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Effect of Staking on Growth and Yield of Tomato (*Lycopersicon esculentum* Mill) Varieties in Edo Humid Forest Zone, Nigeria

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ABSTRACT: Staking or trellising means fastening the plants with upright stakes with the help of plant ties. These stakes provide support and strength to the top-heavy plants and allow them to continue growing skyward without letting rain, high winds, and the weight of flowers or fruits overcome them. Many plants, as they mature, need support to help them grow. This is especially true of tomato plants and such climbing plants as beans, cucumbers, and winter squash. As tomato plants mature, they begin to sprawl along the ground because they become heavy with fruit. Therefore, the objective of this investigation was to find out the effect of staking on the growth and yield of six tomato (*Lycopersicon esculentum* Mill) varieties (UC82, Bufalo, Cobra, Roma VF, Tropimech and Roma savanna) in the Edo humid forest zone of Nigeria using appropriate standard techniques. Results on vegetative and fruit traits showed positive response in plant height of staked plants compared to the non- staked plants while the number of leaves increased with the non-staked plants. Tropimech variety significantly reduced fruit weight per plant (102.83 g and 127.66 g) and fruit yield (2200.54 kg ha $^{-}$1 and 2412.82 kg ha $^{-}$1) compared with the other tomato varieties and staking had no significant effect on tomato fruit yield. This study recommends that farmers in the study area could grow any of these tomato (UC82, Bufalo, Cobra, Roma VF, and Roma savanna) varieties with or without staking for increased growth and fruit yield of tomato.

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Tomato (*Lycopersicon esculentum* L.) is one of the most important horticultural crops and is produced, traded and consumed worldwide (Fernqvist, 2014). For research, tomato is considered a crop of the Solanaceae family, and has therefore been, and is still a major crop subject of studies both in the laboratory and under field conditions. Ahmad and Singh, (2005) ascertain that the short duration of the crop, easiness in cultivation and large number of seeds per fruit has made it an ideal crop for research. Tomato is an excellent source of many nutrients and secondary metabolites that are important for human health. Sesso *et al.*, (2005); Fanasca *et al.*, (2007) reported the beneficial effects of the anti-oxidant properties of tomato in preventing cancer. In Nigeria, tomato has a great demand round the year, studies have shown that the yield of tomato in Nigeria do not always reach the full production potential due to the use of unimproved local varieties and poor agronomic practices (Idowu-Agida *et al.*, 2010). Tomato varieties differ in their growth and yield potential depending mainly on the physiological process which is controlled by interplay of both genetic make-up in partitioning of photosynthetic materials towards economic yield and the environment. Chaerani and Voorrips (2006), reported that successful cultivation of tomato is based essentially on the choice of suitable varieties for a particular environment. There is high demand from

farmers on the use of well adapted early maturing, uniform, better and disease and pest resistance varieties of tomato to improve yield and fruit quality. According to Iken and Anusa (2004), they suggested that because of the differences in the yield potentials of different ecological zones, testing of new varieties of crops across the country must be adopted and established as a practice in plant breeding. Cultural practices such as staking could increase tomato yield substantially this is an important component for healthy productive plant. Staking refers to support of plants with sturdy material to keep the fruits and foliage off the ground. Staking improves air movement around the plants preventing the build - up of high relative humidity which favour development of fungal diseases, It aids cultural operations like spraying, weeding, fertilizers application, earthing up, better exposure of the foliage to sunlight and photosynthetic activities, easy harvesting, increases fruit yield, reduces the proportion of unmarketable fruit and enhances the production of high quality fruits (Patterson, (1990); Akoroda *et al*. (1990); Anon., (2007) and Amina *et al*.(2012). Ali and Moniruzzaman (2017) reported that staking reduces fruit rotting and Sowley and Damba, (2013) found clean and bigger fruits with an increase in total marketable fruit yield with staked plants. Therefore, the objective of this investigation was to find out the effect of staking on the growth and yield of six tomato (*Lycopersicon esculentum* Mill) varieties (UC82, Bufalo, Cobra, Roma VF, Tropimech and Roma savanna) in the Edo humid forest zone of Nigeria.

