

Comparison of Growth, Yield and Fruit Quality Performance of Tomatoes Varieties under Controlled Environment Condition of the Southern Guinea Savannah

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Abstract: Controlled agriculture environment is one of the modern techniques, which has the potential to meet the challenges faced by tomato producers in the country during the off-season. This study was conducted to evaluate the performance of five different varieties of tomatoes under controlled environment (screen house). The results revealed that the Nemoneta variety, performed better compared to other varieties in terms of plant height (8.3cm) and also have the highest shelf life of 14 days followed by Delicious with 7 days, while the number of fruits per plant was height in Small Cherry with an average of 8.733/plant, but Delicious variety gave the highest values in terms of marketable fruit weight (9.33kg) and highest pH values (4.07). In terms of fruit quality, Large Cherry variety contains the highest values for lycopene (1467.30mg/100g), vitamin A & B (56.7mg/100g & 0.62 mg/100g, respectively) and potassium (0.62%).

Key words: Screen house • Tomato varieties • Growth • Yield and quality

INTRODUCTION

Tomato is one of the most highly praised vegetables consumed widely and it is a major source of vitamins and minerals. It is one of the most popular salad vegetables and is taken with great relish. Tomatoes and tomato products are rich in health related food components as they are good source of carotenoids (lycopene and β -carotene), ascorbic acid (vitamin C), vitamin A, vitamin E, folate, flavonoids, minerals, proteins and dietary fibre [1, 2]. Regular consumption of tomatoes has been correlated with a reduce risk of various types of cancer and heart disease. These positive effects are believed to be attributable to the anti-oxidant particularly the carotenoid, flavonoids, ascorbic acid and phenolic compounds [3].

In Nigeria, especially at the Southern or Western region, tomato production is highly seasonal and mostly weather dependent, which as lead to surfeit during the favorable season and scarcity during the unfavorable season. This scenario have caused unfriendly consumer price of this commodities during the off season.

The demands for high quality, moderate sized, red colored tomato with high firm fruit, pleasing appearance

and good taste is increasing, while grower prefer high yielding, higher weight, indeterminate growth habit and resistance to pest and diseases. The solution to these is to find suitable varieties for growing that will meet the consumer's wants under a controlled environment.

Presently imported varieties and hybrid tomatoes are introduced into the market, green house vegetable growers use this varieties without full knowledge of the performance of these varieties under controlled environment. The main aim of this study was to evaluate growth, yield and fruit quality performance of tomatoes varieties under controlled environment conditions and to select promising varieties for commercial level under a controlled environment. Findings will help growers overcome the problem associated with varieties at the same time achieving increase in yield with high quality, typical to this agriculture system.

MATERIALS AND METHODS

The study was conducted at the Screen-House, Teaching and Research Farm, Landmark University Omu-Aran, Kwara State to investigate the varietal differences of five (5) tomatoes *Lycopersicon lycopersicum* cultivars

in the southern Guinea savanna area of Nigeria, (Omu-Aran) Kwara state and their performance in terms of growth, yield and fruit quality under a controlled environment. Five tomatoes varieties namely Large Cherry, Nemoneta, Small Cherry, Delicious and Green Cherry were used for this experiment. The experimental design was randomized complete design and replicated four times.

Polyethylene bags of 45cm x 30cm were used. Growing media in mixture of sterilized: river sand, top soil and poultry manure in ratio 2:2:1 were used to filled the black polythene bags with holes of 10mm diameter punched at the lower one-third of the bag for easy drainage. A vigorous disease and pest free tomatoes seedlings were transplanted at two weeks old into the bags, setting at 1.5 m inter-row x 0.4 m inter-plant spacing. The plants were trellised two weeks after transplanting to tie the plants for support so that the plants remained erect. Pruning (de-suckering) was done 15days after setting, leaving a single stem up. Watering was done through drip irrigation. Fertilizer application was done through drip irrigation using the concentration and volume of Albert's depending at the growing stage of the tomato.

Vegetative growth and yield components of tomato were evaluated. Vegetative growth parameters measured included plant height and number of leaves. Fruit quality parameters were studied using fully ripe fruits at second harvest, the following parameters was observing; number of fruits, average fruit weights, shell life, pH, lycopene content, potassium, vitamin A, vitamin B1 and folic acid. All data collected were subjected to analysis of variance using (Statistical Analysis System) SAS 9.4 (2013) package differences between treatments means were determined by Duncan Multiple Range Test (DMRT) test at 5% level of significance [4].

