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Effect of phosphorus fertilizer and shoot pruning on growth, yield and fruit quality of tomato (*Solanum lycopersicum*)

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Tomato (S*olanum lycopersicum* L.) is a popular and important crop that is ranked as second largest vegetable after potato in terms of production and consumption worldwide (FAO 2016). Tomatoes provide a wide variety of nutrients and many health-related benefits to the body on account of its richness in vitamins, and other phytonutrients (Ayandiji *et al*. 2011). Inorganic fertilizer application like phosphorus has the quickest and easiest way of increasing tomato yield (Musa *et al*. 2021). Studies buttressing the role of phosphorus in enhancing growth, development and yield of tomato have been variously reported (Ahn *et al.* 2005, Adebooye *et al*. 2006). Selective removal of plant parts via pruning are known to enhance yield and fruit quality in tomato (Falodun and Ogedengbe 2019). However, there is dearth of knowledge on how the combination of pruning and fertilization affect bio-productivity and fruit quality of tomato. It is this gap in knowledge the present study attempts to fill. The study aims to fill the gap in knowledge and explore how the combination of pruning and fertilization influences the yield and quality of tomatoes. By examining the impact of different pruning and fertilization treatments on various aspects of tomato growth and development, the study can provide valuable insights into the most effective ways to improve tomato bio-productivity and fruit quality. Ultimately, this research can assist farmers and growers to optimize their tomato production and to achieve higher yields and improved quality fruits.

Sample collection and description of soil: The Tomato-82-B seeds were obtained from Premier Brand Seeds Nigeria Limited, while the local seeds were obtained from Ministry of Agriculture Ilorin, Nigeria. The analyzed soil used was Sandy loam with *p*H of 7.25. The organic carbon and organic matter had a respective value of 4.68 and 8.05%. The soil was rich in Nitrogen (72.49 mg/kg) and Calcium (3.22 mg/kg). Potassium (0.93 mg/kg) and phosphorus (0.43 mg/kg) contents of the soil were low.

Nursery and transplanting: The seeds were sown in beds before seedlings were transplanted three weeks after planting into polythene bags filled with 6 kg of soil. Watering was done at 2-days interval. Manual weeding was carried out at regular interval for crop maintenance. Pruning was done two weeks after transplanting. Phosphorus was applied by mixing each of the rates to 24 kg of sieved soil and same distributed into four polythene bags before transplanting.

Experimental layout and treatment details: The experimental layout was a complete randomized design with four replications during June and September, 2021 in a garden situated at (8° 30' N; 5° 00' E) Ilorin, Nigeria. There were thirteen treatments, viz. T_1, control; T_2, 15 kg P/ha + two-stem pruning; T_3, 30 kg P/ha + two-stem pruning; T_4, 45 kg P/ha + two-stem pruning; T_5, 60 kg P/ha + two-stem pruning; T_6, 15 kg P/ha + three-stem pruning; T_7, 30 kg P/ha + three-stem pruning; T_8, 45 kg P/ha + three-stem pruning; T_9, 60 kg P/ha + three-stem pruning; T_{10}, 15 kg P/ha + four-stem pruning; T_{11}, 30 kg P/ha + four-stem pruning; T_{12}, 45 kg P/ha + four-stem pruning and T_{13}, 60 kg P/ha + four-stem pruning.

Data collection: Growth parameters such as plant height were recorded at 12 WAT. Fruits were harvested at red-ripe stage between 9 and 15 WAT. Tomato fruits were analyzed for proximate composition following the procedure of Analytical Official Association of Chemist (AOAC 2000). The anti-oxidants such as Vitamin C were determined spectrophotometrically as described Barros *et al.* (2010). Phosphorus was determined colorimetrically with Jenway 6100 spectrophotometer using phosphovanado-molybdate method with KH_2PO_4 as the standard.

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Data analysis: Data were subjected to One Way Analysis of Variance. Means were separated using Duncan Multiple Range Test (Duncan 1955) using Statistical Package for Social Science (SPSS).