MATERIALS AND METHODS

Study Area and Experimental Design: Field trials were conducted from November to March, 2017/18 at the Department of Crop Science Experimental Farm, Faculty of Agriculture, University of Benin, Benin City, Edo State, Nigeria, which lies between latitude 6° 14' N and 7° 34' N and longitude 5° 40' E and 6° 43' E in a high-humidity (80%) region. The field has been under continuous cultivation for many years. Weather conditions during the dry cropping season differed (Table 1). The experiments were irrigated. The soil was slightly acidic (pH 5.65), sandy-loam containing 0.03% N, 6.02 mg g $^{-1}$ P and 0.65 cmol kg $^{-1}$ K. The experiment was a 2 x 6 factorial arranged in a randomized complete block design (RCBD) replicated three times. The treatments comprised of six tomato varieties (UC82, Bufalo, Cobra, Roma VF, Tropimech and Roma savanna) and two staking levels (no stake and stake) for a total of thirty-six (36) experimental plots.

Nursery and Transplanting of Seedlings: Nursery beds measuring 5 m × 1.2 m were prepared and mixed thoroughly with poultry manure. Seed of tomato varieties were thinly sown in drills on prepared beds in the nursery on 5 Nov. 2017 and 2018 for first and second experiments respectively. Seeds were mulched with dry grasses and water applied daily for the first 2 weeks and then every other day after the second 2 weeks. The field was prepared by clearing and bedding. Beds measuring 3 × 2 m were 0.5 m apart, and 4-week-old seedlings were transplanted on 5 Dec. 2017 and 2018, using a 0.5 ×0.5 m spacing with 24 plants/plot. A compound N- P- K 15:15:15 fertilizer was applied at 300 kg ha $^{-1}$ in two split applications of 150 kg·ha^{-1} with the first at 2 weeks after transplanting (WAT) and the second 2 weeks later. Wooden stakes of about 60–80 cm were inserted about 20 cm into the soil, just outside the diameter of the tomato seedlings after transplanting when the plant reached about 25 cm in height, the stem of the tomato plants were loosely tied to the supporting stakes. Water was applied to field capacity three times a week during the dry season. Plots were manually weeded at 2, 4, and 8 weeks after transplanting (WAT) and treated with cypermethrin 10% EC at 0.3 L ha $^{-1}$ to control whitefly (*Bemisia tabaci*) at 3 and 6 WAT in each year. Harvesting was done when fruits were at 50% yellowish green stage.

Sampling and measurement: Data collection started four weeks after transplanting (WAT) and continued fortnightly thereafter. Four plants were randomly selected from each plot and tagged for the purpose of collecting data for plant height (cm), number of leaves, number of branches, leaf area (cm) and stem diameter (cm) others include Number of days to 50% flowering, number of flowers, days to 50% maturity, number of fruits and fruits weight (g) to compute the ratio of flowers to fruits (Equation 1) and fruit yield (kg ha $^{-1}$) [Equation 2].

$$\mathrm{RFF} = \frac{\mathrm{AF}}{\mathrm{BF}} \qquad (1)$$

Where RFF = Ratio of flowers to fruits; AF = Total no of flowers in sample plant; BF = Total no of fruits in sample plant

$$\mathrm{FY(kg\ ha^{-1}\ )} = \frac{\text{Plot yield (kg)}}{\text{Plot size (m}^2\text{)}} * 10000 \qquad (2)$$

Where FY = Fruit yield (kg ha $^{-1}$)

Statistical analysis: Data collected were subjected to analysis of variance (ANOVA), using SAS (Statistical Analysis Software) and least significance difference (LSD) test at 5% level of probability was used to compare the significant treatment mean.

