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Full Length Research Paper

Effect of season on growth, fruit yield and nutrient profile of two landraces of *Trichosanthes cucumerina* L.

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Studies were conducted in the early season of 2002 and late season of 2003 at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria to determine the effects of season on growth, fruit yield and nutrient profile of two landraces (Variant I and II) of snake tomato (*Trichosanthes cucumerina* L.). Statistical analysis (P 0.05) showed that the early season crop had significantly higher number of leaves, vine length, number of marketable fruits and fruit yield compared to the late season crop while the late season crop recorded significantly higher number of aborted flowers and cull fruits. Crop yield during the early season averaged 22.2 tons ha^{-1} while it was 13.3 tons ha^{-1} during the late season. The variants had no effect on fruit yield, number of marketable fruits, cull fruits and number of flowers aborted. The early season crop had significantly higher ascorbic acid composition (25.2 mg/100 g) than the late season crop (18.0 mg/100 g) while the late season crop had significantly higher ether extract (0.94 g/100 g), crude fiber (3.40 g/100 g) and total sugars (0.95 g/100 g) compared to the early season crop which had 0.64, 1.60 and 0.50 g/100 g, of ether extract, crude fiber and total sugars, respectively. Variant I had significantly higher ether extract content (0.97 g/100 g) than Variant II (0.64 g/100 g) while Variant II had significantly higher total sugar (0.98 g/100 g) compared to Variant I (0.60 g/100 g). The anti-nutritional oxalate and crude protein compositions were neither affected by variant nor season nor their interaction.

Key words: *Trichosanthes cucumerina*, seasons, growth, fruit yield, nutrient profile.

INTRODUCTION

The snake tomato (*Trichosanthes cucumerina* L.) is a member of the botanical family Cucurbitaceae. The family includes about 70 genera and over 700 species, which are widely distributed all over the world (Robinson and Decker-Walters, 1997) . In Nigeria, *T. cucumerina* is used as a substitute to the regular tomato (*Lycopersicon esculentum* (L.) Mil) . Studies by Adebooye et al. (2005) and Adebooye and Oloyede (2005) have shown that *T. cucumerina* seed is a good source of nutrients containing crude protein (26.2-26.6 g/100g), fat (44.6-57.2 g/100g), phosphorus (78.0-81.5 mg/100g) and calcium (41.0-46.7 mg/100g) while the fruit pulp is a good source of ascorbic acid (23.1-23.3 mg/100g). The studies also reported that the anti-nutritional oxalate (1.20-2.62 g/100g) compositions of both the seed and the pulp are low. Earlier studies by Soladoye and Adebisi (2004) and Adebooye and Oloyede (2005) documented that there was little information in the literature on the agronomic practices for *T. cucumerina*.

The good food value of this plant is an indicator that its cultivation and utilization should be promoted. To promote its cultivation, there is the need to develop agronomic practices package that farmers would need. A major requirement in the development of the agronomic package for *T. cucumerina* is to determine the most appropriate season for fruit production. This study was designed to evaluate the effect of seasons on the vegetative growth, fruit yield and nutrient profile of *T. cucumerina*.

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TABLE 1. ANOVA table for affects of variant and season on fruit production characteristics, fruit yield, and quality factors for Snake tomato.

Source	Number of Vine length	Leaves	Aborted flowers	Cull fruit	Marketable fruit	Yield	Ether extract	Crude		Total sugar	Ascorbic acid	oxalate
								Protein	Fiber			
Variant (V)	ns	ns	ns	ns	ns	ns	*	ns	ns	*	ns	ns
Season (S)	*	*	*	*	*	*	*	*	*	*	*	ns
Interaction VXS	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

ns,*: indicates non-significant, or significant at $P \leq 0.05$ respectively, ANOVA.

