



Evaluation of Four Tomato Varieties (*Lycopersicon esculentum* Mill.) for Vegetative Growth, Yield and Yield Components in Ed Dueim, Sudan

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Authors' contributions

This work was carried out in collaboration between all authors. Author AAHH designed the study, performed the statistical analysis, wrote the protocol and first draft of the manuscript. Authors EAME and MSO managed the analyses of the study. Authors MSO and GEEAE managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Two field experiments were carried out during two successive winter seasons of 2013/14 and 2014/15 at the experimental farm, Faculty of Agriculture and Natural Resources, University of Bahkt Alruda, Ed Dueim, Sudan. The aim of this study was to evaluate four tomato varieties performance under Ed Dueim locality conditions. Experiments consisted of four varieties, viz .Zahrat Enile, Darmali, Castle Rock and Strain B arranged in a randomized complete block design with three replications. Significant differences were observed in tomato vegetative growth, yield and yield components and fruit quality among the varieties. "Darmali" variety showed the maximum number of leaves, the tallest plant, the highest values of stem girth and the shortest period to maturity in the two successive seasons. "Zahrt Elnile" variety produced the highest number of fruits/ plant, the total yield (ton/ha), total marketable yield, the maximum fruit weight and the highest fruit length values in

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the two seasons. The highest values of fruit diameter obtained with Zahrt Elnile variety and Darmali variety in the first and second season, respectively. No significant differences in the total soluble solids content and total acidity were recorded among the varieties. The recently released tomato varieties were found to be superior as compared to commercial tomato varieties in all parameters tested in the two seasons.

Keywords: Evaluation; tomato; varieties; growth, yield; quality; Sudan.

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the very popular vegetables that widely used worldwide, belongs to the family "Solanaceae" [1]. It is one of the most widely grown vegetables in the world comes second only to potato [2]. Tomato world production in 2010 was around 146 million tons [3]. It is economically attractive and the area under cultivation is increasing daily all over the world because of it is a relatively short duration crop and gives high yield [4].

In Sudan, tomato is grown all around the country as a winter crop in a wide range of soil and as an off-season crop during summer and autumn [5]. It is the second most important vegetable after onion [6]. It occupies about 28% of the total area under vegetables production [7]. The annual production of tomato in Sudan is 423.000 tonnes [8].

Tomato yield depends on many factors such as the variety. Plant breeders have produced hundreds of tomato varieties to suit every climate, garden site and taste. Different varieties produce fruit that vary in size from small marbles to giant grapefruits [9]. Variety selection is one of the vital decisions for economical production and introduction of superior varieties for each location is very significant because can save costs and avoid from wasting of soil and water resources [10]. Agricultural Research Corporation (ARC) in Sudan has released many of the tomato varieties such as Zahrt Elnile and Darmali. No research has been done to evaluate performance of different tomato varieties under Ed Duiem locality conditions. Therefore, this study was aimed to evaluate performance four tomato varieties under Ed Duiem locality conditions.

2. MATERIALS AND METHODS

2.1 Location

Field experiments were conducted during the winter seasons of 2013/14 and 2014/15 at the experimental farm, Faculty of Agriculture and Natural Resources, University of Bahkt Alruda,

Ed Duiem, Sudan (longitude 32° 20 ' E and latitude 13° 39 ' N).

2.2 Seed Material

Seeds of Zahrt Elnile and Darmali varieties were collected from the Arab Sudanese seed Company (ASSCO), while Castle Rock and Strain B varieties were collected from local market.

2.3 Sowing

The area allotted for the experiment was disc ploughed, harrowed, leveled and made into ridges meter apart. The seeds were sowing manually in two sides of ridge in 3 – 2 cm deep holes. Spacing between holes was 30 cm .sowing was done at the rate of 5 seeds / hole. The sowing times were the 22 of September and 5th of November for winter seasons 2013/ 2014 and 2014/ 2014, respectively. Recommended agronomic Practices such as weeding, cultivation, irrigation, fertilizer application and disease management were carried out uniformly during the growing season for all plots.

2.4 Experimental Design

The experiment was laid out in randomized complete block design (RCBD) with three replications.