RESULTS

The results of the present study are shown in Table 1 indicated that, there was no significant difference among the varieties used in respect to the growth parameters; plant height, number of leaves at 6, 8, 10 and 12 weeks after planting (WAP). However, the value recorded for each of the varieties increased as the week after planting (WAP) increased. The Nemoneta variety showed the highest performance with regard to plant height at 4, 6 and 8 WAP, while the least

performance was observed in Small Cherry variety. There was also no significant ($P = 0.05$) difference between the varieties in number of leaves. Delicious variety produced the highest number of leaves at 8, 10 and 12 WAP, the least values were observed in the Green Cherry.

The effect of variety on number of fruits and weight of fruits are presented in Table 2, there was a significant difference ($P = 0.05$) among varieties used in average number of fruits and fresh weight. The small Cherry produced the highest number of fruits (103), followed by Green Cherry (82.33), while Large Cherry and delicious were statistical similar (60.33 & 59), compared to the Nemoneta with the lowest average fruit number of 37. From the results obtained, it was noted the Delicious variety has the highest values of 9.333 kg plant⁻¹ in terms of fruit weight, followed by Nemoneta, Large Cherry and Green Cherry (8.433 kg plant⁻¹, 4.733 kg plant⁻¹ & 4.01 kg plant⁻¹), while the least value was obtained from the Small Cherry with value of 3.316 kg plant⁻¹.

The results of the fruit nutritional properties among the five varieties of tomatoes are presented in Table 3 indicated that, the varieties differ in terms of fruit nutritional composition. It was noted that the pH content ranges from 3.82 – 4.07. The maximum pH value was recorded in Delicious (4.07), followed by Large Cherry and Small Cherry (3.92), while the minimum pH was recorded in Nemoneta (3.82) and Green Cherry (3.84). The results of the chemical composition showed that Large Cherry have the highest values for Lycopene (1467.30 mg/100g), Vitamin A (56.70 mg/100g), Vitamin B1 (0.68 mg/100g), Folic Acid (0.18 mg/100g) and Potassium (0.62 %) as compared to Green Cherry which have the lowest values Lycopene (1397.30 mg/100g), Vitamin A (41.20 mg/100g), Vitamin B1 (0.47 mg/100g), Folic Acid (0.07 mg/100g) and Potassium (0.38%) .

The results of shelf life of each tomato variety from are presented in Table 4 showed that Nemoneta had the highest shelf life with zero (0), with no rotten for the period of two weeks under normal room temperature. Delicious had the second highest shelf life with one rotten starting from day7, followed by Large cherry, while Small Cherry took the fourth position in shelf life although with maximum number of fruit deterioration, the Green Cherry had the lowest shelf life among the tomato cultivars, it has the highest number of deterioration among the treatment forms starting from day two.

Table 1: Effects of Tomato varieties on plant height and number of leaves at 6, 8, 10 and 12 WAP

Tomato varieties	6WAP		8WAP		10WAP		12WAP	
	Plant height (cm)	Number of leaves						
Large Cherry	19.58 ^a	8.110 ^a	46.11 ^a	14.33 ^a	70.96 ^a	21.81 ^a	90.94 ^a	31.23 ^a
Nemoneta	20.57 ^a	8.777 ^a	48.78 ^a	13.33 ^a	75.02 ^a	22.39 ^a	93.16 ^a	32.45 ^a
Small Cherry	16.70 ^a	8.777 ^a	41.64 ^a	16.77 ^a	66.49 ^a	19.07 ^a	83.36 ^a	30.42 ^a
Delicious	20.34 ^a	7.330 ^a	47.77 ^a	19.55 ^a	73.11 ^a	24.24 ^a	92.23 ^a	36.58 ^a
Green Cherry	20.57 ^a	7.777 ^a	43.81 ^a	13.98 ^a	69.50 ^a	21.06 ^a	90.25 ^a	30.97 ^a

Mean with the same letter are not significantly different at P=0.05, WAP = Weeks after Planting

Table 2: Varieties response of number of fruits and weight

Treatment	No. of fruits	Average fruit wight (kg plant ⁻¹)
Large Cherry	60.33 ^a	4.733 ^b
Nemoneta	37.00 ^d	8.433 ^{ab}
Small Cherry	103.00 ^a	3.3167 ^c
Delicious	59.00 ^e	9.333 ^a
Green Cherry	82.33 ^b	4.010 ^{bc}

