THE CHARACTERIZATION OF THREE INBREED LINES OF TOMATO GENOTYPES FROM IGBODO

BY

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SR/1987/RPR/22/74

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BENIN CITY.

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF PLANT BIOLOGY AND BIOTECHNOLOGY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF B. SC. (HONOURS) IN PLANT BIOLOGY AND BIOTECHNOLOGY,

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CERTIFICATION

The undersigned hereby certify that this work was carried out by Patience IKPONMWOSA in the Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, Nigeria.

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EXTERNAL EXAMINER Date

DEDICATION

This Research work is dedicated to the Almighty God for his infinite mercies, love and goodness throughout the course of my studies and project research, my beloved parent and my siblings.

ACKNOWLEDGEMENTS

My profound gratitude goes to God Almighty for his infinite mercy and help throughout my first degree programme.

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ABSTRACT

One of the world's most important vegetable plants is the tomato (*Solanum lycopersicum*). It can be consumed raw, cooked, or utilized to make items with tomato as the base. Because lycopene is one of the main sources of carotenoids, it has also been proven to be helpful in studies involving these pigments. In order to identify the tomato genotype that is most likely to be used in tomato breeding, this research was done to characterize three inbreed lines of tomato genotypes from Igbodo. The identification of genetic variability that exists within crop germplasms depends on agronomic evaluation of crop genotypes. In order to do this, the fruits of 3 tomato genotypes were assessed, using a UV spectrophotometer, the lycopene content was calculated. Fruit weight ranged from 6.222±0.660 to 13.96±1.661. RD-igb had the highest fruit weight while PY-igb had the lowest fruit weight. The lycopene content was evaluated for three genotypes; RD-igb, HD-igb and PY-igb. Genotype 2 recorded the highest fruit lycopene content with a value of 1.336±0.321 to 1.715±0.253 while genotype 1 recorded the lowest fruit lycopene content. Some attributes had a significant coefficient of variance, whilst others showed little genotype-to-genotype variation. While some genotypes, such as genotype 1, had low fruit lycopene values, genotype 2 had high fruit lycopene content. When choosing tomato plants with desirable qualities during tomato breeding, these tomato unique diversities can be used as a guide.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO STUDY

The tomato (*Solanum lycopersicum* L.), is one of the most significant and well-known fruits and vegetables in the world. It is an annual crop that is self-pollinated and has the chromosomal number 2n=2x=24. It is a member of the *Solanaceae* family. Due to the widespread cultivation and widespread consumption of this vegetable crop as both fresh vegetables and concentrated processed goods, tomato fruits are an important source of nourishment for major percentages of the world's human population. About 300,000 ha of tropical African land is utilized for tomato farming, with an estimated annual yield of 2.3 million tones; Nigeria is the continent's greatest producer, with 541,800 ha and an annual production of 2,143,500 tones. In terms of production and the number of farmed hectares, Nigeria is third in the world (FAOSTAT, 2014).

Characterization entails capturing those traits that are highly heritable, obvious to the unaided eye, and manifested in all situations. Collecting the available germplasm is necessary before launching any improvement effort for this crop, and their characterization is crucial for varietal development and selection. The evaluation of phenotypic traits like fruit morphology, color intensity, nutritional quality, firmness, flavor, and aroma is difficult and time-consuming due to the quantitative nature of the traits since inbred development is a prerequisite for hybridization.

The genetic analysis of relatedness between or within different species, populations and individuals is a prerequisite towards effective utilization and protection of plant genetic resources (Weising *et al*. 1995). One of the most extensively studied plant genomes is that of the tomato plant and current study indicates that numerous scientists have used molecular markers to identify interesting tomato varietals. The tomato is a versatile vegetable for cooking. A wide variety of processed goods, including paste, powder, ketchup, sauce, soup, and canned whole fruits, are made from ripe tomato fruit in addition to being consumed fresh. Lycopene, a phytochemical that shields cells from oxidative damage, which has been related to cancer, is a key component in it and is a significant source of it.

Popular determinate pure lines known as commercial types are cultivated in open fields with irrigation or rainwater and are suited for processing as well as fresh market sales. This type produces fruits that range in size from medium to large and have a three-week shelf life. However, these commercial types have low yields, producing fewer than 30 tons per hectare, need staking, and lack traits for resistance to bacterial wilt, fusarium wilt, and insect pests. Farmers choose determinate cultivars that need to be staked and are cultivated in open fields with irrigation or rain feed. These types feature qualities that make them suitable for fresh market tomatoes, such as good fruit firmness and salad Ette shape. The maturation stage and potential yield of these kinds haven't been verified, nevertheless.

1.2 THE TOMATO PLANT

The tomato plant, often referred to as *Solanum lycopersicum* L. in scientific literature, is a flowering plant that is grown and used in various parts of the world. It belongs to the Solanaceae family, a broad and diverse family with more than 90 distinct genera. According to Kimura and Sinha (2008), the tomato is assumed to have originated in Western South America but was initially domesticated in Central America. The tomato plant has characteristics that make it an excellent subject for research.

1.2.1 Scientific Classification of Tomato

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Solanales
Family	Solanaceae
Genus	*Solanum*
Species	*lycopersicum*
Botanical name	*Solanum lycopersicum* L.

Source: Kimura *et al*. (2008).

1.3 ORIGIN OF THE TOMATO PLANT

The wild tomato (*Solanum sect. lycopersicon)* is a South America native that grows mostly in the Andean region. The wild tomato is believed to have originated in Peru, Ecuador, and other regions of South America, including the Galapagos Islands. Wild tomatoes are related to the domesticated tomato. Mexico is where it was domesticated and diversified (Jenkins, 1948; Rick, 1979; Peralta, Spooner and Knapp, 2008). Native were already farming the tomato when European explorers arrived in America in the late 15th century. The genetic variety of wild tomato relatives and intermediate forms (landraces or creoles) is rich, and they are crucial genetic resources for crop improvement and conservation programs. Mexico is presumed to be the most probable region of domestication, with Peru as the centre of diversity for wild relatives (Larry and Joanne, 2007).

1.4 BOTANICAL DESCRIPTION OF TOMATO PLANT

Root: Vigorous tap root system that grows to a depth of 50 cm or more. The main root produces dense lateral and adventitious roots.