MATERIAL AND METHODS

The study was conducted at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria, during the early season (April-July) of 2002 and late season (August-November) of 2003. Ile-Ife lies in the rainforest vegetation with a bimodal rainfall pattern with peaks in June and September. Earlier rains usually last from early April to end of July while late rain usually starts in late August and ends in November. Land preparation commenced immediately there was rain, with disc ploughing and harrowing. The experiment was laid out in randomized complete block design with four replications. The plot size was 9 m x 4 m. A path of 1.0 m each separated adjacent replication and plots. The two landraces of *T. cucumerina* which were collected through a survey were named Variant I and Variant II and were distinguished as follows: Variant I has long fruit with deep green background and white stripes while Variant II has light green colored long fruit (Onagoruwa, 2002). Plant was spaced 1.0 m x 1.0 m at 2 plants per stand to give a total of 5 rows and 100 plants per plot. Data were collected from the three middle rows while the first and fifth rows served as guard rows. Plants received water from natural precipitation. Weeding was at 4, 8 and 12 weeks after planting by hand hoeing. NPK 15:15:15 fertilizer was applied uniformly at the rate of 150 kg/ha. At 8 weeks after emergence, flowering started and at 14 weeks fruit began to ripen.

On the field data were collected on the number of leaves per plant up till 7 weeks after emergence(WAE); vine length/plant up till 7 WAE; number of aborted flowers/plant; number of cull fruits/plant; number of marketable fruits/plant and fruit yield/ha. At harvesting, twenty-five ripe fruits of each Variant were spilt open and the pulps were extracted. The pulp for each variant was dried in a forced air oven at 80°C for 48 h. Dried pulp samples of the two variants were ground into powder separately using a Wiley micro-hammer stainless steel mill. To ensure quality control, ground samples were stored separately in screw-capped bottles in a refrigerator at –5°C until they were needed for analyses.

All chemical analyses were carried out using the routine chemical analytical methods of the Association of Official Agricultural Chemists (AOAC, 1980). Fresh samples were used for determination of total sugar immediately after harvest. Deionized water at 80^{o}C was added to 5 g of fresh pulp sample for 1 h to ensure denaturation of enzymes occurred to avoid enzyme-mediated changes during extraction. The extract was heated with anthrone reagent in a boiling water bath for 1 h. Samples were filtered and the absorbance of the filtrate read at 620 nm with the Model 200A spectrophotometer (Buck Scientific, East Norwalk, Conn). Ascorbic acid content was determined by extracting 10 g of fresh pulp in 90 mL of distilled water for 1 hr. The mixture was filtered and stored at -5^{o} C. A standard indophenol solution was prepared and 2 mL of it placed in a burette while the 10 mL sample filtrate was also placed in the burette (AOAC, 1980). Titration was done and the titre value was used in calculating the ascorbic acid concentration.

The ether extract content (comprising fat and oil) was determined by the Soxhlet extraction method using petroleum ether, and crude protein content was determined by first determining nitrogen content by Kjeldahl method and then multiplying the nitrogen value by factor 6.25. For crude fiber determination, ground samples were passed through a 1 mm sieve, and 1 g of samples weighed into a weighed crucible. About 50 mL of boiling tetra-oxo-sulphate (IV) acid (1.25%) was added. The mixture was boiled for 1 h, filtered and the residue washed with hot distilled water until it was free from acid. Hot 1.25 % sodium hydroxide (50 mL), was added and the mix boiled for 1 h. It was then filtered, washed with hot distilled water, and rinsed with acetone. The filtrate was washed with hot distilled water until free from alkali, and then with 10 mL of cold 98% alcohol. It was then dried at 110°C in a forced air oven for about 2 h and the weight recorded. The dry residue was ashed and weighed. The fibre content was calculated by difference, after subtracting the residue weight for the blank crucible. Oxalate content was determined using the HPLC method described by Wilson et al. (1982).

Data were subjected to analyses of variance (ANOVA) using the standard method for randomized complete block design (RCBD) according to Steele and Torrie (1980). Means, where appropriate, were separated using the least significant difference at 5% level of probability.