Mean with the same letter are not significantly different at P = 0.05

Table 3: Variation in physiochemical properties of five (5) tomato varieties

Tomato varieties	Available pH value	Lycopene mg/100g	Vitamin A mg/100g	Vitamin B1 mg/100g	Folic Acid mg/100g	Potassium %
Large Cherry	3.92	1467.30	56.70	0.68	0.18	0.62
Nemoneta	3.82	1418.70	44.80	0.52	0.09	0.43
Small Cherry	3.92	1421.50	45.30	0.55	0.12	0.44
Delicious	4.07	1424.60	51.50	0.59	0.15	0.48
Green Cherry	3.84	1397.30	41.20	0.47	0.07	0.38

Table 4: Variations in the shelf life of five (5) tomato varieties

Tomato varieties	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
Large Cherry	0	0	0	0	1	2	3	3	0	1	1	2
Nemoneta	0	0	0	0	0	0	0	0	0	0	0	0
Small Cherry	0	0	0	0	3	2	1	2	1	1	2	3
Delicious	0	0	0	0	0	0	1	1	2	3	2	3
Green Cherry	0	2	2	3	2	1	1	2	1	2	1	2

DISCUSSION

The results of the present study showed that the tomato varieties responded differently in terms of growth and yield parameters taken. Although significant differences were not recorded among the varieties in terms of plant height and leave numbers been assessed, but there were weekly increased recorded for the growth of the plant after planting. The variation in height is attributed to the inherent genetic differences among the varieties, since plant height is usually a good index of plant vigor which may contribute towards a greater productivity.

From the values recorded, it was also observe that there were significant differences among the varieties for the number of fruits and fresh fruit weight. Small Cherry have the highest number of fruits production, as compare to other varieties, the higher number of fruits may be attributed to the production of smaller size of fruits.

Similar variations in the number of fruits per cluster were reported by Traka Mavrona *et al.* [5] in tomato cultivars grown under greenhouse. In terms of fruit weight the Delicious variety, has the highest value (9.333 g fruit⁻¹) followed by Nemoneta (8.433 gfruit⁻¹) as compared to the Small Cherry (3.3167 g fruit⁻¹). The differences observed among the varieties could be attributable to the genetic makeup of the individual variety and adaptability to the environment under study; similar finding was reported by Fontes *et al.* [6] in tomato cultivars grown under plastic greenhouse. It was also observed that, there were differences with regards to chemical composition among the five varieties, with Large Cherry variety having the highest values, which is in line with those obtained by Traka Mavrona *et al.* (1995), who reported similar variations in chemical composition and TSS content of tomato cultivars grown under greenhouse. Delicious variety recorded the highest pH values 4.07 while Green cherry has the lowest pH value 3.84, these values are in

agreement with those obtained by Hazarika and Phookan [7], who reported that pH values of tomatoes cultivars ranged from 3.56-4.33, because fruit pH affect the time required for heating to achieve sterilization of process commodity.

CONCLUSION

The results of the present study showed, differential response in the tomatoes varieties under controlled (screen house) environment. It could be concluded that Delicious, Large Cherry and Nemoneta varieties are more suitable for growing commercially inside the greenhouse (controlled environment) of the southern Guinea savannah of Nigeria, as they not only possess the desirable marketable fruits weights and numbers for fresh consumption but also have high nutritional quality potentials good for the health of the consumers.

REFERENCES

1. Beecher, G.R., 1998. Nutrient content of tomatoes and tomato products. *Proceedings of the Society of Experimental Biology and Medicine*, 218: 98-100.
2. Davis, J.N. and G.E. Hobson, 1981. The constitutions of tomato fruits. The influence of environment, nutrition and genotype. *Critical Reviews in Food Science and Nutrition*, 15: 205-280.
3. Giovanelli, G., V. Lavelli, C. Peri and S. Nobili, 1999. Variation in antioxidant compound of tomato during vine and post-harvest ripening. *Journal of Science of Food and Agriculture*, 79: 1583-1588.
4. Gomez, K.A. and A.A. Gomez, 1984. *Statistical Procedures for Agricultural Research* (2 Ed.). John Wiley and sons, New York, pp: 680.
5. Traka Mavrona, E., F. Bletosos, M. Grafiadellis, G. Spanomitsios, M.R. Fernandez, J. Cuartero and G.M.L. Gomez, 1995. Evaluation of new tomato cultivars adopted to Mediterranean climatic conditions. *Acta Hort.*, 412: 250-257.
6. Fontes, P.C.R., E.N. Dias, S.R. Zanin and F.L. Finger, 1997. Yield of tomato cultivars in a plastic greenhouse. *Revista Ceres.*, 44(252): 152-160.
7. Hazarika, T.K. and D.B. Phookan, 2005. Performance of tomato cultivars for polyhouse cultivation during spring summer in Assam. *Indian J. Hort.*, 62: 268-271.