Stem: Growth habit ranges between erect and prostrate. It grows to a height of 2-4 m. The stem is solid, coarse, hairy and glandular.

Leaf: Spirally arranged, 15-50 cm long and 10-30 cm wide. Leaflets are ovate to oblong, covered with glandular hairs. Small pinnates appear between larger leaflets. Inflorescence is clustered and produces 6-12 flowers. Petiole is 3-6 cm.

Flower: Bisexual, regular and 1.5-2 cm in diameter. They grow opposite or between leaves. Calyx tube is short and hairy, sepals are persistent. Usually 6 petals up to 1 cm in length, yellow and reflexed when mature. 6 stamens, anthers are bright yellow in colour surrounding the style with an elongated sterile tip. Ovary is superior and with 2-9 compartments. Mostly self- but partly also crosspollinated. Bees and bumblebees are the most important pollinators.

Fruit: Fleshy berry, globular to oblate in shape and 2-15 cm in diameter. The immature fruit is green and hairy. Ripe fruits range from yellow, orange to red. It is usually round, smooth or furrowed.

Seeds: Numerous, kidney or pear shaped. They are hairy, light brown 3-5 mm long and 2-4 mm wide. The embryo is coiled up in the endosperm. Approximate weight of 1000 seeds are 2.5 – 3.5 g. (Shankara *et al*., 2014).

1.5 CLIMATE AND SOIL REQUIREMENTS FOR CULTIVATION OF TOMATO

1.5.1 Temperature and Light

For a high production and top quality, tomatoes need a rather chilly, dry climate. To a wide range of environmental circumstances, nonetheless, from temperate to hot and humid tropical, it is adaptable. Most kinds do best at temperatures between 21 and 24 °C. Although the plants can withstand a variety of temperatures, their tissues are harmed below 10 °C and above 38 °C. In tropical lowlands, the minimum temperature at night is also important. Temperatures below 21 °C can cause fruit abortion. (Shankara *et al*., 2014).

1.5.2 Water and Humidity

To test whether the water sources in your area are enough for growing tomatoes, apply a straightforward rule of thumb. It will be able to grow tomatoes if herbaceous plants, or those with plenty of little leaves, are present in the surrounding landscape. Rainfall for at least three months should be expected. The fruit will split and the buds and blossoms will fall off due to water stress and prolonged dryness. In contrast, fruit will decay if it rains excessively and the humidity level is too high. The rate of tomato ripening will be slowed by cloudy sky. (Shankara *et al.*, 2014).

1.5.3 Soil

The majority of mineral soils with adequate water retention, good air circulation, and no salt content support the growth of tomatoes. Deep, sandy loam soils with good drainage are preferred by it. A porous top layer is required. A good crop requires a soil depth of between 15 and 20 cm. Deep plowing promotes greater root infiltration in heavy clay soils. The tomato can withstand a wide variety of pHs (amounts of acidity) to a moderate extent, but it thrives in soils with a pH between 5.5 and 6.8 and with a sufficient supply of nutrients. Generally speaking, the addition of organic matter is beneficial for healthy growth. Peat soils, which have a very high proportion of organic matter, are less appropriate because of their great propensity to retain water and nutrient deficits. (Shankara *et al.*, 2014).

1.6 CAROTENOIDS

Plants, algae, photosynthetic bacteria, and fungi all create a class of micronutrients or pigments known as carotenoids. They are naturally occurring, water-insoluble pigments with an average carbon atom count of 40. Tomatoes are a very rich source of various carotenoids, especially lycopene, when compared to other commonly consumed foods. The presence of carotenoids in their tissues can be credited with giving most organisms their color. Carotenoids in plants are found in cellular plastids and are either present as semicrystalline structures produced from the plastids or are linked to light-harvesting complexes in thylakoid membranes (Kopsell & Kopsell, 2006). The sole carotenoid present in the skin of different cultivars, and the primary cause of the variation in the redness of different cultivars, is a difference in the levels of lycopene accumulated in their skins (Adewuyi, 2008).

The main carotenoid found in tomatoes, lycopene, is the most powerful antioxidant and singlet oxygen scavenger of all dietary carotenoids. The lycopene content of tomatoes depends on species and increases as the fruit ripens. Processing tomatoes boosts lycopene's bioavailability, unlike preparing fruits and vegetables that contain vitamin C, where boiling reduces nutritional value. From tomato-based sources, processed tomato products such pasteurized tomato juice, soup, sauce, and ketchup have the highest quantities of accessible lycopene. Compared to fresh tomatoes, lycopene in tomato soup and paste is more bioavailable (Liana *et al*., 2009).

1.7 LYCOPENE IN TOMATO FRUIT

Lycopene is a naturally occurring compound that contributes to the red colour of fruits and vegetables and is a carotenoid antioxidant (Shi and Le Maguer, 2000). Lycopene is a bright red carotenoid pigment and phytochemical found in tomatoes and other fruits. It is found in high amounts in tomatoes but is also present in watermelons, pink grapefruits, apricots, gac, papaya, red bell pepper, seabuckhorn, wolfberry and pink guavas (Gester, 1997).

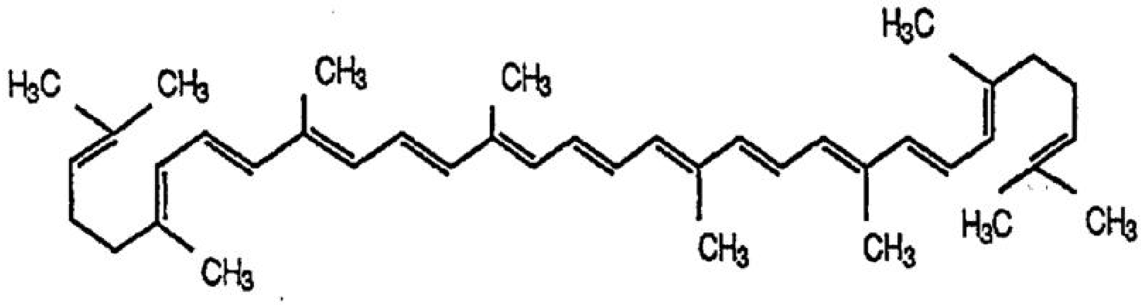


Figure 1: Structure of Lycopene.