RESULTS AND DISCUSSION

The area has an average minimum and maximum temperatures of 24.90 ^{0}C and 27.50 ^{0}C respectively. Monthly rainfall during the period of the experiment was low and ranges from 48.00 mm – 319.00 mm. The scanty rainfall during the period of the experiment necessitated the need for irrigation. The percentage humidity was high almost all year round and ranged from 67 % - 91.00 % while the average sun hours was between 5.00 hrs – 7.40 hrs (Table 1). The effect of staking and tomato varieties was significant on some of the vegetative and reproductive characters measured. The result indicated significant ($p \leq 0.05$) differences among treatments on the plant height in 2018 cropping season and number of leaves in both years. In 2018, staked plants were significantly taller than no staked plants, staking increased plant height from (40.18 cm - 44.14 cm). In both years, there was a significant increase in the number of leaves with the no staked plants. Higher number of leaves (64.18 and 56.10) were produced with no staked compared with (50.19 and 45.21) produced for staked plants in 2017 and 2018, respectively.

The increase in the number of leaves with the no staked plants could be due to the fact that the tomato varieties under this study were the determinate type and may not require staking. This findings corroborate the report of Hanson *et al*., 2000 who opined that determinate varieties do not require stake as the indeterminate varieties. The effect of staking was not significant on the number of branches in both years. However, Tropimech variety produced significantly lower number of branches (8.64) compared with cobra (9.86), UC82 (9.95) and Bufalow (9.93) which were statistically similar and higher in number of leaves (Table 2). The variations in the number of branches with respect to different varieties may be due to phenotypic differences in traits of cultivars through their interaction with environments.

The higher number of branches with Cobra, UC82, Bufalow, Roma VF and Roma Savanna over Tropimec could be attributed to the differences in growth characters of crop varieties to differences in distribution of crop canopy, leaf arrangement, differences in chlorophyll content, photosynthetic activities and suitability to agro-ecological conditions for the varieties, this supports the work of Enujeke (2013), Ibrahim *et al.*, (2000) and Sajjan *et al.*, (2002) who reported that genetic constitution of crop varieties influence growth characters which they express. Stem diameter was not significantly affected by staking and tomato varieties and the leaf area was not uniformly affected. Tomato varieties increased in leaf area for cobra (97.42 cm ^{2}), UC82 (98.21 cm ^{2}), Bufalow (98.34 cm ^{2}) and Roma savanna (96.67 cm ^{2}) compared with Roma VF (92.20 cm ^{2}) and Tropimech (92.13 cm ^{2}), Tropimec variety had lower values for leaf area compared with other varieties studied this probably could be due to the fact that the other varieties had wider leaves with better distribution of leaf surface, higher chlorophyll content and higher photosynthetic activities. This is in support with the findings of Ray and Sinclair (1997).

Number of days to 50% flowering was influenced by staking, no staked plants flowered earlier (42.50) than the staked plants (49.33) in 2017 cropping season while in both seasons Cobra (44.10 and 42.15) ,UC82 (44.48 and 42.72), Bufalow (42.25 and 41.24), Roma VF (41.95 and 42.62) and Roma savanna (42.21 and 41.32) tomato varieties flowered significantly earlier than Tropimech (50.42 and 49.06) Table 3. The differences in days to 50% flowering among the varieties may be due to the differences in the genetic constitution and day length or radiation hours.

Abdelmageed and Gruda (2009) and Singh *et al.*, (2014), stated that both genotypic and environmental factors influence tomato plants to flower early or delay in flowering. Staking and tomato varieties did not have a significant effect on number of flowers but the ratio of flowers to fruits were higher in Cobra, UC82 and Tropimec varieties (Table 4). Significant ($p < 0.05$) differences were observed in fruit weight, staked plants increased in fruit weight (134.67g) above no staked (132.24 g). In both years, Bufalow variety produced more fruits (6.17 and 6.12) and weightier fruits (139.18 g and 159.37g) which were statistically at par with UC82 (5.03 and 6.04) and (141.11 g and 156.52 g) and Roma Savanna (4.33 and 5.39) and (140.05 g and 156.34 g).

This was followed by RomaVF (4.19 and 5.73) and (133.42 g and 153.34 g) and then cobra variety (4.14 and 4.21) and (133.30 g and 142.15 g) while Tropimech (4.04 and 4.17) and (102.83 g and 127.66 g) produced significantly lowest number of fruits and fruits weight (Table 5). Days to 50% fruit maturity was significantly ($P<0.05$) influenced by variety (Table 4).