Effect on growth and yield: In both varieties, different combination of phosphorus fertilizer and pruning significantly influenced all the growth attributes and fruit yield (Table 1). In local variety, the growth attributes were significantly enhanced under 30 kg P/ha + two-stem pruning (T_3). Tomato plants receiving 60 kg P/ha + four-stem pruning (T_{13}) showed the least values in all the growth attributes. The results of the growth attributes in Tomato 82-B followed similar trends as recorded. Varietal difference indicated that local variety had higher growth attributes than Tomato 82-B. A closer look at the results revealed that aside from T_{12} and T_{13} where highest number of pruning were carried out, all other treatments at low or moderate combinations, especially at 30 kg P/ha + two-stem pruning, had marked influence on tomato growth and development than those tomato receiving zero phosphorus fertilizer and pruning (control). This result conforms to the findings of Falodun and Ogedegbe (2019) and Xu *et al*. (2020) who have variously reported that pruning directly stimulates the formation of leaves and other vegetative growth characters in tomato plants. Higo *et al.* (2020) had also observed that in tomato plants, phosphorus fertilizer input (low and high) without

Table 1 Effect of combination of phosphorus fertilizer and shoot pruning on growth and yield of two tomato varieties

Variety	Treatment	Plant height (cm)	Number of leaves	Leaf area (cm^2)	Above ground dry weight (g)	Fruits/ plant	Fruit weight/ plant	Fruit yield/ha (kg/ha)
	T_1	68.05 ± 9.2^{ab}	377.12 ± 11.7^{cd}	4769.76 ± 156.8^{cde}	15.62 ± 14.5^{ab}	8.50 ± 2.21^{b}	206.92 ± 50.93^{ab}	642.12 ± 167.28^{ab}
	T_2	70.57 ± 3.1^{ab}	553.25 ± 4.4^{bc}	11263.96 ± 83.6^{b}	17.25 ± 16.6^{ab}	12.00 ± 3.34^{b}	302.05 ± 74.52^{ab}	911.47 ± 225.59^{ab}
	T_3	80.07 ± 5.4^{a}	736.00 ± 7.7^{a}	18108.84 ± 125.1^{a}	19.87 ± 18.^{a}	11.25 ± 2.13^{b}	274.75 ± 83.12^{ab}	832.45 ± 251.88^{ab}
	T_4	57.12 ± 5.3^{b}	378.75 ± 82.8^{cd}	4817.08 ± 1053.7^{cde}	14.32 ± 6.8^{bc}	5.50 ± 1.32^{b}	114.80 ± 45.41^{b}	347.82 ± 137.61^{b}
	T_5	75.55 ± 9.1^{ab}	551.00 ± 23.7^{bc}	3494.98 ± 142.7^{de}	17.57 ± 16.5^{ab}	6.75 ± 0.62^{b}	150.05 ± 22.15^{ab}	454.62 ± 67.14^{ab}
	T_6	64.70 ± 9.5^{ab}	426.75 ± 45.5^{bcd}	2881.39 ± 308.7^{e}	15.02 ± 9.8^{ab}	8.00 ± 3.48^{b}	161.00 ± 70.02^{ab}	487.80 ± 212.18^{ab}
Local	T_7	72.52 ± 6.134^{ab}	585.25 ± 7.122 ^{b}	4861.18 ± 86.3^{cde}	18.17 ± 17.6^{ab}	11.25 ± 4.62^{b}	328.87 ± 231.32^{ab}	665.25 ± 316.30^{ab}
	T_8	66.42 ± 8.5^{ab}	472.75 ± 89.4^{bc}	5514.67 ± 1025.2^{cde}	15.62 ± 8.4^{ab}	8.25 ± 1.79^{b}	265.37 ± 50.92^{ab}	804.07 ± 154.29^{ab}
	T_9	68.20 ± 0.9^{ab}	506.50 ± 51.8^{bc}	5847.25 ± 659.6^{cde}	17.05 ± 14.9^{ab}	9.25 ± 1.75^{b}	281.42 ± 62.67^{ab}	852.72 ± 189.90^{ab}
	T_{10}	69.35 ± 2.1^{ab}	427.25 ± 77.2^{bcd}	5299.72 ± 1011.4^{cde}	15.07 ± 9.1^{b}	10.50 ± 3.22^{b}	204.02 ± 28.55^{ab}	618.22 ± 86.50^{ab}
	T_{11}	68.92 ± 5.4^{ab}	483.00 ± 86.2^{bc}	11024.65 ± 2033.8^{b}	15.70 ± 9.2^{ab}	8.75 ± 3.11 ^{b}	392.25 ± 215.31^{ab}	1188.52 ± 652.40^{ab}
	T_{12}	66.35 ± 2.3^{ab}	533.00 ± 63.2^{d}	7341.50 ± 864.5^{c}	16.85 ± 13.2^{ab}	12.25 ± 6.00^{a}	492.42 ± 101.98^{a}	1492.07 ± 700.90^{a}
	T_{13}	60.92 ± 6.6^{ab}	267.50 ± 42.9^{d}	3806.03 ± 619.7^{de}	10.32 ± 4.73^{c}	5.50 ± 1.50^{b}	153.20 ± 56.76^{ab}	464.20 ± 172.00^{ab}
	Mean	68.3	484.4	6848.5	16.0	9.05	255.93	750.87
	P-value	0.04	<0.001	<0.001	0.012	0.028	0.0427	0.0465
	T_1	53.00 ± 2.4^{a}	160.50 ± 6.2^{b}	2669.88 ± 111.5^{d}	9.37 ± 0.6^{a}	2.00 ± 0.40^{b}	72.15 ± 37.18^{b}	218.62 ± 112.68^{b}
	T_2	62.50 ± 6.3^{a}	200.75 ± 41.2^{b}	3929.98 ± 803.3^{bcd}	8.55 ± 0.6^{ab}	1.75 ± 1.03^{b}	99.92 ± 58.85^{b}	302.80 ± 178.35^{b}
	T_3	60.02 ± 5.1^{a}	372.75 ± 83.7^{a}	8755.32 ± 1958.3^{a}	9.17 ± 0.5^{a}	6.50 ± 2.32^{a}	452.25 ± 225.73^{a}	1370.30 ± 683.98^{a}
	T_4	53.45 ± 4.2^{a}	263.25 ± 54.4^{ab}	5925.81 ± 1219.9^{b}	7.07 ± 0.5^{ab}	3.25 ± 1.97^{ab}	179.70 ± 106.36^{b}	544.62 ± 322.33^{ab}