Source: Kumar *et al*. (2017).

Acyclic hydrocarbon lycopene has 13 carbon-carbon double bonds, 11 of which are conjugated. An important characteristic of the chemicals that make up the light-absorbing chromophore is the extended conjugated double-bond system of carotenoids; the more conjugated bonds there are, the higher the measured wavelength value for maximum absorption is (Kong *et al*., 2010). Due to the lack of a terminal beta ionone ring, it has no provitamin action (Rao and Rao, 2007).

According to Preedy and Watson (2008), lycopene isomers differ from their all-trans counterparts in terms of their physical traits and chemical behavior. These traits include decreased color intensity, lower melting points, increased polarity, a reduced tendency to crystallize, and increased solubility in oil and hydrocarbon solvents. All trans-lycopene is a lipophilic compound with hydrophobic properties because of its acyclic structure, which makes it soluble in organic solvents like chloroform, hexane, benzene, dichloromethane, acetone, and petroleum ether while being considered insoluble in water and only slightly soluble in lower alcohols (such as methanol and ethanol) (Preedy and Watson, 2008).

In plants, algae, and other photosynthetic organisms, lycopene is a crucial intermediary in the biosynthesis of numerous carotenoids, including beta carotene, which is in charge of producing the yellow, orange, or red colouring, as well as photosynthesis and photo-protection. Lycopene is a helpful food colouring because of its vibrant colour and non-toxicity (Alda *et al.*, 2009).

Structurally, it is a tetraterpene assembled from eight isoprene units, composed entirely of carbon and hydrogen. Lycopene, a C40 polyisoprenoid compound containing 13 double bonds, is the most abundant carotenoid, accounting for approximately 80–90% of the total pigment contents in ripe tomatoes. With its 11 conjugated and two non-conjugated double bonds, it was found to be a more efficient antioxidant (singlet oxygen quencher) thsan β-carotene, α-carotene, and α-tocopherol (Alda *et al*., 2009).

1.7.1 Lycopene Benefits

The tomato's red pigment is called lycopene. It attracted considerable interest after a clinical trial on human subjects discovered a strong inverse relationship between the presence of lycopene in blood serum and the development of post-tumor cancer (Giovannucci *et al.*, 1995). Since then, additional research on the health advantages of lycopene has revealed that regular consumption of a lycopene-rich diet can help prevent certain cancers and cardiovascular diseases (Agarwal and Rao, 2000; Astorg, 1997; Clinton, 1998; Gerster, 1997; Massev *et al*., 1997; Weisburger, 1998). According to Hua *et al*. (2019), lycopene has reduced the spinal cord ischemia/reperfusion injury that results in neurological impairments, neuronal cell death, and neuroinflammation. Malekiyan *et al*. (2019) discovered that lycopene, either alone or in conjunction with insulin, effectively protected hippocampus neuroglia against streptozotocin, which lessened the impairment of learning and memory. Lycopene has been designated as Generally Recognized as Safe (GRAS) by the US Food and Drug Administration (FDA) (Amarowicz, 2001). Lycopene is an antioxidant that also affects other mechanisms in human health, such as the metabolic pathway, hormonal and immune system regulation, and intercellular gap junction communication (Kun *et al.*, 2006). Furthermore, an increase in lycopene status in the body may control gene activities, enhance intercellular communication, adjust hormone and immune response, or control metabolism, reducing the risk for chronic diseases (Agarwal and Rao, 2000). Carotenoids, for example, are dietary antioxidants that may have important anti-oxidant and anti-inflammatory effects (Maria *et al.*, 2015; Di pietro *et al.*, 2016). As a result, they play a critical role in lowering the risk of cardiovascular disease. Pharmaceutical firms are not the only ones who have a strong demand for lycopene. The sources of lycopene have been extensively used in medicine, cosmetics, and other fields (Song *et al.*, 2019). Lycopene usage and a decrease in skin cancer have been linked, according to research. In biological systems, carotenoids often function as a light filter to minimize light exposure, which helps shield the skin from oxidative stressors (Stahl and Sies, 2003). As a result, it was proposed that lycopene might operate favorably against free radicals to prevent the development of a potential carcinogenic effect in the skin (Gerster, 1997; Clinton, 1998).

1.8 AIM

The aim of this research is to analyze the characterization of 3 inbreed lines of tomato genotypes from Igbudu.

1.9 OBJECTIVES

1. To characterize and evaluate the morphological variability of tomato genotypes gathered from various breeding lines.
2. To evaluate the morphological traits; hypocotyl color, fruit shapes, leaf morphology and fruit form, utilized to differentiate between tomato genotypes from Igbudu.
3. To evaluate and study the lycopene content of different tomato genotypes from Igbudu.

CHAPTER TWO

MATERIALS AND METHODS

2.1 COLLECTION OF TOMATO GERMPLASM

Tomato germplasm for the first planting was collected from Igbudu, Delta State which were classified into three (3) varieties labeled: Gem 1, Gem 2 and Gem 3.

2.2 SITE PREPARATION

Field work of three sets of planting was carried out on the Botanical garden, Department of Plant Biology and Biotechnology, University of Benin, Benin (60.30N, 5.37E). From 30th of March - 15th of July, 2023.

Benin is a lowland forest with an annual rainfall of about 2000 – 3000mm. Rainfall is distributed in bimodal pattern for about nine months with a spell of dry period, which allows two growing seasons. The relative humidity varies directly with the peak of rainfall and is about 75% - 85% (Okhakhu, 2016). Planting was carried out two times at this site consecutively, at different times.

2.3 PREPARATION OF NURSERY

Nursery beds where prepared two times consecutively during the course of this experiment.