RESULTS AND DISCUSSION

The number of leaves/plant, vine length/plant, number of cull fruits/plant; number of marketable fruits/plant, number of flowers aborted per plant and fruit yield for Variants I and II did not differ significantly (Table 1). For Variant I, the number of leaves/plant at 7 WAE, vine length/plant at 7WAE, number of cull fruits/plant, number of marketable fruit/plant, number of flowers aborted/plant and fruit yield averaged 28, 1.9 m/plant, 6.8 fruits/plant, 13.5 fruits/plant, 15.8 flowers/plant and 17.4 tons/ha, respectively, while for Variant II the measurements averaged 28.4, 1.8 m/plant, 6.7 fruits/plant, 13.3 fruits/plant, 16.8 flowers/plant and 17.8 tons/ha, respectively. The interaction of Variant and Season did not significantly affect number of leaves, vine length, number of flowers aborted, number of cull fruits, number of marketable fruits and fruit yield (Table 1)

The season, according to ANOVA (Table 1) significantly affected the number of leaves, vine length, number of flowers aborted, number of cull fruits, number of marketable fruits and fruit yield. In the early season,

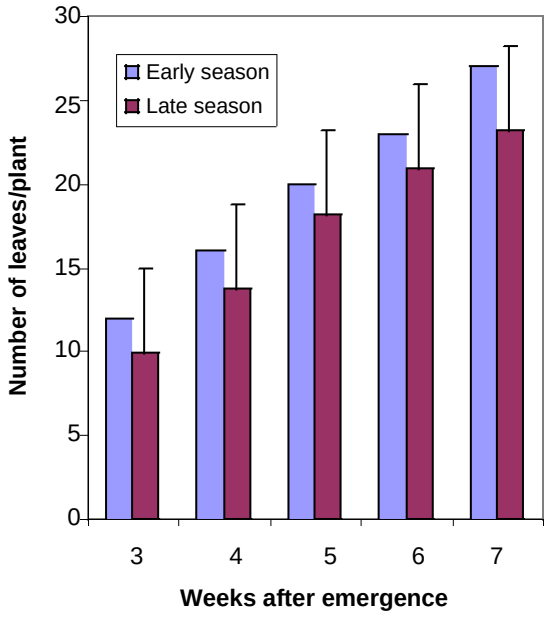

Figure 1. Effect of season on number of leaves/plant of snake tomato at weekly intervals during the early season of 2002 and late season of 2003.

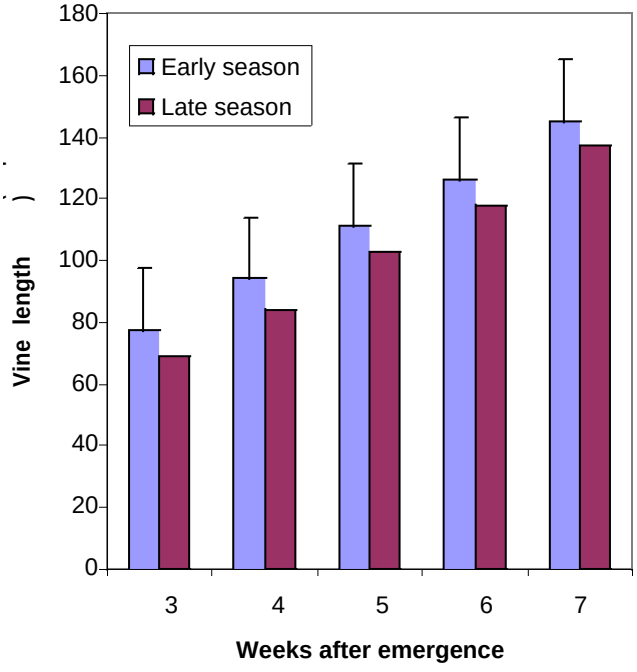

Figure 2. Effect of season on vine length (cm/plant) of snake tomato at different intervals after emergence in the early season of 2002 and late season of 2003.

significantly more leaves per plant (Figure 1) and longer vine length/plant (Figure 2) were produced at each sampling week compared to the late season. As shown in Table 2, significantly lower number of aborted flowers and cull fruit; and higher number of marketable fruits and fruit yield were recorded in the early season compared to the late season. The numbers of marketable fruits for Variants I and II during the early season were 93.8 and 91.4%, respectively, higher than the late season. The fruit yield for Variants I and II during the early season were 66.9 and 67.4%, respectively, higher than the late season crop. Also, for Variants I and II, plants in the late season aborted 123.4 and 114.7%, respectively, more flowers than early season crop. These results showed that early season crop performed better in terms of fruit yield than the late season crop. This can be attributed to steady and well-distributed natural precipitation that characterized the early season. It was observed during the course of the late season study that when natural precipitation became infrequent and dryness set in; new flowers started aborting at a fast rate and already formed fruits started premature ripening and aborting. These observations are clearly shown in Table 2. Previous reports on *T. cucumerina* showed that the plant does not tolerate dry soil and requires a good moisture reserve in the soil; and it is sensitive to water logging (Soladoye and Adebisi, 2004). Other report by Robinson and Decker-Walters (1997) showed that water stress in cucurbits affects all major physiological processes, from photosynthesis to carbohydrate metabolism. Early evidence of serious water stress in cucurbits was said to include the loss of colour in the lobes of older leaves and tips of developing fruits resulting in premature ripening and irreversible wilting (Robinson and Decker-Walters, 1997).

