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Agronomic and Lycopene Evaluation in Tomato (*Lycopersicon lycopersicum* Mill.) As a Function of Genotype

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Abstract: Agronomic evaluation of crop genotypes is essential in identifying the genetic variability that exists within crop germplasm and it is also the starting point for genetic improvement of any crop species. To this end, nine tomato genotypes were evaluated for the variability in their agronomic characteristics and lycopene content. The tomato lines differ widely in the agronomic characters evaluated. Fruit weight ranged between 0.256g and 0.003g with'NHBig local' having the highest while 'NHCherry' had the lowest respectively. Genotype 'NHLeader' flowered the earliest with a mean number of days of 40.28, while 'NHCherry' flowered latest with a mean number of days of 72.389. 'NHCherry' had the highest number of fruits per truss and fruits per plant with a mean of 5.111 and 6.056, respectively. The content of Lycopene an important phytonutrient was also evaluated among the genotypes and it ranged from 70.25 to 147.29 µg/g, with 'NHLindo' having the lowest and 'NHLeader' having the highest. This paper gives information on the agronomic variation in the nine tomato genotypes assessed which can invariably serve as an index to selecting putative parents in breeding for new tomato variety that will combine desirable agronomic characteristics with high lycopene content.

Key words: Antioxidant % Genotype % Germplasm % Phytonutrient % Putative % Variability

INTRODUCTION

Tomatoes constitute an important agricultural crop and are an integral part of the human diet. They are the second-most consumed vegetable after potato [1]. Although tomatoes are commonly consumed fresh, over 80% of tomato consumption comes from processed products such as tomato juice, paste, puree, ketchup and sauce [2]. Mayeaux *et al* [3] indicated the potential health benefits of a diet rich in tomatoes and tomato products. Lycopene, the pigment that is responsible for the characteristic deep red colour of ripe tomatoes and their products plays an important role in human health and epidemiological studies have shown it to reduce the risk of chronic diseases. Lycopene is a major carotenoid without provitamin A activity and is considered responsible for their beneficial effects [4, 5]. The ability of lycopene to act as a potent antioxidant is thought to be responsible for protecting cells against oxidative damage and thereby decreasing the risk of chronic diseases [6]. In fresh tomatoes, the content of lycopene was reported to range from 25 to 2000 µg/g in raw tomato [7]. The level of lycopene is directly related to ripeness and increasing pH [8]. The variation in the redness of different cultivars is mainly due to a difference in the levels of lycopene accumulated in their skins and the only carotenoid constituent in the skin is lycopene [9].

Genetic variability in crops as manifested in morphological or molecular diversity is essential for crop improvement, leading to the production of preferred crop types. Collection, characterization and evaluation of crop germplasm are key steps towards selection of new varieties for direct production or for use in hybridization programmes [10, 11]. Morphological traits have been identified as equally important as yield components in breaking yield barriers as no crop can perform higher than its genetic potential even under a very conducive environment [12].

The objectives of this study therefore, are to evaluate the cultivated germplasm tomato for morphological and lycopene variability pioneering breeding for an improved tomato variety that can be recommended as potential varieties for processing and for improvement of nutritional value in breeding programmes.

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MATERIALS AND METHODS

The study was conducted at the experimental field of National Horticultural Research Institute, Ibadan, Nigeria, between May 2008 and August 2008. The experimental site was a newly cultivated site having a clay-loam soil texture (Sand 35.8 %, Clay 34.9%, Silt 29.2%), with pH 6.2, extractable acid 0.23, organic matter content 2.2%, Ca 27.7cmol/L, mg 11.7cmol/L, K 0.96cmol/L and a cation exchange capacity of 40.4cmol/L. The tomato seeds were first raised in the nursery and later transplanted to the field four weeks after planting. The seedlings were arranged in a randomized complete block design with nine plots in four replicates. The experimental plot contained 15 plants arranged in three rows spaced 50cm apart with 1m between each plot. The varieties were the treatments and were randomized within the replicates using table of random numbers. Data collection started at four weeks after transplanting on the following growth and fruit characteristics: Plant height at 4wks after transplanting, number of leaves, number of branches at flowering, height at flowering, number of branches, number of days to flowering, number of fruits per truss, number of fruits per plant and fruit weight.

Lycopene Estimation: Lycopene from tomato products was extracted with hexane: methanol: acetone (2:1:1), containing 2.5% BHT (butylated hydroxy toluene). Optical density of the hexane extract was measured spectrophotometrically at 502 nm against a hexane blank. Concentration of lycopene was calculated using the extinction coefficient (E%) of 3150. Results are expressed as µg/g fresh weight (fw).