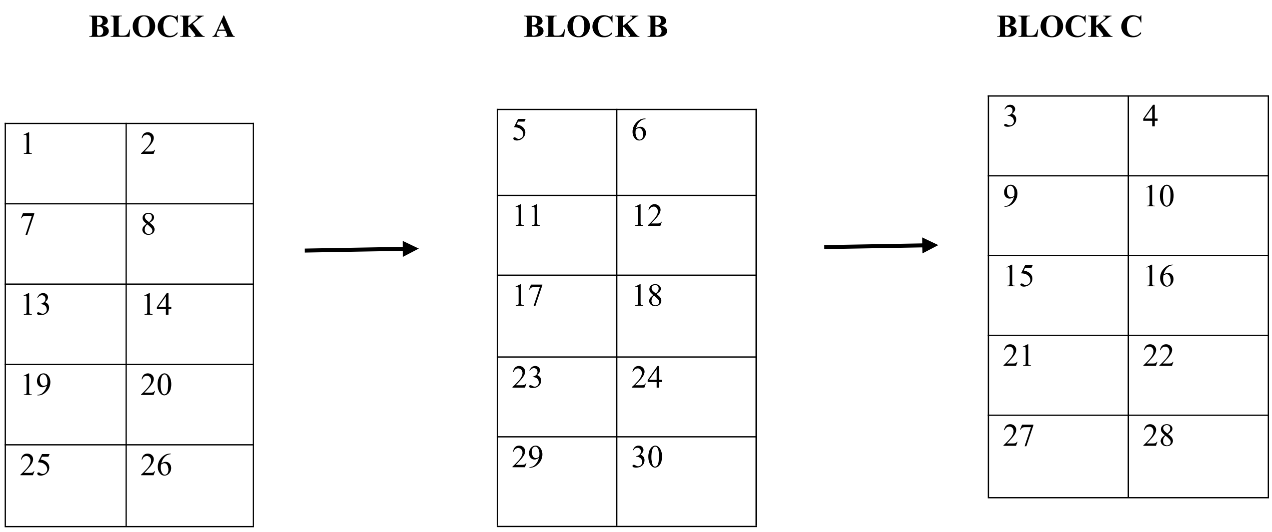
First planting: Nursery was prepared for germplasms collected from Igbudu. Three (3) tomato genotypes were seeded out on the nursery bed on the 30th, march 2023. The nursery bed was watered daily. The young plants were transplanted after 4 weeks.

Second planting: The three (3) different genotypes were transplanted into 30 different pots (ten (10) pots per tomato germplasm). The pots were watered daily.

2.4 EXPERIMENTAL DESIGN

The experiment used a randomized block design as its foundation. Using a randomized block design, the three accessions were transplanted simultaneously between units. The design aims to minimize the edaphic effect and get rid of any variables that can affect the outcomes.

In order to contain three replicates in each block, the randomized block design for this experiment was broken into three blocks: BLOCK A, BLOCK B, and BLOCK C. Each block has two units, each of which has five (5) tomato plants. Each block included a subunit spaced at 1m, and each subunit contained five (5) plants spaced at 0.3m apart.



Figures 2.4: Layout of randomized block experimental design.

Plate 1: Nursery of tomato plants from Igbudu.

Plate 2: Blocks of randomized experimental design of the three tomato varieties

2.5 CULTURAL PRACTICES

1. Regular weeding was done to keep weeds from taking over the field experiment and planting sites.

2. The soil was treated with organic chicken litter dung.

3. To keep fruit from coming into contact with the ground, plants were staked.

4. The nursery and experimental field were frequently irrigated throughout the time of very little rainfall to maintain a steady water supply.

2.6 GROWTH CHARACTERISTICS

Growth characteristics such the quantity of leaves at flowering, the height of the plant at flowering, the number of fruits produced per plant, the number of days till blooming, the size and weight of the fruits, whether they are determinate or indeterminate, and the amount of lycopene.

- **Height of plant at flowering**

  A standard metre rule was used to measure the height of the tomato plants. In centimeters (cm), the tomato plant's height was recorded.

- **Leaf morphology**

  Three different leaf shapes were recognized and documented for each plant, which were created from the flowering stage until the completion of their fruiting period.

- **Weight of tomato fruit**

  An electronic balance was used in the lab to measure the fresh weight of tomato fruits right after they were harvested. The weight was expressed in grams (g).

- **Fruit diameter**

After weighing, the tomato fruit was cut into half using a knife. A meter rule was used in taking measurement and the diameter of each fruit was taken in centimeters (cm).

- **Shape of fruits**

  The different fruit shape produced by each plant were identified and recorded upon ripening. The plant showed variation in fruit shape with three different types being identified and recorded.

- **Fruit colour**

  Each tomato genotype's fruit colour was also documented and some of the fruits were bright crimson, while the others were not. The difference in colour was caused by differences in the lycopene concentration of the tomato varieties.

2.7 EXTRACTION AND QUANTIFICATION OF LYCOPENE CONTENT

The weight of each tomato fruit was measured and recorded separately after it was harvested. The seeds were then taken out of the fruits, leaving only the pulp, and the seeds were properly dried. Tomato juice was produced by separately pounding the pulp from each fruit with a mortar and pestle, and poured into a McCartney bottle. Each McCartney bottle was then labeled for easy identification and stored in the refrigerator with the juice from each fruit split into it. A 2:1:1 mixture of 100ml hexane, 50ml acetone and 50ml ethanol was prepared and stored in well-sealed bottle for later use.

Utilizing hexane/ethanol/acetone and an absorbance measurement at 503 nm, lycopene concentration was evaluated using spectrophotometry.

A 100µL Drummond micropipette was used to take a sample of the homogenized tomato juice, which was then dispensed into a screw-cap tube. Additionally, several control samples were made using 100µL of water instead of tomato pulp.

Each McCartney bottle of tomato juice was filled with 8.0ml of a hexane/acetone/ethanol mixture, which was then vortexed for at least three minutes. Then it was kept away from harsh light while it was incubated. 1.0 mL of sterilized water was added after at least 10 minutes, and the mixture was vortexed for an additional 3 minutes. In order to allow the sample's contents to separate into phases, it was then set up. Using an eppendorf tube and a micropipette, the topmost phase which contains lycopene was collected and preserved. Following that, the specimens were brought into a UV room to measure the light absorbance using a spectrophotometer.

Before using the cuvette in the spectrophotometer, a tiny amount of the hexane/acetone/ethanol solution was used to rinse it. A fresh solution of hexane, acetone, and ethanol was added to the cuvette after the previous mixture was discarded to zero the spectrophotometer. After that, each specimen was sent through the UV-VIS spectrophotometer, which was set to 503 nm, to assess how much lycopene was present in each.