The shortest number of days to 50% fruit maturity was recorded from Bufalow variety (71.38 days and 72.25 days) which was not significantly different from Cobra (75.15 days and 75.21 days), UC82 (75.23 days and 75.03 days), Roma VF (75.17 days and 75.73 days) and Roma Savanna (75.23 days and 75.39 days) varieties. While maximum days required to attain 50% fruit maturity was recorded from Tropimech (77.14 days and 80.17 days). The delay in 50% flowering and maturity with Tropimec variety could be the reason for

their low yield. Falodun and Emede (2019) showed that early flowering varieties have a beneficial effect for attaining higher yield of tomato fruits. Fruit diameter increased with Roma Savanna (1.72 cm and 1.80 cm), but it was not significantly different from Bufalow (1.65 cm and 1.84 cm) and Roma VF (1.64 cm and 1.82 cm) while Cobra (1.55 cm and 1.64 cm) and UC82 (1.48 cm and 1.51 cm) were statistically at par, the fruit diameter decreased with Tropimech (1.28 cm and 1.40 cm) variety (Table 4).

Fruit length was almost similar in all the varieties except for Tropimech and UC82 varieties. Significant differences were not observed in the fruit yield with respect to staking however, in both years Tropimech produced significantly ($P<0.05$) lowest fruit yield (2200.54 kg ha $^{-1}$ and 2412.82 kg ha $^{-1}$) compared with other varieties which were statistically higher, UC82 (3141.91 kg ha $^{-1}$ and 3552.70 kg ha $^{-1}$), Bufalow (3055.03 kg ha $^{-1}$ and 3373.14 kg ha $^{-1}$), Roma Savanna (2994.22 kg ha $^{-1}$ and 3386.61.82 kg ha $^{-1}$), Roma VF (2832.36 kg ha $^{-1}$ and 3276.25 kg ha $^{-1}$) and then Cobra variety (2743.83 kg ha $^{-1}$ and 2924.62 kg ha $^{-1}$) Table 6. The higher fruit yield with Cobra, UC82, Bufalow, Roma VF and Roma Savanna varieties could be attributed to the growth and yield differences of these varieties to genetic resources and favourable environmental conditions.

This is consistent with the work of (Iken and Anusa, 2004). Enujeke and Emuh (2015) also reported differences in tomato fruit yield with different varieties. Although there was increase in fruit weight per hectare of tomato yield due to staking but it was not significant. This could be attributed to the fact that the varieties used were the determinate type which may not require staking (Hanson, 2000).

Table 1: Weather data for the period of experiment

Months	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Av. Temp. ^{0}C	24.90	25.80	26.70	27.30	27.50	27.00
Rainfall (mm)	319.00	133.00	48.00	51.00	82.00	174.00
Humidity (%)	91.00	88.00	76.00	67.00	76.00	84.00
Av. Sun hours (hrs)	5.00	5.50	6.90	7.40	6.80	6.50

Data 1991- 2021, Avg. Temp, Rainfall and Humidity; Data 1999- 2019, Avg. Sun hours; Source Climate – Data. Org.

Table 2: Effects of staking on some vegetative characters of tomato varieties (*Lycopersicon esculentum* Mill)

Cropping season Treatment	2017 Plant height (cm)	2018 Plant height (cm)	2017 Number of Leaves	2018 Number of Leaves	2017 Number of branches	2018 Number of branches
Staking						
No stake	37.01a	40.18b	64.18a	56.10a	9.62^{a}	8.85^{a}
Stake	38.53a	44.14a	50.19b	45.21b	9.24^{a}	8.01^{a}
Significances	Ns	*	*	*	Ns	Ns
Varieties						
Cobra	40.50^{a}	42.31^{a}	59.31^{a}	48.21^{a}	10.06^{ab}	9.86^{a}
UC82	38.00^{a}	40.02^{a}	62.91^{a}	52.37^{a}	10.15^{a}	9.95^{a}
Bufalow	37.95^{a}	40.14^{a}	55.01^{a}	50.12^{a}	9.49^{ab}	9.93^{a}
Roma VF	37.49^{a}	40.32^{a}	57.43^{a}	50.54^{a}	9.26^{ab}	9.34^{ab}
Tropimech	34.02^{a}	37.13^{a}	53.28^{a}	45.17^{a}	8.71^{ab}	8.64^{b}
Roma Savanna	37.80^{a}	40.26^{a}	55.17^{a}	50.14^{a}	9.62^{ab}	9.38^{ab}
Significances	Ns	Ns	Ns	Ns	Ns	*

