

Comparative Productivity of Two *Solanum lycopersicum* Varieties Under Net House Conditions in Sokoto State, Nigeria

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Abstract

Solanum lycopersicum is among the most important vegetable crops produced in Nigeria. This study examined the productivity of two varieties of tomatoes under net house conditions. Data for the study was obtained from field experimentation in the net house. The results from the study indicated that Eva 1 consistently outperformed the UC varieties in plant height with an average mean of 88.5 cm and F value of 2.58 which is not significantly different. The highest fruit size was observed in Eva 1 with an F-value of 7.98 and P-value of < 0.01 which is a significant difference between the varieties. Eva 1 has the largest fruit size and significantly outperforms both UC varieties. The highest fruit weight of 166 was observed in Eva 1 while the least fruit weight was recorded in UC 3 with an average of 89 which is statistically significant with an F-value of 7.81, the difference between UC 2 and UC 3 is not statistically significant and shows only a small practical effect. fruit quantity per plant did not differ significantly among varieties with moderate effect sizes suggesting practical differences, particularly between Eva 1 (19.0 fruits/plant) and UC 2. In conclusion, for all the parameter tested Eva is the most productive among the all varieties tested. Additional agronomic practices such as optimized fertilization and irrigation should be explored aiming for high yield.

Keywords: Tomato Varieties, Eva, Net House, Agronomic Traits, Plant Productivity.

Introduction

Solanum lycopersicum belongs to the family Solanaceae and is considered one of the most important vegetable crops being produced in Nigeria that usually reach a height of 1 to 3 meters with a weak stem that tend to sprawl along the ground or climb over nearby plants (Godi *et al.*, 2018). Tomatoes are rich in lycopene, a powerful biogenic and antioxidant which offer significant health benefits and the fruits is used in various form such as eaten as raw, cooked as salads or processed into other food products, including tomato paste (Aremu *et al.*, 2016).

Nigeria is one of the world's top tomato producers cultivating almost about 0.5 to 4 hectares of land contributing about 85% of the total tomato production and the leading producer in Sub-Saharan Africa, where over 1.8 million metric tonnes, accounting for approximately

68.4% of the total tomato production in West Africa (Ugonna *et al.*, 2015). Despite the large area covering about 541,800 hectares cultivated for tomato production in Nigeria, average farmers generate very low yields of tomatoes in African (FAOSTAT, 2014). Among the constraint identified that results in low yield weed infestation and the poor production practices including utilization of obsolete varieties, soil infertility and greatest post-harvest losses due to the diseases, poor handling, distribution system, poor storage and lack of good processing facilities with a lot of tomato produced in Nigeria wasted (Sahel Research, 2015 and Arah *et al.*, 2015).

A part from this global and regional ranking in tomato production, the country still imports tomato from neighboring countries to meet its demands (Okojie, 2017). This challenge has prompted the development of high-tech precision agriculture systems to cultivate tomatoes under protected conditions as a promising in many countries that result in higher yields and superior quality produce compared to grown in open fields which have been reported to be obstacle of meeting export quality and standards (Godi *et al.*, 2018).

Currently climatic condition in sub-Saharan regions is well equipped by intensive solar radiation very long and hot climate, hazy and dry weather with limited water supply (Kusumiyati, 2023). These climatic constraints negatively impact tomato production, yield and their nutritional compositions and hence affects productivity. However, there is a need for the implementation of innovative and classical management strategies to avert the menace (Elahi *et al.*, 2022). These limitation to tomato production requires utilization of highly improved varieties good soil conditions and sustainable environmental management strategies to improve the production and quality of tomato fruits (Rahul *et al.*, 2018). Netting of tomato is now considered as one of the high throughput technologies to avert crops from excessive effects of solar radiation (Leyva *et al.*, 2014). Therefore, this study was carried out to compare the productivity of the two improve varieties of tomatoes grown under net house environment in Rabah Local Government Sokoto State Nigeria.

