

Yield Performance of Improved Tomato (*Lycopersicon esculentum* Mill.) Varieties at West Shoa Zone, Ethiopia

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Abstract: Tomato (*Lycopersicon esculentum* Mill.) belongs to the family Solanaceae and is one of the most popular, important edible and nutritious vegetable crops in the world. Most parts of the world produce and consume tomato from the home gardens and greenhouse to the larger commercial farms as it is able to various agro ecological conditions. The promising growth performance and high yield of tomato depends on the selection of appropriate varieties for a particular location. A field experiment with the objective of evaluating the adaptability and yield performance of improved tomato varieties was conducted at Ambo and Toke kutaye districts of west Shoa zone during 2017 and 2018 growing seasons. Six tomato varieties namely Cochoro, Fetan, Chali, Melka shola, ARP tomato d2 and Melka salsa were evaluated for adaptability and yield performance. Data were recorded on growth and yield contributing parameters like plant height, canopy diameter, and primary branches plant⁻¹, number of cluster plant⁻¹, number of fruits cluster⁻¹, unmarketable and marketable yield. The study showed that there was difference in growth and yield of tomato among different varieties while non-significant result was observed between the two locations. After two years evaluation, the longest plant height (50.7cm), number of primary branches (10.84), number of cluster plant⁻¹ (17.92), number of fruit cluster⁻¹ (32.6), and marketable yield (27.12 ton ha⁻¹) were recorded in tomato variety ARP tomato d2 at Ambo and Toke Kutayedistricts. Therefore, variety ARP tomato d2 is promising variety in providing high yield for the test sites.

Keywords: Adaptation, Tomato, Variety, Yield Performance

1. Introduction

Tomato (*Lycopersicon esculentum* Mill.) belongs to the family Solanaceae and is one of the most popular, important edible and nutritious vegetable crops in the world [1]. The Central and South America are believed to be the origin of the crop. It became distributed to Europe and Asia in the early and mid-1960s. The crop spread via traders to Egypt, Sudan, South Africa, West Africa and to the rest of the world [2]. Like other vegetable crops, tomato is vital sources of carbohydrates, minerals, sugars, amino acids, vitamins (especially vitamin B and C), Phosphorus and dietary fibers [3]. Most parts of the world produce and consume tomato from the home gardens and greenhouse to the larger

commercial farms as it is able to various agro ecological conditions [4]. With respect to world vegetables production, tomato ranks third next to potato and sweet potato [5]. China is the world's leading producer of tomato with the annual production of more than 30 million tons and followed by United States, India, Turkey, Egypt, and Italy, respectively [6].

In Ethiopia tomato can be consumed in raw, ingredient in many dishes, salads, sauces and drinks. It is an important ingredient of diet for the majority of people in almost every household. It is also among the most economically important vegetable crop [7]. The total production and productivity in Ethiopia however is far below than the world and major African producers. The area coverage by tomato in 2015 was

around 5000 ha with the production of 40 tones and productivity of 6 ton ha⁻¹ that is far below average world production and productivity [8]. Tomato is widely grown vegetable crop in Ethiopia. The total production of tomato in the Ethiopia has shown a marked increase recently, indicating that it became the most profitable crop providing a higher income to small-scale farmers compared to other vegetable beside the low production and productivity [9].

Tomato is an annual plant which can grow to up to more than two meter in which the first harvest can possible after one month and half of flowering or three to four month after sowing [10]. Though adapted to wider agro eco climate conditions, tomato prefer temperature of 20 – 27°C for better fruit setting and yield and when the temperature go more than 30°C or fall below 10°C fruit setting is very poor [11]. Likewise, researches in the early study stated, deep well drained sandy loam soil with the pH of 6-7 is better for production of Tomato [12]. Currently there are progresses in increasing tomato production at global level. However, around half of majority of developing countries like Ethiopia does not have an access to adequate tomato supplies. Among many different contributing factors for the low yield and poor quality tomato product, lack of improved variety that is adapted to growing condition and poor management practices [13].