Contd.

Table 1 (*Concluded*)

Variety	Treatment	Plant height (cm)	Number of leaves	Leaf area (cm^{2})	Above ground dry weight (g)	Fruits/ plant	Fruit weight/ plant	Fruit yield/ha (kg/ha)
	T_5	53.47 ± 2.3^{a}	245.75 ± 10.8^{b}	5730.60 ± 226.5^{bc}	8.52 ± 0.3^{ab}	4.00 ± 1.77^{ab}	153.95 ± 61.85^{b}	466.47 ± 187.41^{ab}
	T_6	52.42 ± 5.6^{a}	192.75 ± 40.1^{b}	4388.10 ± 908.5^{bcd}	8.35 ± 0.1^{ab}	2.00 ± 1.22^{b}	84.07 ± 48.55^{b}	254.72 ± 147.11^{b}
Tomato 82-B	T_7	53.35 ± 0.7^{a}	265.25 ± 13.9^{ab}	6052.29 ± 313.9^{b}	9.27 ± 0.3^{a}	3.25 ± 0.47^{ab}	244.37 ± 51.63^{a}	743.42 ± 157.01^{ab}
	T_8	55.25 ± 3.1^{a}	261.75 ± 3.4^{ab}	5980.92 ± 76.2^{b}	8.60 ± 0.6^{ab}	4.25 ± 0.75^{ab}	313.75 ± 79.96^{a}	950.67 ± 242.24^{ab}
	T_9	49.75 ± 2.4^{a}	201.00 ± 11.6^{b}	3161.34 ± 190.8^{cd}	7.80 ± 0.8^{ab}	3.00 ± 1.00^{ab}	109.60 ± 43.31^{b}	526.35 ± 288.74^{ab}
	T_{10}	61.50 ± 2.4^{a}	207.25 ± 25.9^{b}	3655.44 ± 458.7^{bcd}	5.95 ± 0.4^{b}	3.00 ± 0.40^{ab}	146.20 ± 74.52^{b}	613.02 ± 391.73^{ab}
	T_{11}	55.82 ± 4.2^{a}	179.50 ± 26.7^{b}	4523.94 ± 663.9^{bcd}	9.22 ± 0.6^{a}	2.75 ± 0.94^{ab}	92.75 ± 36.96^{b}	281.02 ± 111.99 ^{b}
	T_{12}	56.62 ± 5.6^{a}	174.25 ± 37.1^{b}	2421.15 ± 515.1^{d}	9.85 ± 2.7^{a}	2.00 ± 0.81^{b}	40.70 ± 14.48^{b}	123.32 ± 43.88^{b}
	T_{13}	61.15 ± 5.8^{a}	249.75 ± 25.9^{ab}	4128.78 ± 385.5^{bcd}	8.40 ± 0.8^{ab}	3.50 ± 0.28^{ab}	92.80 ± 16.93^{b}	281.17 ± 51.31^{b}
	Mean	56.02	228.80	4717.20	8.47	3.17	160.17	513.58
	P-value	0.555	0.019	<0.001	0.0301	0.0374	0.04	0.014

