



Tomato (*Solanum lycopersicon* L.) seed conservation strategies: A veritable tool for improvement and breeding programmes

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Abstract

Key words:

Seed conservation, ambient temperature, genotypes, improvement, viability

An experiment on tomato seed production was conducted in the cropping seasons of 2017/2018 on three genotypes of tomatoes NG/AA/SEP/09/042, AK/1/18 and AK/2/18. A randomized complete block design replicated four times was adopted on seedlings raised in the nursery for 2 – 3 weeks and transplanted to the open field at a spacing of 30 cm x 60 cm within and between rows. Morphological and yield traits were measured and all cultural practices such as weeding, thinning, pest and disease control measures were carried out periodically in order to ensure a clean and disease-free condition. At fruit maturity, ripen fruits were plucked and seeds extracted from the berry, air-dried under ambient temperature of 27⁰C to 30⁰C and relative humidity of 60 – 70% for about 5 – 6 days. The air-dried seeds were then stored in a perforated plastic container for good aeration but devoid of insect infestation. In this condition the seeds can store for about 24 months and still retain its viability status. The result showed that NG/AA/SEP/09/042 and AK/1/18 had the highest number of fruits yield and the heaviest fruit weight among the three genotypes therefore good quality seeds could be obtained from them. Therefore, improvement of the AK/2/18 can be carried out through hybridization programme. It is recommended that for seed conservation programmes the target should be plants with the highest number of fruits.

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INTRODUCTION

Tomato (*Solanum lycopersicon* L.) is an important vegetable crop grown widely all over the world. Considering its importance there is need to adopt an enduring seed conservation strategy that will ensure availability of good quality seed all the year round. Ripe fruit of tomato is consumed fresh as salads, in cooked form, stew and also used in the provision of various forms processed products like paste, powder, ketchup, sauce and canned whole fruit (Osekita and Ademiluyi, 2014).

Tomato is an important condiment in most diets and a very cheap source of vitamins A, C and E, and minerals that are very good for the body and as protection against diseases (Taylor, 1987; Osekita and Ademiluyi, 2014). It is a tropical day neutral plant and predominantly self-pollinated, but a certain percentage of cross pollination occurs. It is a warm season crop reasonably resistant to heat and drought and grows under wide range of soil and climatic conditions (Shashikanth *et al.*, 2010). Considering the potentiality of this crop, there is a need to improve the stability in yield and to obtain varieties with good quality through the employment of adequate seed conservation strategies. Thus, genetic improvement of

cultivated tomato for yield and quality can normally be achieved through selection of genotypes with desirable traits that may exist in nature or by hybridization. (Osekita and Ademiluyi 2014).

Studies have indicated that higher plant densities have increased yield in tomatoes. However, the plant population per hectare is influenced by the genotype (Bryan *et al.*, 1967; Fery and Janick, 1970; Wilcox, 1970; Navarro and Locascio, 1971; Zahara and Timm, 1973; Kays and Nicklow, 1974 and Csizinszky, 1980). At higher than optimum plant densities, marketable fruit yields per hectare remain constant or decrease and mean fruit size is generally smaller. Likewise, fruit quality often decreases at high plant populations since insect and diseases are generally more difficult to control. This possibly may be attributed, at least in part to higher relative humidity and inadequate pesticide coverage in a dense plant canopy (Stoffella *et al.*, 1988). Number of fruits and average fruit size had been reported by various researchers, Kumar *et al.*, 2006 indicated in his study that a range of 27.33 to 64.67 number of fruits per plant was observed, 14 to 65 (Upadhyay *et al.* 2005), 8.08 to 41.56 (Joshi *et al.* 2004). Mean fruit number per plant had been reported to be 19.65 (Haydar *et al.*, 2007), 43.09 (Kumar *et al.*, 2006) and 33.20 by (Upadhyay *et al.*, 2005). Average fruit weight ranges had also been reported by different scholars as follows 36.33 to 71.07 grams (Veershetty, 2004), 16.13 to 95.7 grams (Joshi *et al.* 2004), 29.83 to 92.67 grams (Mohanty, 2003). There appears to be significant genetic variation for these traits in tomatoes. This is important because the success of crop improvement depends on the magnitude of genetic variability. Hence, the study aim at examining fruit characters that aids in adequate seed production and for conservation purposes

MATERIALS AND METHODS

Three genotypes of tomato were obtained from Plant Breeding Unit of the Department of Plant Science and Biotechnology, Adekunle Ajasin University Akungba Akoko. The genotypes are NG/AA/SEP/09/042, AK/1/18 and AK/2/18. A randomized complete block design replicated four times was adopted on seedlings raised in the nursery for 2 – 3 weeks and transplanted to the field at a spacing of 30 cm x 60 cm within and between rows. Morphological and yield data were recorded and all cultural practices such as weeding, thinning, pest and disease control measures were carried out periodically in order to ensure a clean and

disease free condition. At fruit maturity, ripen fruits were plucked and seeds extracted from the berry, air-dried under ambient temperature of 27°C to 30°C and relative humidity of 60 – 70% for about 5 – 6 days. The air-dried seeds were then stored in a perforated plastic container for good aeration but devoid of insect infestation.