The success of vegetables production in general and tomato in particular is mainly dependent up on the selection of appropriate varieties for a particular location. In the last few decades several high yielding varieties and hybrids have been developed and recommended by different Agricultural research centers in Ethiopia. However, the yield potential, Productivity and quality need to be tested under various agro ecology and climatic conditions. Therefore, the objective of this study was to evaluate improved tomato varieties for their adaptability and yield performance in Ambo and Toke Kutaye districts, west Shoa zone, Oromia regional state.

2. Materials and Methods

2.1. Study Area

The current field experiment was conducted at two locations of west Shoa zones; Ambo and Toke Kutaye districts for two consecutive years. The experiment was carried out during 2017 and 2018 years in the dry season using furrows irrigation method. Ambo is located at latitude of 8°59'N and longitude 37°51'E. and an elevation of 2101 m.a.s.l. and Toke Kutaye is located at the altitude of between 1900 and 3100 m.a.s.l, with 8°58' to 8.97°N latitude and 37°46'to 38°E longitude The two areas receive heavy rain from onset of July to the end of August. The annual rainfall ranges from 1000 -1588.06 mm and the temperature of the district ranged between 9.44°C and 21.86°C with average of 15.65°C. The physical and chemical properties soil in the study area is characterized as vertisols with light red in color, clay loam in texture and pH value of 6.8 [14, 15].

2.2. Methodology

Nationally released six improved tomato varieties namely, Cochoro, Fetan, Chali, Melka shola, ARP Tomato d2 and Melka salsa were obtained from Melkassa Agriculture research center were used for both Ambo and Toke Kutaye field experiment. The descriptions of these varieties were presented in table 1. In both experimental locations, the treatments were arranged in a Randomized Complete Block Design (RCBD) with four replications. Seedlings were raised in nursery beds and the undamaged and uniform medium-sized seedlings were carefully transplanted after 6 weeks to the experimental plots of 2m x 3m dimensions at a spacing of 70 cm x 30 cm between rows and plants, respectively. The spacing between two plots in each replication and between adjacent blocks was 0.5m x 1m, respectively. All agronomic managements were practiced following the recommendation [2].

Table 1. Description of Tomato Varieties Used For the Experiment.

Variety	Growth habit	Maturity days	Fruit shape	Average fruit weight (gm)	Average yield (q/ha)	year of release	Purpose
ARP Tomato d2	Determinate	75-80	Cylindrical	-----	395	2012	fresh market
Fetan	Determinate	75-80	Cylindrical	110-120	454	2005	fresh market
Chali	Determinate	85-100	Square	80-90	430	2007	Processing & fresh market
Cochoro	Determinate	85-90	Square	70-80	463	2007	Processing & fresh market
Melka Shola	Determinate	100-120	Cylindrical	70-80	430	1998	Processing & fresh market
Melka Salsa	Determinate	100-110	Pear	40-50	150	1998	Processing & fresh market

Source: [16].

2.3. Data Collection

Six randomly selected plants were used from the central three rows for all treatment prior to flowering to record quantitative data measurements such as: plant height (cm), number of primary branches (No.), number of fruit cluster per plant (No.), number of fruit per cluster (No.), marketable yield and unmarketable yield (g plot-1, then later converted to ton per hectare).

2.4. Data Analysis

The data recorded were subjected to analysis of variance (ANOVA) using SAS statistical software. The significant difference between the means was tested using LSD at 5% level of significance. T-test was used to compare the yields of the crops on the two locations.