2.8 STATISTICAL ANALYSIS

The data presented in the tables and graphs is the Mean(X) $\pm$ Standard Error(S.E.) of three replicates.

$$\overline{X} = \frac{\Sigma X}{N} \qquad S = \sqrt{\frac{\Sigma[X-X]^2}{N}}$$

$$S.E = \frac{S}{N}$$

S = Standard Deviation

S.E = Standard Error

X = Raw values

$\bar{X}$ = Mean

N = Number of data

Lycopene (mg/kg fresh weight) = (wavelength at 503nm × molecular weight of lycopene × volume of mixed solvent × volume of the upper layer of the mixed solvent)/(weight of tomato × extinction coefficient of lycopene in hexane).

CHAPTER THREE

RESULTS

Data was collected from all the germplasm planted during the course of this experiment. The following are data for some agronomic parameters and it includes height of plants, number of leaves and weight of fruits from randomly selecting 3 specimens each from all ten genotypes.

3.1 AGRONOMIC CHARACTERISTICS

At the 4th week of plant growth, the plant was transplanted and during this period, the height of each plant was measured and significant difference in the height of plants was observed.

The table below (Table 1) shows the fruit weight per plant of tomato genotype from Igbodo. RD-igb recorded a fruit weight of 13.96±1.661cm indicating the genotype with the highest fruit size, followed by HD-igb. PY-igb recorded the smallest fruit, with a value of 6.222±0.660cm.

Table 1: Fruit Weight Of Tomato Genotypes

VARIETY	FRUIT WEIGHT (g)
RD-igb	13.96±1.661
HD-igb	10.18±0.957
PY-igb	6.222±0.660

Table 2 shows the diameter of each fruit per plant of all 3 genotypes used during the course of this experiment. RD-igb recorded the highest diameter with a value of 10.286±0.703, followed by HD-igb having a value of 9.12±0.287 and the least was produced by PY-igb with a value of 7.54±0.384.

Table 2: Fruit Diameter Of Tomato Genotypes

VARIETY	FRUIT DIAMETER(cm)
RD-igb	10.286±0.703
HD-igb	9.12±0.287
PY-igb	7.54±0.384

Table 3 shows the height of the plants after transplanting stage. PY-igb recorded the highest after 6 weeks at a height of 80.095 ± 1.314, followed by RD-igb with a height of 64.947 ± 1.323. HD-igb recorded a height of 54.356 ± 7.003 indicating the plant having the lowest height after 6 weeks.

Table 3: Height Of Plant After Transplanting

VARIETY	HEIGHT AT 2 WEEKS AFTER TRANSPLANTING (cm)	HEIGHT AT 4 WEEKS AFTER TRANSPLANTING (cm)	HEIGHT AT 6 WEEKS AFTER TRANSPLANTING (cm)
RD-igb	21.463±1.174	44.196±1.375	64.947±1.323
HD-igb	18.062±1.595	34.883±5.040	54.356±7.003
PY-igb	26.67±4.808	60.452±6.098	80.095±1.314

Table 4 shows the number of fruit produced by each plant. RD-igb showed the least number of fruits produced with a value of 2.125±0.227, followed by HD-igb which had a value of 2.429±0.369. PY-igb had a value of 3.000±0.577, indicating the plant with the highest number of fruit produced.

Table 4: Number Of Fruits Produced Per Plant

VARIETY	NUMBER OF FRUIT PER PLANT
RD-igb	2.125±0.227
HD-igb	2.429±0.369
PY-igb	3.000±0.577

Table 5 shows the number of days taken for the genotypes from igbodo to flower. PY-igb recorded 65.666±0.333 days to flowering, indicating the earliest flowering genotype. This was followed by HD-igb with a value of 66.857±0.595 days. RD-igb recorded the longest days to flowering with a value of 67.375±0.498.

Table 5: Number Of Days To Flowering Of Tomato Genotypes From Igbodo.

VARIETY	NUMBER OF DAYS TO FLOWERING
RD-igb	67.375±0.498
HD-igb	66.857±0.595
PY-igb	65.666±0.333

Table 6 shows the lycopene content of 3 genotypes; RD-igb, HD-igb and PY-igb. From these 3 genotypes, RD-igb recorded the least amount of lycopene content with a value of 1.336±0.321, followed by PY-igb which has a value of 1.338±0.272. HD-igb showed the highest lycopene content with a value of 1.715±0.253.

Table 6: Fruit Lycopene Content Of Tomato Genotypes

VARIETY	LYCOPENE CONTENT (mg/100g)
RD-igb	1.336±0.321
HD-igb	1.715±0.253
PY-igb	1.338±0.272

Figure 1 shows the fruit weight per plant of tomato genotype from Igbodo. RD-igb recorded a fruit weight of 13.96±1.661cm indicating the genotype with the highest fruit size, followed closely by HD-igb. PY-igb recorded the smallest fruit, with a value of 6.222±0.660cm.