*Means with the same letter along the column are not significantly different at 5% level of probability; ns - not significant at 5% level of probability; * Significant at 5% level of probability*

Table 3: Effects of staking on some vegetative characters and number of flowers of tomato varieties (*Lycopersicon esculentum* Mill)

Cropping season Treatment	2017 Stem diameter (cm)	2018 Stem diameter (cm)	2017 Leaf area (cm)	2018 Leaf area (cm)	2017 No of days to 50% flowering	2018 No of days to 50% flowering
Staking						
Non stake	0.25^{a}	0.26^{a}	94.53^{a}	98.17^{a}	42.50^{b}	44.37^{a}
Stake	0.29^{a}	0.28^{a}	94.19^{a}	94.32^{a}	49.33^{a}	46.11^{a}
Significances	Ns	Ns	Ns	Ns	*	Ns
Varieties						
Cobra	0.20^{a}	0.23^{a}	94.57^{a}	96.42^{ab}	44.10^{a}	42.15^{a}
UC82	0.25^{a}	0.25^{a}	92.98^{ab}	98.21^{a}	44.48^{a}	42.72^{a}
Bufalow	0.25^{a}	0.26^{a}	94.30^{a}	98.34^{a}	42.25^{a}	41.24^{a}
Roma VF	0.20^{a}	0.22^{a}	92.98^{ab}	92.20^{b}	41.95^{a}	42.62^{a}
Tropimech	0.24^{a}	0.25^{a}	91.10^{b}	92.13^{b}	50.42^{b}	49.06^{b}
Roma Savanna	0.24^{a}	0.25^{a}	94.21^{ab}	96.67^{ab}	42.21^{a}	41.32^{a}
Significances	Ns	Ns	*	*	*	*

*Means with the same letter along the column are not significantly different at 5% level of probability; ns - not significant at 5% level of probability; * Significant at 5% level of probability*

Table 4: Effects of staking on some reproductive characters of tomato varieties (*Lycopersicon esculentum* Mill)

Cropping season	2017	2018	2017	2018
Treatment	Number of flowers	Number of flowers	Ratio of flowers to fruits	Ratio of flowers to fruits
Staking				
Non stake	5.75[a]	6.32[a]	1.68[a]	1.06[a]
Stake	5.73[a]	6.17[a]	1.81[a]	1.22[a]
Significances	Ns	Ns	Ns	Ns
Varieties				
Cobra	5.74[a]	6.15[a]	1.38[a]	1.46[a]
UC82	6.77[a]	7.16[a]	1.34[a]	1.18[b]
Bufalow	7.10[a]	7.21[a]	1.15[b]	1.16[b]
Roma VF	4.76[a]	6.10[a]	1.13[b]	1.28[ab]
Tropimech	6.04[a]	6.11[a]	1.49[a]	1.18[b]
Roma Savanna	5.62[a]	6.24[a]	1.29	1.15[b]
Significances	Ns	Ns	*	*

*Means with the same letter along the column are not significantly different at 5% level of probability; ns - not significant at 5% level of probability; * Significant at 5% level of probability*

Table 5: Effects of staking on some reproductive characters of tomato varieties (*Lycopersicon esculentum* Mill)