Materials and Methods

Study Area

The study was carried out in Rabah District, Rabah Local Government area of Sokoto State, Nigeria. It lies within the geopolitical zone of the northwest, an area that shares borders with neighboring states like Zamfara and Kebbi. Rabah LGA is known for its rich history, cultural diversity, and agrarian economy, with most of its inhabitants primarily engaged in farming and livestock rearing. The population of Rabah LGA is diverse, consisting of various ethnic groups, including Hausa, Fulani, and a mix of other smaller groups. The primary languages spoken are Hausa and Fulfulde, and Islam is the dominant religion. It is situated at about 50km East of Sokoto Metropolis, between latitudes 13° 08' 45" and 13° 05' 45" N and longitude 5° 02' 45" and 5° 03' 45" E. Sokoto State is located in the North Western part of Nigeria on latitude 13° 01' N and longitude 5° 15' E at an elevation of 308m above sea level within the Sudan Savannah belt (Muhammad *et al.*, 2020). The region's geographical features include a mix of lowland areas and rocky outcrops, with a tropical climate characterized by distinct wet and dry seasons. The wet season lasts from May to

September, while the dry season extends from October to April. This climatic condition influences agricultural activities, with crops such as millet, sorghum, maize, groundnut, cowpea and tomatoes being commonly cultivated. Livestock farming, including cattle, sheep, and goats, is also an important aspect of the local economy. The soils had contrasting textures of clay loam, sandy loam, silty clay loam, loamy sand, sandy clay, clay loam and clay. The soils were classified in the USDA Soil Taxonomy order as Vertisols in RBH1 and Ultisols in soil units RBH 2, 3, 4, 5 and 6 (Buji *et al.*, 2022).

Treatments and Experimental Design

A total of 486 tomato seedlings were used in this experiment. The experiment comprised of two tomato varieties Eva and UC. The seeds of these *Solanum lycopersicum* varieties were sourced from a certified seed dealer. All the varieties were subjected to identification and authentication by a taxonomist from the Department of Plant Science and Biotechnology, Kebbi State University of Science and Technology, Aliero. A voucher specimen was deposited in the university herbarium. Two seedbeds measuring 2m² each were prepared within a net house. The soil was harrowed to ensure proper bed preparation. Seeds of each variety were broadcasted by hand into the separate seedbeds. After germination, the seedlings were transplanted into two different types of locally sourced potting soil, labeled as Soil A and Soil B:

Potting Soil A: Composed of two parts topsoil and one-part organic matter.

Potting Soil B: Composed of one part topsoil and one-part organic matter.

The seedlings were then transplanted a net house using a factorial arrangement with three replications in a Randomized Complete Block Design (RCBD). Four experimental plots were established in the net house and labeled as follows:

Plot A: Eva variety grown in Soil Type A.

Plot B: Eva variety grown in Soil Type B.

Plot C: UC variety grown in Soil Type A.

Plot D: UC variety grown in Soil Type B.

At two weeks after transplanting, five plants from each plot were randomly selected and tagged for data collection. Observations and measurements were taken at 2, 4, 8, and 10 weeks after transplanting. The following growth and yield parameters were measured progressively such as: Plant height, number of leaves, number of branches, number of fruits, fruit size, fruit weight, and total fruit quantity.

Data Analysis

The data obtained was subjected to analysis of variance (ANOVA) using Genstat 17th edition. Similarly, Bonferroni Post hoc was used to identified varietal effect and Cohense D to show the effect size of the parameters tested.

Result and Discussion

Table 1 showed Eva 1 has the highest plant of 88.5 which outperforms both UC varieties in plant height with an F-value of 2.58, although differences are not statistically significant at $P < 0.05$ level, the effect sizes suggest moderate practical significance. Similarly, it also showed that UC 3 slightly outperforms UC 2, but the difference is negligible with tiny effect size of $r = 0.063$. This finding agrees with (Singh and Kumar, 2020). who found that taller tomato plants, especially in protected environments (like net houses), tend to support higher fruit yield per plant due to better canopy development and photosynthesis. Therefore, Eva 1’s superior height could imply higher productivity potential, especially in loamy soils or controlled conditions. Similarly, Khan *et al.* (2021), reported that tomato varieties differ significantly in morphological traits, including plant height, which directly correlates with light interception and photosynthesis efficiency.

Table 1: Bonferroni and cohense D values of Plant Height in two Varieties of *Solanum lycopersicum*

Varieties	Mean (cm)	F- Value	Contrast	Bonferroni t value	P> Itl	Effect size cohense D	Conclusion
Eva 1	88.5	2.58	2 vs. 1 (-40.2)	-2.07	0.139	0.795 (r=0.369)	UC worse than Eva
UC 2	48.2		3 vs. 1(-36.2)	-1.83	0.232	0.710 (r=0.334)	UC worse than Eva
UC 3	52		3 vs.2 (3.99)	0.20	1.000	0.127 (r=0.063)	UC worse than UC3

Table 2 compares fruit size (in mm) among three tomato varieties: Eva 1, UC 2, and UC 3. The highest fruit size was observed in Eva 1 with F-value of 7.98 and P value of < 0.01 which is significantly difference between the varieties. Eva 1 has the largest fruit size and significantly outperforms both UC varieties. The differences between UC 3 and UC 2 are not statistically significant, but the effect size is large, indicating potential practical importance. This finding aligns with (Sahu *et al.*, 2022). Who depicted that varieties with larger fruit size like Eva 1 are preferred for fresh consumption and slicing markets and it is a major trait influencing market value, processing suitability, and consumer preference. Similarly, Ali *et al.* (2020), showed that elite lines produce larger fruit size due to better sink strength and hormonal regulation.