Values followed by the same superscripts along the column are statistically the same at P≤ 0.05. Refer to methodology for treatment details.

pruning resulted in greater growth as compared to zero phosphorus fertilizer. Also, the fruit yield values recorded in the combinations of phosphorus and pruning treatments in this study were higher than when only phosphorus was used as found in Filho *et al.* (2020).

Effect on proximate composition and fruit yield: The proximate composition and fruit quality in both varieties differed significantly under the influence of the combination of phosphorus fertilizer and pruning (Table 2). The recorded proximate composition appeared similar in both varieties except for ash and carbohydrate. Percentage moisture was highest with lowest fat contents and this is typical of all tomato cultivars. The high moisture content is a disadvantage when it comes to storability and shelf-life, whereas the low-fat content is of great health benefit in the diet of patient with coronary disease (Olayinka *et al.* (2017). The ash contents in both varieties were significantly greater in treatments with high combination of phosphorus fertilizer and pruning (T_{12} and T_{13}). The amount of ash had a direct proportional relationship with amount of mineral elements (Musa *et al.* 2010). The average fibre content was within the reported values reported by Adebooye *et al*. (2006). Protein content in both varieties with average value of 0.89% was lower than the mean value of 1.01% reported for other varieties of tomato grown under different weed control methods (Olayinka *et al.* 2017). An indication of the fact that treatments may influence composition of the fruit. The average carbohydrate in both varieties was

Table 2 Effect of combination of phosphorus fertilizer and shoot pruning on the proximate compositions and fruit quality of two tomato varieties

Variety	Treatment	Moisture	Ash	Crude fibre (%)	Crude protein	Crude fat	Carbohy-drate	Vitamin C	Beta-carotene (mg/kg)	Lycopene	Phos-phorus
	T_1	94.84 ± 0.007^{e}	0.79 ± 0.002^{ab}	1.25 ± 0.003^{a}	0.99 ± 0.003^{a}	0.31 ± 0.003^{gh}	1.82 ± 0.003^{b}	7.32 ± 0.025^{j}	0.02 ± 0.001^{e}	0.12 ± 0.000^{c}	322.39 ± 0.009^{b}
	T_2	95.07 ± 0.034^{e}	0.88 ± 0.006^{ab}	1.12 ± 0.002^{d}	0.89 ± 0.001^{d}	0.32 ± 0.001^{ef}	1.72 ± 0.027^{bc}	6.49 ± 0.006^{l}	0.01 ± 0.000^{j}	0.31 ± 0.002^{b}	345.28 ± 0.020^{b}
	T_3	94.78 ± 0.033^{e}	0.66 ± 0.001^{b}	1.25 ± 0.001^{a}	0.99 ± 0.002^{a}	0.29 ± 0.004^{i}	2.02 ± 0.039^{b}	7.78 ± 0.009^{g}	0.04 ± 0.000^{d}	0.12 ± 0.008^{c}	345.45 ± 0.025^{b}
	T_4	95.37 ± 0.004^{c}	0.94 ± 0.004^{ab}	1.24 ± 0.002^{a}	0.93 ± 0.004^{c}	0.31 ± 0.002g^{h}	1.21 ± 0.012^{d}	8.41 ± 0.002^{f}	0.02 ± 0.000f	0.41 ± 0.002^{a}	347.43 ± 0.012^{b}