Cropping season	2017	2018	2017	2018	2017	2018
Treatment	Days to 50% maturity	Days to 50% maturity	Fruit diameter (cm)	Fruit diameter (cm)	Fruit length (cm)	Fruit length (cm)
Staking						
Non stake	73.87[a]	75.43[a]	1.46[a]	1.65[a]	2.48[a]	2.55[a]
Stake	73.76[a]	75.25[a]	1.50[a]	1.62[a]	2.43[a]	2.47[a]
Significances	Ns	Ns	Ns	Ns	Ns	Ns
Varieties						
Cobra	75.15[ab]	75.21[ab]	1.55 [b]	1.64 [ab]	2.47 [a]	2.38 [a]
UC82	75.23[ab]	75.03[ab]	1.48 [b]	1.51 [b]	2.15 [a]	2.11 [ab]
Bufalow	71.28[b]	72.25[b]	1.64 [a]	1.84 [a]	2.57 [a]	2.49 [a]
Roma VF	75.17[ab]	75.73[ab]	1.64 [a]	1.82 [a]	2.63 [a]	2.44 [a]
Tropimech	77.14[a]	80.17[a]	1.28 [c]	1.40 [b]	2.12 [a]	2.08 [b]
Roma Savanna	75.23[ab]	75.39[ab]	1.72 [a]	1.80 [a]	2.78 [a]	2.56 [a]
Significances	*	*	*	*	Ns	*

*Means with the same letter along the column are not significantly different at 5% level of probability; ns - not significant at 5% level of probability; * Significant at 5% level of probability*

Table 6: Effects of staking on some reproductive characters of tomato varieties (*Lycopersicon esculentum* Mill)

Cropping season	2017	2018	2017	2018	2017	2018
Treatment	Number of fruits	Number of fruits	Fruit weight (g)	Fruit weight (g)	Fruit yield (kg/ha)	Fruit yield (kg/ha)
Staking						
Non stake	3.42[a]	5.92[a]	132.24[b]	141.22[a]	3693.14[a]	3802.32[a]
Stake	3.15[a]	5.04[a]	134.67[a]	144.67[a]	3760.35[a]	3837.84[a]
Significances	Ns	Ns	*	Ns	Ns	Ns
Varieties						
Cobra	4.14[b]	4.21[b]	133.30[b]	142.15[b]	2743.83[ab]	2924.62[ab]
UC82	5.03[ab]	6.03[ab]	141.11[a]	156.52[a]	3141.91[a]	3552.70[a]
Bufalow	6.17[a]	6.21[a]	139.18[a]	159.37[a]	3055.03[a]	3373.14[a]
Roma VF	4.19[ab]	5.73[ab]	133.30[b]	153.34[a]	2832.36[b]	3276.25[a]
Tropimech	4.04[b]	4.17[b]	102.83[c]	127.66[c]	2200.54[c]	2412.82[b]
Roma Savanna	4.33[ab]	5.39[ab]	140.05[a]	156.34[a]	2994.22[ab]	3386.61[a]
Significances	*	*	*	*	*	*

*Means with the same letter along the column are not significantly different at 5% level of probability; ns - not significant at 5% level of probability; * Significant at 5% level of probability*

Conclusion: Staking increased the plant height, number of days to 50 % flowering and fruit weight of tomato but decreased the number of leaves per plant. Although fruit yield was increased by staking it was however not significant. It was observed that UC82, Bufalow, Roma Savanna, Roma VF and Cobra varieties were superior to Tropimech variety in terms of some growth and yield attributes and could be recommended to farmers in this locality for increased growth and yield of tomato.

REFERENCES

Abdelmageed, AHA; Gruda, N (2009). Performance of different tomato genotypes in the arid tropics of Sudan during the summer season. II. Generative

development. *J. Agric. Rural Dev. Trop. Subj.*, 110: 145-154.

Ahmad, A; Singh, A (2005). Effects of staking and row-spacing on the yield of tomato (*Lycopersicon lycopersicum* Mill.) cultivar Roma VF in the Sokoto Fadama, Nigeria. *Nig. J. Hort. Sci.* 10: 94 - 98.

Akoroda, MA; Ogbechei-Odinaka, NI; Adebayo, MI; Ugwu, OE; Fuwa, B (1990). Flowering pollination and fruiting in fluted pumpkin (*Telfairia occidentals*). *Scientia Hort.* 43: 197 – 206.