Statistical analysis

The data collected were analyzed using general linear model of SPSS version 20 for analysis of variance (ANOVA) and other genetic parameters estimated according to the procedure of Osekita and Ajayi (2013).

RESULTS AND DISCUSSION

Results

The mean sum of squares due to various sources of variation for ten (10) characters viz., plant height, number of branches, number of clusters per plant, number of fruits per cluster, number of fruits per plant, number of days to first flowering, number of days to first fruit set, fruit weight, number of locules, pericarp thickness and coefficient of variation are presented in Table 1. The variation due to genotype effect (Table 1) was significant for plant height, number of branches per plant, number of cluster per plant, number of fruits per cluster, number of fruits per plant, number of days to first flowering, number of days to first fruit set, fruit weight and pericarp thickness indicating that differences exist among the five tomato genotypes in almost all the parameters measured. The non-significant difference observed for number of locules is an indication that all the tomato genotypes had uniform number of locules irrespective of the size and shape of the tomato fruits.

The variation due to replication effect was significant for number of branches, number of clusters per plant, number of fruits per cluster, number of days to first flowering, number of days to first fruit set, fruit weight, number of locules and pericarp thickness. Plant height and number of fruits per plant was not significant, this showed that effect of replication does not affect the height and fruit yield of tomato. Coefficients of variation for all the traits were presented in Table 1. Number of cluster per plant, number of fruits per cluster, number of fruits per plant, fruit weight, number of locules, pericarp thickness, plant height had high coefficient of variation whereas number of branches had the highest

coefficient of variation (82.58%) that is the most varied traits and number of days to first fruit set had lowest (5.05%) coefficient of variation. Therefore,

subsequent improvement programmes can be initiated for the varied traits because of significant differences that exist among the genotypes.

Table 1: Mean squares and coefficient of variation on ten quantitative traits of tomato

*, **indicate significant level at 5% and 1% respectively, ns is not significant. PH: Plant height; NB: Number of branches; NCP: Number of cluster per plant; NFC: Number of fruits per cluster; NFP: Number of fruits per plant; NDFD: Number of days to first flowering; NDFFS: Number of days to first fruit set; FW:

Source of variation	df	PH	NB	NCP	NFC	NFP	NDFD	NDFFS	FW	NL	PT
Genotype	2	469.35*	2.61*	3.54*	2.33*	3.75*	149.29**	142.21*	168.8*	0.04 ^{ns}	3.05*
Replication	3	44.72 ^{ns}	2.37*	2.18*	0.33*	0.79 ^{ns}	29.02*	9.45*	49.8*	0.12*	0.19*
Error	6	77.72	0.72	1.02	0.42	2.26	10.10	11.67	69.5	0.07	0.29
CV%		17.88	82.58	60.38	26.79	46.61	5.66	5.05	35.8	11.5	19.0

Fruit weight; NL: Number of locules; PT: Pericarp thickness.

Table 2: Mean performance among three tomato genotypes based on ten quantitative traits measured

Genotypes	PH	NB	NCP	NFC	NFP	NDFD	NDFFS	FW	NL	PT
NG/AA/SEP/09/042	55.3±1.3 ^a	1.6±0.3 ^a	6.1±0.2 ^a	4.6±0.1 ^a	24.6±1.6 ^a	63.0±3.1 ^b	74.4±2.7 ^b	24.2±4.5 ^a	2.3±0.2 ^a	3.2±0.3 ^b
Ak/1/18	66.7±4.5 ^b	1.2±0.5 ^a	6.9±0.3 ^a	4.3±0.3 ^a	24.5±1.0 ^a	54.1±0.4 ^a	65.4±0.2 ^a	29.4±5.1 ^b	2.2±0.1 ^a	3.5±0.3 ^b
AK /2/18	67.4±3.1 ^b	2.6±0.6 ^a	5.9±0.4 ^a	4.4±0.4 ^a	22.1±1.2 ^a	51.3±1.6 ^a	63.1±1.0 ^a	16.5±1.3 ^a	2.4±0.1 ^a	1.9±0.2 ^a