Contd.

Table 2 (*Concluded*)

Variety	Treatment	Moisture	Ash	Crude fibre (%)	Crude protein	Crude fat	Carbohydrate	Vitamin C	Beta-carotene (mg/kg)	Lycopene	Phosphorus
	T_5	94.69 ± 0.016^{f}	0.87 ± 0.004^{ab}	0.99 ± 0.007^{h}	0.89 ± 0.002^{d}	0.39 ± 0.002^{c}	2.16 ± 0.013^{b}	9.75 ± 0.024^{b}	0.05 ± 0.000^{b}	0.13 ± 0.000^{c}	349.91 ± 0.005^{b}
	T_6	94.59 ± 0.005^{g}	0.90 ± 0.004^{ab}	1.23 ± 0.001^{b}	0.93 ± 0.001^{c}	0.32 ± 0.001^{e}	2.03 ± 0.011^{b}	6.42 ± 0.025^{m}	0.01 ± 0.000^{k}	0.07 ± 0.001^{f}	345.59 ± 0.085^{b}
Local	T_7	95.82 ± 0.004^{a}	0.83 ± 0.002^{ab}	1.02 ± 0.001^{g}	0.99 ± 0.002^{a}	0.30 ± 0.001^{hi}	1.05 ± 0.009^{d}	7.51 ± 0.006^{h}	0.02 ± 0.001^{h}	0.06 ± 0.001^{g}	345.56 ± 0.105^{b}
	T_8	94.69 ± 0.032^{f}	1.06 ± 0.004^{ab}	1.25 ± 0.004^{a}	0.85 ± 0.003^{f}	0.39 ± 0.001^{b}	1.76 ± 0.036^{b}	9.48 ± 0.026^{d}	0.01 ± 0.000^{i}	0.05 ± 0.001^{g}	346.78 ± 0.002^{b}
	T_9	95.64 ± 0.005^{b}	0.79 ± 0.001^{ab}	1.05 ± 0.002^{f}	0.83 ± 0.001^{g}	0.41 ± 0.005^{a}	1.29 ± 0.004^{cd}	9.61 ± 0.010^{c}	0.02 ± 0.000^{f}	0.09 ± 0.001^{d}	401.01 ± 50.026^{a}
	T_{10}	94.08 ± 0.049^{i}	0.75 ± 0.002^{b}	1.10 ± 0.001^{e}	0.95 ± 0.001^{b}	0.32 ± 0.002^{e}	2.80 ± 0.054^{a}	7.16 ± 0.045^{k}	0.04 ± 0.000^{c}	0.02 ± 0.000^{hi}	344.98 ± 0.040^{b}
	T_{11}	95.67 ± 0.003^{b}	0.65 ± 0.004^{b}	1.21 ± 0.002^{c}	0.88 ± 0.002^{e}	0.31 ± 0.001^{fg}	1.29 ± 0.008^{cd}	7.40 ± 0.007^{i}	0.02 ± 0.000^{e}	0.01 ± 0.001^{i}	345.36 ± 0.001^{b}
	T_{12}	94.81 ± 0.017^{e}	0.69 ± 0.506^{b}	1.19 ± 0.001^{c}	0.93 ± 0.002^{c}	0.38 ± 0.001^{d}	2.00 ± 0.487^{b}	8.89 ± 0.007^{f}	0.07 ± 0.000^{a}	0.03 ± 0.000^{h}	347.98 ± 0.018^{b}
	T_{13}	94.31 ± 0.040^{h}	1.24 ± 0.001^{a}	1.11 ± 0.007^{e}	0.77 ± 0.002^{h}	0.39 ± 0.001^{bc}	2.18 ± 0.045^{b}	9.85 ± 0.023^{a}	0.02 ± 0.000^{g}	0.08 ± 0.001^{e}	351.27 ± 0.048a
	Mean	94.95	0.85	1.16	0.91	0.34	1.79	8.16	0.03	0.12	349.15
	P-value	<0.001	0.271	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.233
	T_1	94.57 ± 0.003^{h}	0.92 ± 0.005^{b}	1.23 ± 0.003^{d}	1.00 ± 0.002^{a}	0.33 ± 0.003^{d}	1.95 ± 0.006^{c}	7.25 ± 0.022^{g}	0.04 ± 0.000^{bc}	0.05 ± 0.001^{j}	320.53 ± 0.154^{e}
	T_2	93.99 ± 0.020^{i}	0.65 ± 0.003j	1.14 ± 0.002^{g}	0.89 ± 0.001^{e}	0.32 ± 0.002^{e}	3.01 ± 0.028^{b}	6.72 ± 0.049^{h}	0.03 ± 0.011^{cdef}	0.05 ± 0.000^{k}	345.36 ± 0.022^{d}