Table 2: Bonferroni and cohense D values of Fruit Size in two Varieties of *Solanum lycopersicum*

Variety	Mean (mm)	F- Value	Contrast	Bonferroni t value	P> Itl	Effect size cohense D	Conclusion
Eva 1	584	7.98	2vs.1 (-126.5)	3.93	0.001	1.357(r=0.561)	UC worse than Eva
UC 2	457		3 vs. 1 (-83.3)	2.53	0.050	0.934(r=0.423)	UC worse than Eva
UC 3	500		3 vs. 2 (43.4)	1.32	0.590	1.07(r=0.47)	UC2 worse than UC3

Table 3 presents a comparative analysis of fruit weight (in grams) across three tomato varieties—Eva 1, UC 2, and UC 3. Eva 1 has the highest fruit weight average of 166 while the least fruit weight was observed in UC 3 with the average of 89 which is statistically significant F-value of 7.81 and with large effect sizes which confirm the superiority. The difference between UC 2 and UC 3 is not statistically significant and shows only a small practical effect. Fruit weight is a key yield component. Higher fruit weight often contributes to higher marketable yield, especially in table tomato varieties. This finding agreed with (Kumar *et al.*, 2021). who noted that genotypic variability significantly affects fruit weight, with high-yielding cultivars typically exhibiting greater average fruit mass. According to (Gupta *et al.*, 2020). tomato fruit weight can increase by 15–30% under net house conditions, especially for responsive cultivars like Eva 1, due to reduced biotic stress, better humidity control and improved microclimate.

Table 3: Bonferroni and cohense D values of Fruit Weight in two Varieties of *Solanum lycopersicum*

Variety	Mean (gram)	F- Value	Contrast	Bonferroni t value	P> Itl	Effect size cohense D	Conclusion
Eva 1	166	7.81	2 vs. 1 (-52)	2.85	0.023	1.061(0.468)	UC worse than Eva
UC 2	109		3 vs. 1 (-76)	3.78	0.002	1.487 (0.596)	UC worse than Eva
UC 3	89		3 vs. 2 (-20)	1.00	0.976	0.229 (0.113)	UC3 worse than UC2

This table 4 evaluates three tomato varieties Eva 1, UC 2, and UC 3 in terms of fruit quantity, specifically the number of fruits per plant. The highest fruit quantity was observed in Eva 1 with an average mean of 19.0 while the least was observed in UC 3 with the average of 17.0

and F-value of 0.64 which indicates no statistically significant difference in fruit quantity among the three varieties. However, moderate effect sizes suggest practical differences may still exist, particularly between Eva 1 and UC 2. The lack of significant differences in this study might be attributed to a buffered growing environment. The number of fruits per plant is a crucial component of total yield. However, it is often inversely correlated with fruit size or weight due to resource partitioning (Kumar *et al.*, 2020).

Table 4: Bonferroni and cohense D values of Fruit Quantity in two Varieties of *Solanum lycopersicum*

Variety	Mean (number)	F-Value	Contrast	Bonferroni t value	P> Itl	Effect size cohense D	Conclusion
Eva 1	19.0	0.64	2 vs. 1 (-3.3)	-1.13	0.800	0.535 (r=0.254)	UC worse than Eva
UC 2	15.0		3 vs. 1 (-1.6)	-0.57	1.000	0.207 (r=0.103)	UC worse than Eva
UC 3	17.0		3 vs. 2 (1.5)	0.54	1.000	0.229 (r=0.113)	UC2 worse than UC3

Conclusion

This study highlights differences in tomato productivity between the Eva and UC tomato varieties. Eva, an indeterminate variety, exhibits significantly greater height compared to the determinate UC varieties. Similarly, Eva produces larger and heavier fruits than UC across both soil conditions, with sandy soil promoting slightly larger and heavier fruits. However, fruit quantity does not differ between the two varieties, but Eva variety produces larger and heavier fruits.

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