2.5 Data Collection

Five plants were randomly selected from each plot for data collection. Data collected were plant height, number of leaves, stem girth, number of branches, days to maturity, number of fruits/ plant, fruit length, fruit diameter, individual fruit weight, fruit yield (T/ha), total acidity and total soluble solid (TSS) content.

2.6 Statistical Analysis

Data were subjected to analysis of variance using SAS Statistical Analysis System. Means were separated using Duncan's multiple Range Test (DMRT) at the 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Vegetative Growth

Varietal responses of tomato to vegetative growth during season 2013/ 2014 and 2014/ 2015 are shown in Table 1 and 2, respectively. Varieties showed significant differences in all vegetative growth parameters during season 2013/ 2014 and number of leaves, number of primary branches and plant height during season 2014/ 2015.

Maximum number of leaves was obtained with Darmali variety in the two seasons. This finding is similar to that shown by Biswas et al. [11] who reported that number of leaves/plant on tomato varied significantly among the varieties. The highest values of number of branches were obtained with Zahrt Elnile (9.67) in the first season and Darmalmi (8.53) in the second season. This result was in conformity with the results reported by Sharma and Rastogi [12] who reported that the number of branches/plant varied significantly among tomato varieties.

The tallest plant was obtained with Darmali variety in the two seasons. Plant height varied among the varieties of tomato due to the variation of varieties Olaniyi et al. [13]. Darmali variety also showed the highest values of stem girth in the two successive seasons. This is consistent with the finding of Sajjan et al. [14] who reported that genetic constitution of crop varieties influences growth characters that they express.

3.2 Yield and Yield Components

Varietal responses of tomato to yield and yield components during season 2013/ 2014 and 2014/2105 are shown in Table 3 and 4, respectively.

Number of days from flowering to maturity values ranged from 47 - 60 days in the two seasons. Castle Rock took the longest period to maturity while Darmali took the shortest period to maturity. These findings are similar to those found by Dufera [15] who reported wide range of difference in maturity (73-93 days) for 21 tomato genotypes.

The highest number of fruits/plant was produced by Zahrt Elnile variety. This is in harmony with the findings of Enujeke and Emuh [16] who reported significant differences in number of fruits/ plant among five tomato varieties.

The total yield (ton/ha) and total marketable yield were obtained with Zahrt Elnile variety in the two seasons. The highest total yield obtained from Zahrt Elnile over other varieties investigated may be attributed to the possibility of possession of higher stomatal conductance, better partitioning of photosynthetic materials towards economic yield, better genetic structure and higher potential to transport photosynthetic materials within plants Enujeke and Emuh, 2015 [16]. Varietal influence on the yield of fruit per hectare was also, reported by Ahmed et al. [17].

Table 1. Varietal responses of tomato to vegetative growth during season 2013/ 2014

Varieties	No of leaves	No of primary branches	Plant height (cm)	Stem girth (cm)
Zahrt Elnile	31.19a	9.67a	91.4a	1.50a
Darmali	33.18a	9.33a	95.1a	1.80a
Castle Rock	21.45b	3.86b	49.50b	1b
Strain B	21.36b	4.20b	49.36a	1.2b
CV %	9.26	27.02	5.66	22.09

Means within columns followed by the same letter(s) are not significantly different at $P < 0.05$ level according to Duncan's Multiple Range Test

Table 2. Varietal responses of tomato to vegetative growth during season 2014/ 2015

Varieties	No of leaves	No of primary branches	plant height (cm)	Stem girth (cm)
Zahrt Elnile	30.27a	8.13a	86.4a	1
Darmali	32.27a	8.53a	87.4a	1.2
Castle Rock	22.63b	3.86b	41.77c	0.8
Strain B	22.30b	4.2b	45.23b	0.9
CV%	7.36	5.56	2.45	5.13

Means within columns followed by the same letter(s) are not significantly different at $P < 0.05$ level according to Duncan's Multiple Range Test

3.3 Fruit Quality Parameters

Varietal responses of tomato to fruit quality parameters during season 2013/2014 and 2014/2015 are shown in Table 5 and 6, respectively.

Fruit weight results indicated significant differences among the varieties. Zahrt Elnile recorded maximum fruit weight in the two seasons. The differences observed among the varieties in fruit weight could be attributable to the genetic makeup of the individual variety and adaptability to the environment under study Dunsin et al. [18]; similarly Hussain et al. [19] reported a wide variation in fruit weight for 11 tomato genotypes.

