which 45kg P_2O_5/ha was applied had highest Na (sodium) content comparable to the fruits of plots with maximum P_2O_5, 60kg/ha while fruits of the other P_2O_5 treatments had significantly lower Na content. Mg content of fruits increased significantly with P_2O_5 application with 60kg P_2O_5/ha giving the highest, although not significant, Vitamin C and B carotene content of the fruit was higher at 15kg/ha P_2O_5 than those of other P_2O_5 treatments. Vitamin A content was significantly higher in fruits of the plots with 15, 30 and 60 kg/ha compared with those without P_2O_5. Brix content of fruit tissue was highest at 15 and 30 kg/ha P_2O_5 than those of the other P_2O_5 treatment. Although not significant, acidity of the fruit content was highest in fruits of plots given 30 kg P_2O_5/ha. The ascorbic acid content recorded in this study was also higher than that reported by Adebooye *et al*., (2005). This might be due to the fertilizer type used. The anti nutritional factor, oxalate content of the fruit is 0.111 which is lower than the range reported by Adebooye *et al*., (2005) and Adebooye and Oloyede (2005) (1.20-2.62 mg/100g). This might be as a result of the fertilizer used in this study.

Conclusion and **Recommendations**

It can be concluded that phosphorus application at 30 kg/ha is the optimum for *Trichosanthes cucumerina* growth and productivity and also improved its nutrient composition. Further studies should be carried out using different fertilizer application at varying levels and trial should be conducted during dry season so as to ascertain the possibility of cultivating the crop in both seasons.

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Tables

Table 1: Effect of phosphorus on yield of Snake tomato (*Trichosanthes cucumerina* L.*)*

Phosphorus level (kgP_2O_5ha[1])	Fruit Weight (kg/plant)	Fruit Yield (Tons/Ha)
0	0.91	2.21
15	4.90	4.90
30	5.22	6.22
45	2.79	2.80
60	1.12	1.42
LSD	0.57	1.15

Table 2: Chemical Composition of Trichosanthes cucumerina at different Phosphorus Rates

P_2O_5 (kg/ha)	Na^+ mg/100g	K mg/100g	Pb mg/100g	Ni mg/100g	Mg mg/100g	P mg/100g	Vit C mg/100g	Vit A%	Oxalate%	B Carotene %	BMix%	Acid
0	0.160 c	0.715	4.955	0.015	0.035 d	0.045	27.905	1.465 b	0.104	1.650	1.510 b	0.520
15	0.195 c	0.880	6.680	0.025	0.043 cd	0.050	34.125	1.900 a	0.104	2.015	1.655 a	0.530
30	0.235 bc	0.015	4.550	0.035	0.068 bc	0.600	30.000	1.890 a	0.106	1.985	1.665 a	0.540
45	0.335 ab	1.335	11.650	0.055	0.082 b	0.550	24.815	1.730 ab	0.111	1.940	1.335 b	0.490
60	0.395 a	1.220	1.970	0.070	0.110 a	0.070	33.000	1.865 a	0.107	2.000	1.335 b	0.495
S.E	0.031	Ns	Ns	Ns	0.007	Ns	Ns	0.0707	Ns	Ns	0.022	Ns
C.V %	16.25	17.39	52.37	40.31	16.17	16.46	18.94	5.61	2.47	11.16	1.99	3.68

Figures

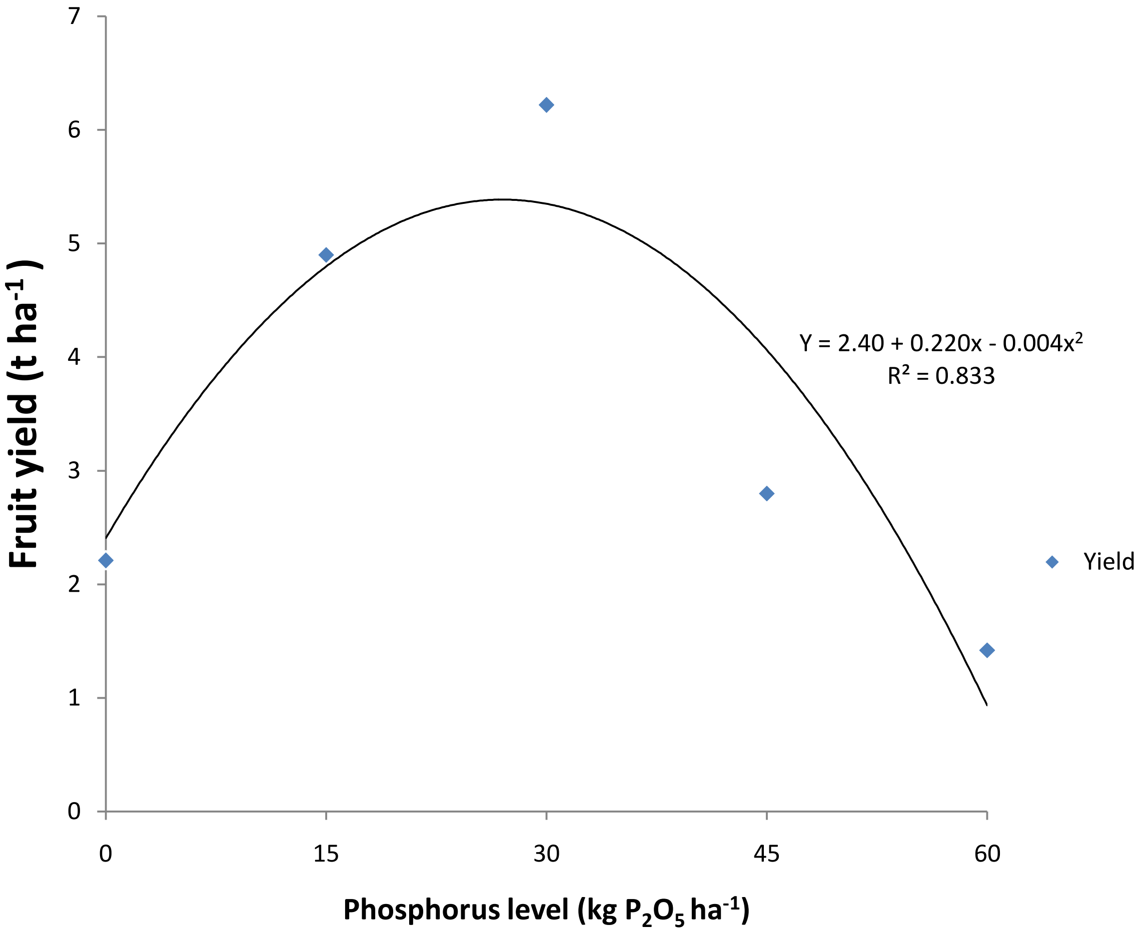

Fig 1: Polynomial response of snake tomato yield to phosphorus application