	T_3	95.16 ± 0.009^{e}	0.67 ± 0.002i	1.22 ± 0.001^{e}	1.00 ± 0.001^{a}	0.31 ± 0.001^{ef}	1.63 ± 0.011^{df}	7.74 ± 0.037^{g}	0.03 ± 0.000^{def}	0.17 ± 0.001^{b}	346.21 ± 0.003^{cd}
	T_4	95.27 ± 0.021^{cd}	0.71 ± 0.001^{g}	1.18 ± 0.000^{f}	0.98 ± 0.004^{b}	0.31 ± 0.002^{fg}	1.56 ± 0.023^{efg}	8.72 ± 0.006^{d}	0.03 ± 0.001^{ef}	0.06 ± 0.001^{h}	346.96 ± 0.103^{bcd}
	T_5	95.67 ± 0.006^{a}	0.79 ± 0.003^{f}	1.10 ± 0.001^{h}	0.90 ± 0.002^{d}	0.38 ± 0.001^{c}	1.15 ± 0.007^{i}	9.90 ± 0.007^{b}	0.02 ± 0.000^{fg}	0.07 ± 0.000^{f}	351.03 ± 0.074^{ab}
	T_6	93.48 ± 0.013^{j}	0.67 ± 0.004^{i}	1.14 ± 0.002^{g}	0.89 ± 0.003^{de}	0.29 ± 0.002^{g}	3.52 ± 0.019^{a}	6.43 ± 0.112^{i}	0.09 ± 0.000^{a}	0.11 ± 0.000^{e}	343.56 ± 0.003^{d}
Tomato 82-B	T_7	95.33 ± 0.004^{bc}	0.80 ± 0.001^{f}	0.91 ± 0.003^{j}	0.94 ± 0.003^{c}	0.30 ± 0.003^{g}	1.63 ± 0.009^{def}	7.78 ± 0.058^{f}	0.05 ± 0.000^{b}	0.21 ± 0.000^{a}	351.99 ± 5.009^{ab}
	T_8	94.90 ± 0.010^{g}	0.89 ± 0.002^{c}	1.26 ± 0.001^{c}	0.87 ± 0.002^{f}	0.39 ± 0.004^{ab}	1.68 ± 0.006^{d}	8.29 ± 0.008^{e}	0.03 ± 0.000^{cdef}	0.05 ± 0.001^{i}	346.87 ± 0.008^{bcd}
	T_9	95.29 ± 0.015^{bc}	0.60 ± 0.003^{k}	0.91 ± 0.004^{j}	0.84 ± 0.003^{g}	0.40 ± 0.001^{a}	1.86 ± 0.024^{c}	9.97 ± 0.032^{ab}	0.02 ± 0.000^{gh}	0.04 ± 0.000^{l}	350.76 ± 0.014^{abc}
	T_{10}	95.18 ± 0.030^{de}	0.70 ± 0.005^{h}	1.30 ± 0.003^{a}	0.98 ± 0.001^{b}	0.32 ± 0.001^{d}	1.53 ± 0.023^{fgh}	7.21 ± 0.004^{g}	0.01 ± 0.001^{h}	0.07 ± 0.000^{g}	344.39 ± 0.008^{d}
	T_{11}	95.24 ± 0.016^{cde}	0.87 ± 0.003^{d}	1.11 ± 0.002^{h}	0.89 ± 0.005^{de}	0.31 ± 0.002^{ef}	1.58 ± 0.019^{defg}	7.31 ± 0.029^{g}	0.05 ± 0.001^{b}	0.12 ± 0.000^{d}	344.37 ± 0.482^{d}
	T_{12}	95.01 ± 0.090^{f}	0.98 ± 0.002^{a}	1.28 ± 0.002^{b}	0.89 ± 0.001^{e}	0.40 ± 0.001^{a}	1.44 ± 0.096^{h}	9.49 ± 0.010^{c}	0.04 ± 0.000^{bcd}	0.14 ± 0.001^{c}	347.22 ± 0.005^{bcd}
	T_{13}	95.38 ± 0.022^{b}	0.82 ± 0.003^{e}	1.08 ± 0.002^{i}	0.82 ± 0.003^{h}	0.39 ± 0.001^{b}	1.51 ± 0.018^{gf}	10.04 ± 0.002^{a}	0.04 ± 0.000^{cde}	0.01 ± 0.001^{m}	351.43 ± 0.029^{a}
	Mean	94.96	0.77	1.16	0.92	0.34	1.85	8.72	0.04	0.09	345.44
	P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Values followed by the same superscripts along the column are statistically the same at $P \leq 0.05$. Refer to methodology for treatment details.