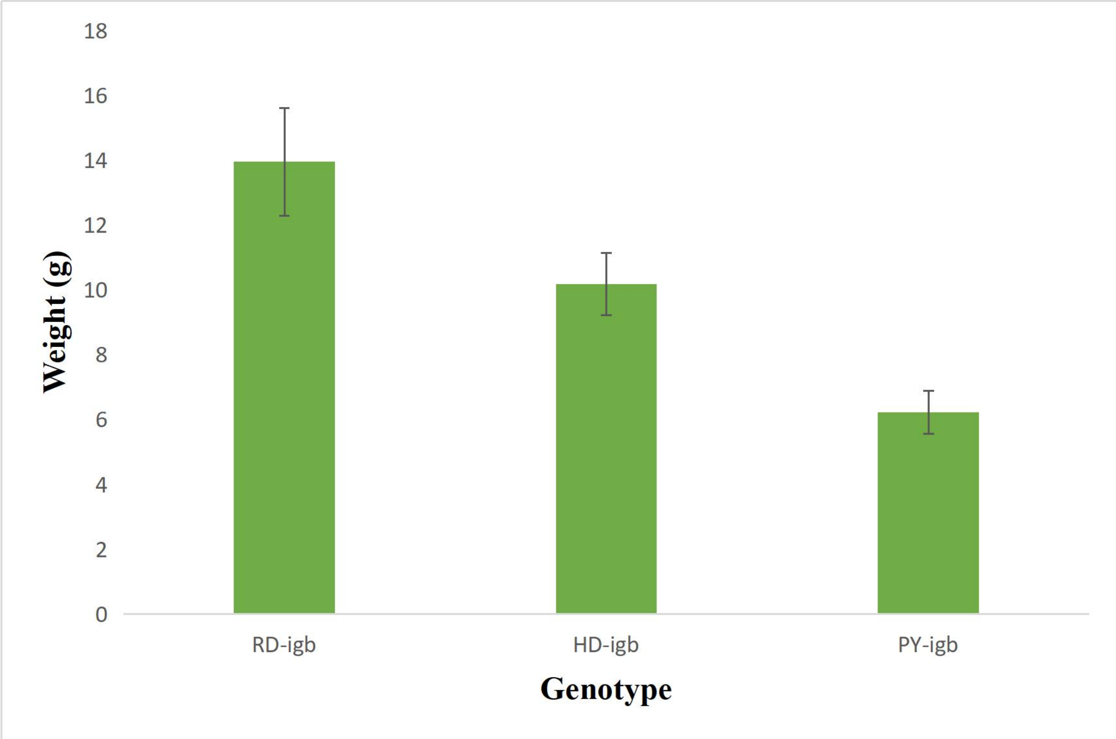


Figure 1: Fruit weight of tomato genotypes

As shown in figure 2, RD-igb recorded the highest diameter having a value of 10.286±0.703, followed by HD-igb having a value of 9.12±0.287 and the least was produced by PY-igb with a value of 7.54±0.384.

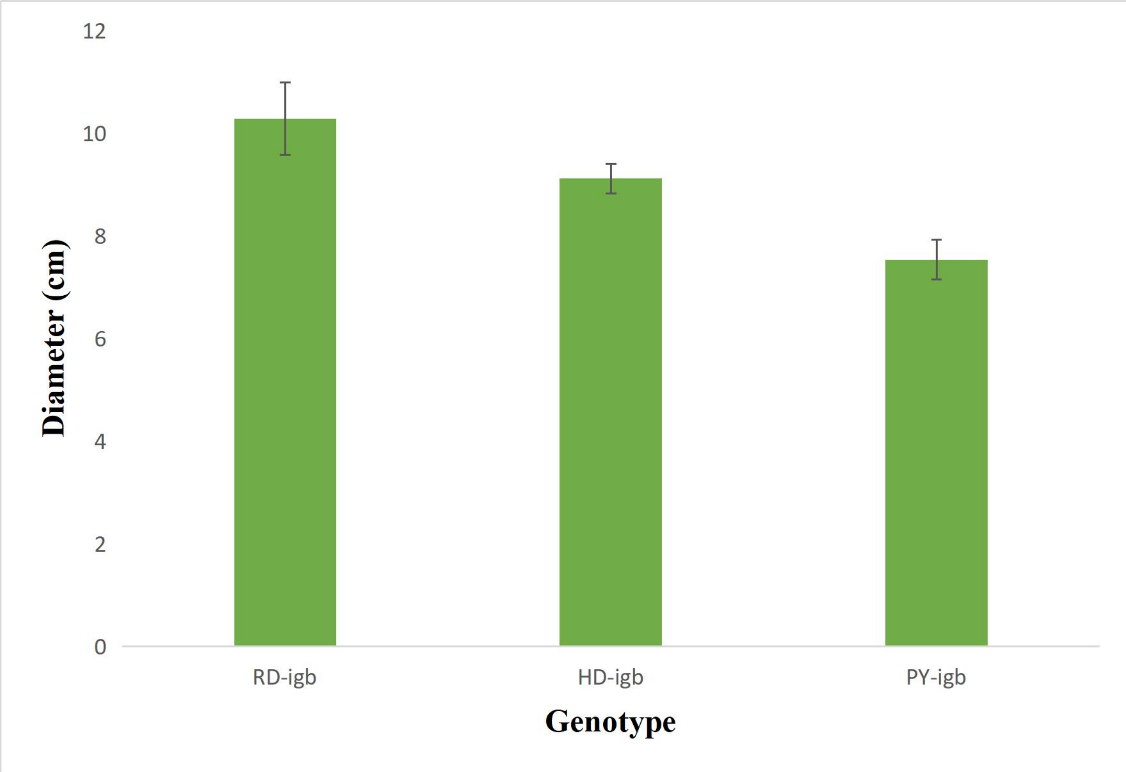


Figure 2: Fruit diameter of tomato genotypes

As shown in figure 3, PY-igb recorded the highest after 6 weeks at a height of 80.095 ± 1.314, followed by RD-igb with a height of 64.947 ± 1.323. HD-igb recorded a height of 54.356 ± 7.003 indicating the plant having the lowest height after 6 weeks.