Data Analysis: The data was subjected to analysis of variance (ANOVA) using the generalized linear model (GLM) of SAS (Statistical Analysis System) software version 8.02 [13]. Means were separated by Duncan's multiple range test (DMRT) and significance level was determined at $P<0.05$.

RESULTS AND DISCUSSION

Results of the analysis are presented in Tables 1 to 3. The highest estimate of coefficient of variation in traits such as fruit weight, number of branches per plant and number of fruits per plant indicated that variation among the genotypes for these characters was high and therefore, the traits can serve as indices of selection for

Table 1: Growth characteristics of tomato as a function of genotype

Genotypes	Plant height @4wks after transplanting (cm)	No of leaves	No of branches @flowering	Height@ flowering (cm)
NH158	15.59bc	29.44c	1.78e	57.34c
NH3Lobed	17.53ab	47.28a	2.06bcd	44.52d
NHRonita	16.33bc	32.56c	2.39bcd	35.58e
NH Small local	19.24a	40.00b	2.89b	64.92b
NH4Lobed	15.27bc	34.72c	2.39bcd	34.14e
NHLeader	17.05ab	31.83c	2.56bc	54.88c
NHLindo	14.80bc	33.56c	1.94de	52.57c
NHBig local	13.63c	31.50c	1.67e	55.61c
NHCherry	17.27ab	41.39b	4.44a	74.76a
Mean±SE	16.30±0.93	35.81±1.76	2.46±0.18	52.70± 2.09
CV (%)	24.07	20.85	30.20	16.78

Values with same subscripts in the same column are not significantly different at 5% level of significance

Table 2: Fruit characteristics of tomato as a function of genotype

Genotypes	No of days to flowering	No of fruit/truss	No of fruits/ plant	Fruit weight (g)
NH158	50.72b	1.94de	5.94a	0.19b
NH3Lobed	42.22cd	2.17cd	3.89b	0.04de
NHRonita	52.61b	2.11cde	3.17c	0.03de
NH Small local	45.11c	2.44bc	2.67c	0.13c
NH4Lobed	53.11b	1.72e	3.11c	0.06d
NHLeader	40.28d	2.61b	2.56c	0.04de
NHLindo	42.17cd	2.44bc	3.17c	0.07d
NHBig local	51.50b	2.28bcd	2.83c	0.26a
NHCherry	72.39a	5.11a	6.06a	0.01e
Mean±SE	50.01±1.30	2.54±0.13	3.71±0.24	0.09±0.01
CV (%)	10.00	22.40	26.81	62.94

Values with same subscripts in the same column are not significantly different at 5% level of significance

Table 3: Variation in lycopene content in tomato as a function of genotype

Genotypes	Lycopene content µggG1
NH 158	91.67±0.56c
NH3 Lobed	75.01±1.24f
NHRonita	83.69±1.30d
NHSmall local	79.77±0.98e
NHLeader	147.29±0.94a
NHLindo	70.25±0.96g
NHBig local	100.41±0.72b
NHCherry	90.09±1.10c
Mean	92.27
Range	70.25-147.29

Values are means of triplicate analyses±Standard deviation (SD) Values with same subscripts in the same column are not significantly different at 5% level of significance

yield in tomato breeding programme, while low coefficient of variation in traits like number of days to flowering, height at flowering suggests that the genotypes do not differ much for these traits [11]. Genotype NHSmall local had the highest plant height at four weeks after transplanting of 19.24cm, while NH big local had the least height of 13.63cm (Table 1). Earliness in growth has been found to be an important trait to select for especially in areas of less seasonal rainfall [14]. NHLeader was the earliest to flower, while NHCherry was the latest to flower with 40.28 and 72.39, respectively (Table 2).

Lycopene is a phytonutrient and an antioxidant and this pigment is responsible for the characteristic deep red colour of ripe tomatoes and their products. The lycopene content of the raw tomatoes were analyzed in all eight cultivars. The lycopene content ranged from 70.25 to 147.29 µg/g on a fresh weight basis (Table 3). This is comparable to values reported for fresh tomatoes (20.4 to 141 µg/g FW) by George *et al.* [15] and (25 to 2000 µg/g FW) by (10); but lower than values (3110 to 6700 µg/g FW) reported by Dewanto *et al.* [16] and (3310 µg/g FW) reported by (5). NHLeader had the highest lycopene content of 147.29uggG1 while NHLindo has the least 0f 70.25uggG1.

CONCLUSION

This study provides a morphological basis for differentiating the nine tomato genotypes evaluated. The genetic basis of the potential of the different traits assessed need to be studied in order to ascertain their constancy in population. The use of DNA markers linked to the respective traits need to be used for molecular characterization of the tomato genotypes.

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