1.82% and is lower than the value reported by Garuba *et al*. (2018).

Varietal differences indicated that Tomato 82-B had higher fruit quality than local varieties except for lycopene (Table 2). With regard to treatments, there were greater accumulations of vitamin C in tomato grown under 45 kg P/ha + four-stem pruning (T_{13}) when compared to other treatments. However, local and Tomato 82-B varieties had significant increase in beta-carotene in tomato grown under 45 kg P/ha + four-stem pruning (T_{12}) and 15 kg P/ha + three-stem pruning (T_6) respectively than treatments (Table 2). The foregoing results are inconsistent. It is therefore pertinent to ascribe the observed variation recorded in fruit quality to factors such as growing condition and cultivars or genetic constitutions (Klee 2010). The phosphorus uptake in fruit increased with increase in combination of phosphorus fertilizer and pruning as indicated in Table 2. Varietal difference indicated that the uptake was more in local variety than Tomato 82-B. The results agrees with the finding of Higo *et al.* (2020).

Application of 45 kg P/ha + four stems pruning and 30 kg P/ha + two-stem pruning in local and Tomato 82-B respectively resulted in tremendous growth and yield. Proximate and fruit qualities showed inconsistent results. Combination of 45 kg P/ha + four-stem pruning and 30 kg P/ha + two-stem pruning are optimum for improving the yield of tomato and this should be adopted in tomato production by farmers.

SUMMARY

Phosphorus fertilization or pruning as sole practice has been established to enhance tomato yield. However, there is a dearth of knowledge when both practices are combined. Under potted experiment, two tomato varieties (Tomato 82-B and Local) were subjected to 13 treatment combinations of phosphorus fertilization and pruning between June and September, 2021 in a garden situated at Ilorin, Nigeria. In both varieties, plants receiving 30 kg P/ha + two-stem pruning recorded highest growth indices. Marketable fruit yield was remarkably enhanced under 45 kg P/ha + four-stem pruning and 30 kg P/ha + two-stem pruning in local and Tomato 82-B respectively. Local variety showed more vigorous growth and yield than Tomato 82-B. Proximate compositions showed inconsistent results. Ascorbic acid, beta-carotene and lycopene were highest in tomato plants receiving 60 kg P/ha + four-stem pruning, 15 kg P/ha + three-stem pruning and 45 kg P/ha + four-stem respectively. Tomato 82-B had higher ascorbic acid and beta-carotene than the local variety. Conclusively, four-stem pruning + 45 kg/ha and two-stem pruning + 30 kg/ha are considered optimum for improving the yield of tomato varieties studied and that combination of pruning and phosphorus fertilization showed little influence on the fruit quality.