Ali, MK; Moniruzzaman, M (2017). Effect of Stem Pruning and Staking on Growth and Yield of Tomato (*Lycopersicon esculentum* L.). *J. Agr. Nat. Res. Mgt.* 4, 1-4.

Amina, JG; Derbew, B; Ali, M (2012). Yield and quality of Indeterminate Tomato (*lycopersicon esculentum* mill) Varieties with staking methods in Jimma, Singapore. *J. Sci. Res. 2: 33-46.*

Anonymous, (2007). Green beans integrated pest management. An Ecological Guide Training Resource Text in Crop Development, Major Agronomic Practice, Disease and Insect Ecology, Insect Pest, Natural Enemies and Diseases of Green Bean. Food and Agriculture Organization, Rome, Italy.

Chaerani, R; Voorrips, RE (2006). Tomato early blight (Alternaria solani): the pathogen, genetics and breeding for resistance. *J. Gen. Plant Patho.*72: 335-347

Enujeke, EC (2013). Effects of variety and spacing on growth characters of hybrid maize. *Asian J. Agric. Rur. Deve.* 3(5): 296-310.

Enujeke, EC; Emuh, FN (2015). Evaluation of some growth and yield indices of five varieties of tomato (*Lycopersicon esculentum* Mill) in Asaba area of Delta State, Nigeria. *Global J. Bio- Sci. Biotech*. 4 (1) 2015: 21-26.

Fanasca, S; Martino, A; Heuvelink, E; Stanghellini, C (2007). Effect of electrical conductivity, fruit pruning, and truss position on quality in greenhouse tomato fruit. *J. Hort. Sci. Biotech.* 82: 488–494.

Fernqvist, F (2014). Consumer experiences of tomato quality and the effects of credence. PhD dissertation, Swedish University of Agricultural Sciences, Ultuna, Uppsala

Hanson, P; Chen, JT; Kuo, CG; Morris, R; Opena, RT (2000). Suggested cultural practice for tomato international cooperators, Guide. Asia Vegetable Research and development.

Ibrahim, K; Amans, A; Abubakar, IU (2000). Growth indices and yield of Tomato (*Lycopersicon esculentum*) varieties as influenced by crop spacing at Samaru. Proceedings. 18th HORTSON Conference. 1, 40-47.

Idowu-Agida, OO; Adetimirin, VO; Nwanguma, EI; Makinde, AA (2010). Effects of seasonal variability on the performance of Long Cayenne pepper collected from Southwestern Nigeria. *Res.* 2 (10):85–92.

Iken, JE; Anusa, A (2004). Maize Research and Production in Nigeria. *Afr. J.Biotech.*3 (6): 302-307.

Patterson, CL (1990). Effect of cultural system on initiation, progression and severity of early blight. *Phytopath.* 80: 438 - 440.

Ray, JD; Sinclair, TR (1997). Stomatal closure of maize hybrid in response to drying soil. *Crop Sci*. 37(30): 803-807 (1997).

Sajjan, AS; Shekhargounda, M; Badanur, VP (2002). Influence of date of sowing, spacing and levels of nitrogen on yield attributes and seed yield of Okro. *karnataka. Indian. J. Agric. Sci.* 15:2, 267-274.

Sesso, HD; Buring, JE; Zhang, SM; Norkus, EP; Gaziano, JM (2005). Dietary and plasma lycopene and the risk of breast cancer. *Cancer Epidemi. Biomark*. Preview. 14:1074 - 1081.

Singh, T; Singh, N; Bahuguna, A; Nautiyal, M; Sharma, VK (2014). Performance of Tomato (Solanum lycopersicum L.) Hybrids for Growth, Yield and Quality inside Polyhouse under Mid Hill Condition of Uttarakh. *Amer. J. Drug Discov. Dev.* 4: 202-209.

Sowley, ENK; Damba, Y (2013). Influence of staking and pruning on growth and yield of tomato in the Guinea Savannah Zone of Ghana. *Inter. J. Sci. Tech. Res.* 2:12: 103-107.