The variant effect is not significant for crude protein, crude fibre, ascorbic acid and oxalate compositions (Table 1). The interaction of variants and season did not have any effect on the ether extract, crude protein, crude fibre, total sugar, ascorbic acid and oxalate composition (Table 1) . Table 3 shows that the ether extract content of Variant I (0.97 g/100 g) was significantly higher than that of Variant II (0.64 g/100 g) while the total sugar content of Variant II (0.98 g/100 g) was significantly higher than that of Variant I (0.60 g/100 g). This finding confirmed earlier reports by Adebooye et al. (2005) and Adebooye and Oloyede (2005) that the two landraces of snake tomato differ in ether extract and total sugar composition. Results in Table 4 showed that the ether extract, crude fibre and total soluble solids contents were significantly higher in the late season than the early season while the ascorbic acid content was significantly higher in the early season than the late season. Previous published works on the effects of season or water on chemical composition of crops are not consistent. For example, Adebooye (2001) reported that the ascorbic acid content of *L. esculentum* were higher during late season compared to the early season, irrespective of the factors imposed. While on the contrary, Fatunla and Ogunsua (1972) had earlier reported that cloudy weather,

Table 2. Effect of variant and season on fruit yield and yield components of two landraces of snake tomato.

	Season	Number of marketable fruit Plant^{-1}	Fruit yield (tons ha^{-1})	Number of cull fruit plant^{-1}	Number of flower aborted plant^{-1}
Variant 1	Early	13.1	22.2	2.3	6.4
	Late	6.8	13.3	10.2	14.3
Variant 2	Early	12.9	22.1	2.5	6.8
	Late	6.7	13.2	10.1	14.6
Lsd 5%^{z}		3.6	4.0	4.1	4.2

^{z} indicates significant at 5% level of probability.

Table 3. Main effect of variants on the average proximate composition of snake tomato fruit pulp across the seasons.

Variant	Ether extract g/100 g	Total Sugar g/100 g
1	0.97	0.60
2	0.64	0.98
LSD 5%^{z}	0.24	0.10

^{l}Indicates significant at 5% level of probability. Values are means of triplicate analyses expressed on dry matter basis.

Table 4. Main effect of season on average nutrient and anti-nutrient concentration in snake tomato across variants.

Season	Ether extract g/100g	Crude		Total sugar g/100g	Ascorbic acid mg/100g	Oxalate mg/100g
		Protein g/100g	Fiber g/100g			
Late	0.94	2.14	3.40	0.95	18.0	1.30
Early	0.64	2.10	1.60	0.50	25.2	1.51
Lsd (5%)^{z}	0.15	ns	1.20	0.14	3.20	ns

^{z}Indicates significant at 5% level of probability. Values are means of triplicate analyses expressed on dry matter basis.

especially like that in the early season (March - August) caused low vitamin C level in tomato fruits. Daskoloff and Ogjanowa (1962) and Murneek et al. (1954) reported that tomato fruits grown in full sunlight were found to have more ascorbic acid than those shaded. It was reported by Konova and Rainova (1981) that soybean that received less water have higher crude protein and lower pH. They also stated that when moisture is high, the cell plasma is dilute, protein forming enzymes are retarded thus reducing protein synthesis. The differences between the above cited works and the results of this study on *T. cucumerina* might be attributed to differences in genotype and physiology of the different plants studied by the various workers.

It can be safely concluded from the results of this study that early season is the best for *T. cucumerina* production because it gave significantly higher fruit yield with commensurate food value. During the early season, flower abortion and number of cull fruits are significantly reduced compared to the late season.

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