REFERENCES

AOAC. Assn. of Official Analytical Chemists. 2000. Coffee and tea. *Official Methods of Analysis*, 17th edn. Gaithersburg.

Adebooye O C, Adeoye G O and Tijani-Eniola H. 2006. Quality of fruits of three varieties of tomato (L*ycopersicon esculentum* (L.) Mill) as affected by phosphorus rates. *Journal of Agronomy* **5**(3): 396–400.

Ahn T, Oke M, Schofield A and Paliyath G. 2005. Effects of phosphorus fertilizer supplementation on antioxidant enzyme activities in tomato fruits. *Journal of Agricultural and Food Chemistry* **53**(5): 1539–45.

Ayandiji A, Adeniyi OD and Omidiji D. 2011. Determinant post-harvest losses among tomato farmers in Imeko-Afon local government area of Ogun State, Nigeria. *Global Journal of Science Frontier Research* **11**(5): 23–27.

Barros L, Carvalho A M and Ferreira I C. 2010. Leaves, flowers, immature fruits and leafy flowered stems of Malva sylvestris: A comparative study of the nutraceutical potential and composition. *Food and Chemical Toxicology* **48**(6): 1466–72.

Duncan D B. 1955. Duncan new multiple range test. *Biometrics* **11**: 1–42.

Falodun E J and Ogedegbe S A. 2019. Effects of pruning location on growth and fruiting of three tomato (*Lycopersicon esculentum* Mill) varieties in rainforest zone of Nigeria. *Agro-Science* **18**(3): 1–4.

FAO. 2016. FAO Database. Food and Agriculture Organization, United Nations. *http:// www.fao.org/faostat/en/#data/QC.*

Filho A B C, Trevizaneli B and Rugeles-Reyes S M. 2020. Phosphorus (P) improves industrial tomato quality and yield in soil with high phosphorus content. *Australian Journal of Crop Science* **14**: 1335–41.

Garuba T, Mustapha O T and Oyeyiola G P. 2018. Shelf life and proximate composition of tomato (*Solanum lycopersicum* L.) fruits as influenced by storage methods. *Ceylon Journal of Science* **47**(4): 387–93.

Higo M, Azuma M, Kamiyoshihara Y, Kanda A, Tatewaki Y and Isobe K. 2020. Impact of phosphorus fertilization on tomato growth and arbuscular mycorrhizal fungal communities. *Microorganisms* **8**(2): 178.

Klee H J. 2010. Improving the flavor of fresh fruits: genomics, biochemistry and biotechnology. *New Phytologist* **187**: 44–56.

Musa A K, Kalejaiye D M, Ismail L E and Oyerinde A A. 2010. Proximate composition of selected groundnut varieties and their susceptibility to *Trogoderma granarium* Everts attack. *Journal of Stored Products and Post-Harvest Research* **1**(2): 13–17.

Musa U T, Yusuf M and Olukotun D M. 2021. Effect of varying levels of poultry manure and inorganic fertilizer on the growth and yield of cucumber in Anyigba, Kogi state. *American Journal of Agricultural Science, Engineering and Technology* **5**(2): 326–38.

Olayinka B U, Esan O O, Anwo I O and Etejere E O. 2017. Comparative growth analysis and fruit quality of two varieties of tomato under hand weeding and pendimethalin herbicide. *Journal of Agricultural Sciences* **12**(3): 149–61.

Xu Y, Liu X, Shi Q, Cheng F, Zhang L, Shao C and Gong B. 2020. Pruning length of lateral branches affects tomato growth and yields in relation to auxin-cytokinin cross talk. *Plant Growth Regulation* **92**(1): 1–13.