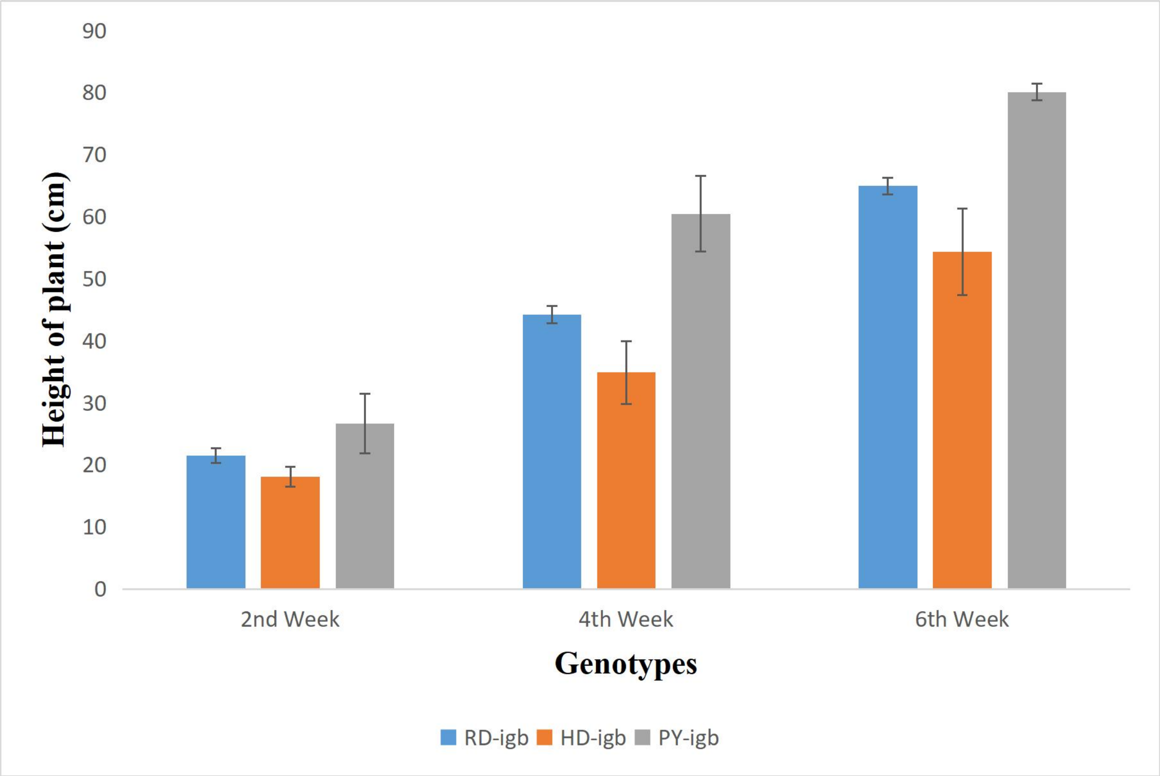


Figure 3: Height of plant after transplanting

Figure 4 shows the number of fruit produced by each plant. RD-igb showed the least number of fruits produced with a value of 2.125±0.227, followed by HD-igb which had a value of 2.429±0.369. PY-igb had a value of 3.000±0.577, indicating the plant with the highest number of fruit produced.

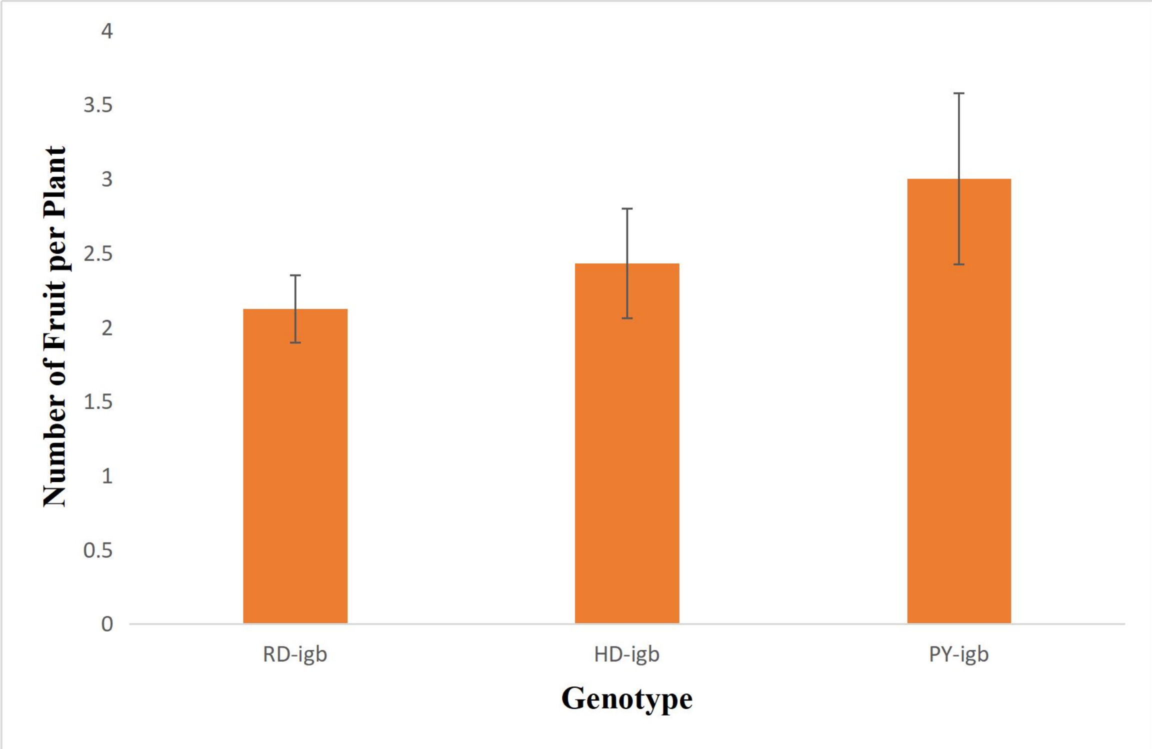


Figure 4: Number of fruit produced per plant

As shown in figure 5, PY-igb recorded 65.666±0.333 days to flowering, indicating the earliest flowering genotype. This was followed by HD-igb with a value of 66.857±0.595 days. RD-igb recorded the longest days to flowering with a value of 67.375±0.498.