There were significant differences in fruit length among varieties in two seasons. The highest fruit length values were obtained with

Zahrt Elnile variety (6.20 and 5.23 cm in the first and second season, respectively). These results get support from the previous findings of Rehman et al. [20] who found variation in different tomato varieties for fruit length as maximum fruit length was observed in Tanja (6.90 cm).

Fruit diameter showed significant differences in the first season while in the second season it was not significant. The highest value of fruit diameter obtained with Zahrt Elnile variety (5.60 cm) and Darmali variety (4.74 cm) in the first and second season, respectively. Similarly, Hamid et al. [21] reported that maximum fruit diameter in tomato cultivar Raickoi Naclazdenie.

No significant differences in the total soluble solids content were found among the varieties. Maximum TSS content was found from Darmali variety (4.76%) while minimum from Strain B

Table 3. Varietal responses of tomato to yield and yield components during season 2013/ 2014

Cultivars	No of days from flowering to maturity	No of fruits/ plant	Total yield ton / ha	Marketable yield ton / ha
Zahrt Elnile	57.00a	18.93a	60.38a	50.67a
Darmali	49b	18.33a	54.69. b	48.80a
Castle Rock	60.00a	7.63b	15.62c	10.80b
Strain B	58.00a	6.80b	14.61c	9.40b
C.V%	4.79	10.41	16.11	15.42

Means within columns followed by the same letter(s) are not significantly different at $P < 0.05$ level according to Duncan's Multiple Range Test

Table 4. Varietal responses of tomato to yield and yield components during season during season 2014/ 2015

Cultivars	No of days from flowering to maturity	No of fruits/ plant	Total yield ton/ ha	Marketable yield ton/ ha
Zahrt Elnile	47.33c	15.96a	46.34a	29.90a
Darmali	47c	15.27a	44.53a	27.73a
Castle Rock	57.67a	6.23b	11.64b	5.17b
Strain B	51.33b	5.77b	11.63b	6.73b
C.V%	4.50	4.41	8.44	9.75

Means within columns followed by the same letter(s) are not significantly different at $P < 0.05$ level according to Duncan's Multiple Range Test

Table 5. Varietal responses of tomato to fruit quality parameters during season 2013/ 2014

Cultivars	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	TSS (%)	Total acidity (%)
Zahrt Elnile	53.16a	6.20a	5.60a	4.67	4.77
Darmali	49.73a	6.9a	5.23a	4.76	4.37
Castle Rock	37.20b	3.70b	4.10b	4.72	4.23
Strain B	35.80b	3.33b	3.90b	4.70	4.30
CV %	9.24	23.80	13.91	1.97	2.59

Means within columns followed by the same letter(s) are not significantly different at $P < 0.05$ level according to Duncan's Multiple Range Test

Table 6. Varietal responses of tomato to fruit quality parameters during season 2014/ 2015

Varieties	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	TSS (%)	Total acidity (%)
Zahrt Elnile	48.60a	5.23a	4.33a	4.65	4.67
Darmali	48.40a	5a	4.47a	4.76	4.57
Castle Rock	30.67b	3.7b	3.60a	4.70	4.33
Strain B	33.10b	4.03b	3.70a	4.30	4.30
CV%	8.98	3.52	7.23	4.71	3.59

Means within columns followed by the same letter(s) are not significantly different at $P < 0.05$ level according to Duncan's Multiple Range Test

variety (4.30%). This result was similar with that found by Biswas et al. [11] who reported that there were no significant differences in total soluble solids content among four tomato varieties.

Titrateable acidity is used as acidity indicator in tomato. In this study although, there were no significant differences in titrateable acidity but Zahrt Elnile showed the highest values in the two seasons.

4. CONCLUSION

Results of this study revealed that vegetative growth, Yield and yield components and fruit quality parameters were significantly different among the evaluated tomato varieties. Accordingly, the recently released tomato varieties were found to be superior as compared to commercial tomato varieties in all parameters tested in the two seasons. Based on these findings, farmers can grow Zahrt Elnile and Darmali varieties for increasing growth and yield of tomato in ED Dueim, White Nile State, Sudan.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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