Means with the same alphabet in the same column are not significantly different by DMRT (P=0.05). PH: Plant height; NB: Number of branches; NCP: Number of cluster per plant; NFC: Number of fruits per cluster; NFP: Number of fruits per plant; NDFD: Number of days to first flowering; NDFFS: Number of days to first fruit set; FW: Fruit weight; NL: Number of locules; PT: Pericarp thickness

Mean performance in elite and two local genotypes of tomato in ten quantitative traits of tomato were presented in Table 2. There was significant variability in plant height, number of days to first flowering and number of days to first fruit set, fruit weight and pericarp thickness, similar results were obtained by Singh *et al.*, (2002). Whereas no significant variations were observed in number of branches, number of cluster per plant, number of fruits per cluster, number of fruits per plant, fruit weight and number of locules. AK/2/18 (67.4 cm) is the tallest plant while the shortest (55.3 cm) was observed in NG/AA/SEP/09/042. The highest number of cluster per plant (6.9) was observed in AK/1/18 while lowest mean value (5.9) in AK/2/18. Number of fruits per cluster was highest in NG/AA/SEP/09/042 (4.6) and lowest (4.3) in AK/1/18. Number of fruits per plant is highest (24.6) in NG/AA/SEP/09/042 and lowest (22.1) in AK/2/18. Number of days to first flowering had the longest number of days (63.0) in NG/AA/SEP/09/042 and shortest days to flowering (51.3) were observed in AK/2/18. The longest number of days to first fruit set (74.4) was observed in NG/AA/SEP/09/042 and the shortest (63.1) days in AK/2/18. The heaviest fruit (29.4 g) was observed in AK/1/18 and lightest (16.5 g) in AK/2/18. Pericarp thickness was highest (3.5 mm) in AK/1/18 and lowest value (1.9 mm) was observed in AK/2/18. The fruit shapes of the three tomato genotypes were presented in plates 1, 2 and 3.

DISCUSSION

The fruit and yield traits indicated no significant variation compared to the morphological traits which are the most varied parameters therefore, improvement programmes can be directed at such traits. In seed conservation strategies number of clusters per plant, number of fruits per cluster, total number of fruits per plant and number of locules per fruit determines the amount of seeds that can be obtained and conserved for subsequent sowing. The range of fruits traits observed in this study had similar results with those obtained by (Mohanty, 2003; Joshi *et al.*, 2004; Veershetty, 2004; Upadhyay *et al.*, 2005). The quality of fruit determines the quantity and quality of seeds that can be obtained compared with diseased fruit in which the biochemical component of the fruit juice had been degraded and the pH altered which may not produce good cured seed. Hence, fresh and robust fruits are harvested and the seeds extracted from the locules through a little press to release the seeds along with the fluid slightly acidic in nature and

serve as a protective coat during air-drying. This fluid may likely aid in retaining viability and long duration in storage. The seeds after air-drying for about 5 days can be kept in small plastic container with perforated cover to allow exchange of gases and prevention of insect damage during storage.

CONCLUSIONS AND RECOMMENDATIONS

The result showed that NG/AA/SEP/09/042 and AK/1/18 had the highest number of fruit yield and the heaviest fruit weight among the three genotypes therefore good quality seeds could be obtained from them. Whereas, AK/2/18 is fleshier with very little seeds, hence improvement of the AK/2/18 for inheritance of more seeds can be carried out through hybridization programme. It is recommended that for seed conservation programmes the target should be plants with the highest number of fruits.

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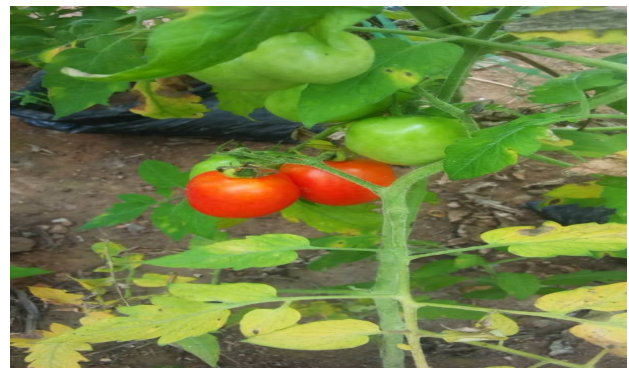


Plate 1: NG/AA/SEP/09/042



Plate 2: AK/1/18



Plate 3: AK/2/18

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