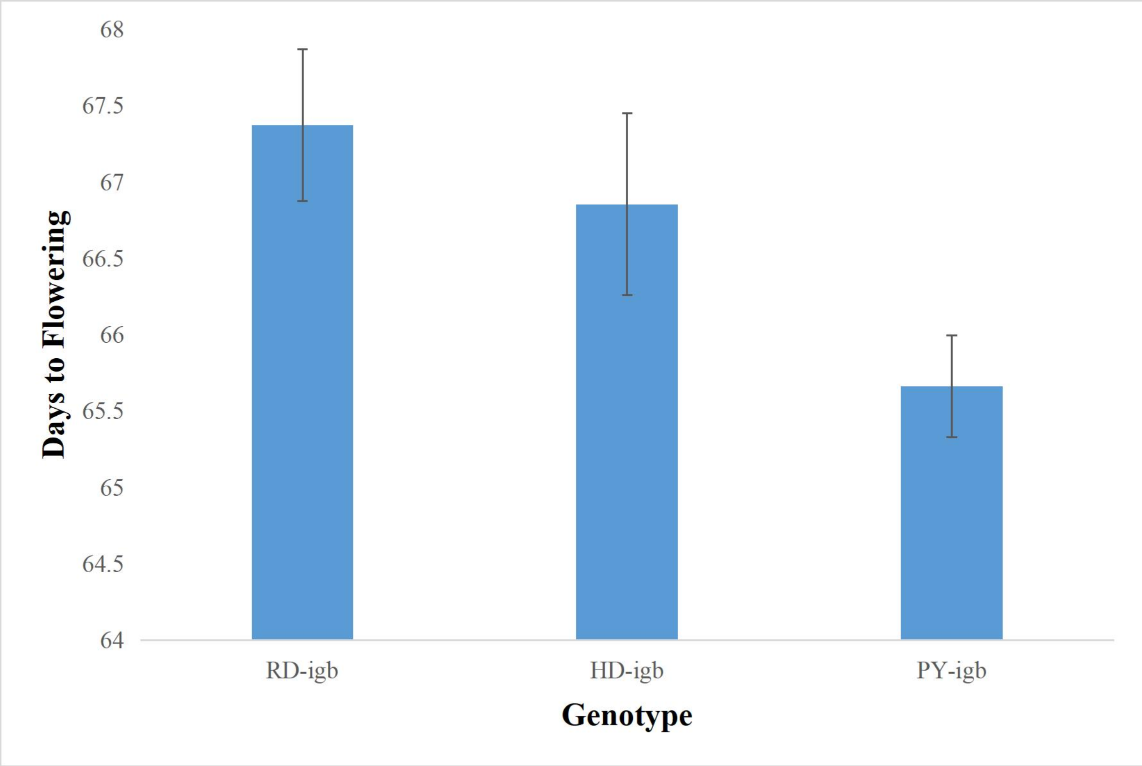


Figure 5: Number of days to flowering

Genotype 3: PY-igb

Genotype 2: HD-igb

Genotype 1: RD-igb

Plate 3: Fruit Colour/Shapes Of Tomato Varieties

Plate 4: Extracted Lycopene In Hexane Solution

CHAPTER 4

DISCUSSION

Lycopene content in the fruits of three (3) tomato genotypes were examined. The three genotypes were derived from the products of germplasm purchased from the local market in Igbodo. Direct data on lycopene assessment were gathered from the three genotypes. According to the analysis's findings (Table 6), the fruit's lycopene concentration ranged from 1.336±0.321 to 1.715±0.253 mg/100g. The HD-igb fruit had the highest lycopene concentration, according to Ibitoye *et al*. (2009), who reported greater lycopene levels of 6–16 mg/100g and 14.73 mg/100g, respectively. Lower range of 0.9 - 3.39 mg/100g according to Dufera (2013).

The observed variations in lycopene content can be a result of reactions to various environmental and climatic factors. The range of lycopene examined for this experiment shows that there is significant variance in tomato lycopene concentration throughout the South-West of Nigeria. According to Schierle *et al*. (1997), the amount of lycopene in tomatoes varies from 7 mg/100g to 13 mg/100g depending on the variety, region, mode of growing, and climatic and environmental factors.

When compared to the lycopene content of the other types, HD-igb had the highest concentration, at 1.715±0.253mg/100g. According to Dufera (2013), targeted breeding progress could be used as a method to combine genotypes with high lycopene content with other variety that have marketable attributes like long, large fruits and other economically significant traits.

According to Ibitoye *et al*. (2009), lycopene, a phytonutrient and antioxidant, is the pigment that gives ripe tomatoes and tomato-related products their distinctively deep red color. Tobacco products (Bicanic *et al*., 2005), the ripening process, and storage temperature (Barrett and Garcia, 2006) all affect the concentration of lycopene, which Hart and Scott (1995) estimate to range between 3 and 5 mg per 100g of raw material for tomatoes.

Fruit attributes like fruit weight, fruit height, and fruit diameter were investigated. The analysis's findings revealed that fruit weights ranged from 6.222±0.660 to 13.96±1.661. PY-igb recorded the least amount of fruit weight, whereas RD-igb had the maximum amount. RD-igb(5), RD-igb(9), HD-igb(8), and HD-igb(10) were four of the genotypes that failed to yield any fruit.

Each tomato genotype's fruit's diameter were measured. The analysis's findings showed that genotype 1(RD-igb) had a value of 10.286±0.703, which indicated the plant with the largest fruit diameter. Genotype 3 (PY-igb), which recorded 7.54±0.384, had the smallest diameter of fruit produced.

Starting in the second week of post-transplant growth and continuing every two weeks until the sixth week, the height of the plants were measured. As a result of the investigation, it was determined that the plants' heights ranged from 54.356±7.003 to 80.095±1.314 (Table 3). The heights at flowering for PY-igb and HD-igb were the highest and lowest, respectively. According to research by Ofori *et al*. (2005), locations with seasonal rainfall should prioritize selection for traits that favor early growth.

With a value of 3.000±0.577 , PY-igb recorded the highest number of fruits produced, however it did not record the highest number of flowers. In comparison to PY-igb, RD-igb reported a lower value for the quantity of fruits produced (2.125±0.227), but it generated the most blooms. Given the high rate of flower abortion and the fact that some flowers dried out and eventually dropped off, it's possible that the low yield seen in PY-igb was caused by the flowers failing to mature into fruits. Only approximately 50% of the blossoms generated by tomato plants turned into fruits, according to Adelena's (1975) research. Given that different tomato genotypes were used, genetic variability among them may possibly contribute to the difference in yield.

CONCLUSION AND RECOMMENDATION

According to the study, traits like fruit weight, plant height, fruit diameter, number of fruits per plant, and days until flowering had the highest estimates of variation, indicating that there was a high degree of variation among genotypes for these characters and that the traits could be used as selection indices for tomato breeding programs. In contrast, traits like plant height had low coefficients of variation, suggesting that the genotypes do not differ significantly in these traits. When compared to other genotypes employed in this study, genotype 3 had a high record for yield parameters because of a significant positive relationship between fruit lycopene content and plant height, number of fruits produced, and lycopene content.

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