3. Result and Discussion

3.1. Growth Parameters

3.1.1. Plant Height

There was no significance difference between the two growing locations in plant height. ARP tomato d2 was the tallest variety followed by Fetan. Both varieties were however statistically similar in their plant height. On the other hand Melka salsa was found to be the shortest variety among the six tested varieties. The mean value of plant height ranges between 31.79 cm and 50.70 cm (Figure 1). These results coincide with the findings of different researchers, who

reported differences in plant height among cultivars/hybrids of tomato put under evaluation and screening trials [17, 18]. The tallness, shortness and other morphological differences are varietal characteristics, which are controlled and expressed by certain genes. Similarly in line with the observations of earlier finding who found that the heights of tomato plants vary from Variety to variety [1]. The tallest tomato varieties usually require longer duration of growth period and special management practices such as staking. On the other hand the short varieties may not need staking and their production may require less labor expense that makes them highly popular for commercial cultivation in tropical conditions [19].

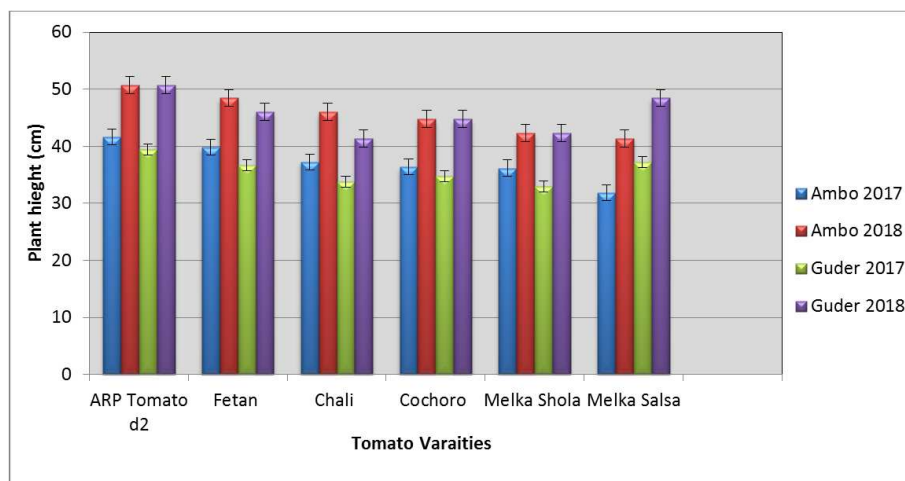


Figure 1. Response of varieties on plant height over the two years in Ambo and Toke Kutaye, West Shoa, Ethiopia. Error bars indicate mean \pm standard error (SE).

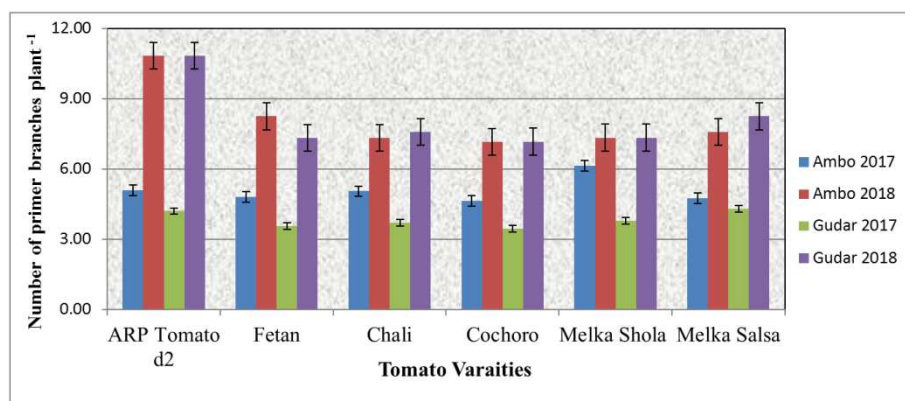


Figure 2. Number of primer branches per plant as affected by different varieties. Error bars indicate mean \pm SE.

3.1.2. Number of Primary Branches

The number of primary branches per plant was counted because is an important parameter which indicates the yielding capacity of tomato variety. As result the highest number of primary branches per plant (10.84) was recorded for variety ARP tomato d2. The least number of primary branches numbers (3.45) was recorded for variety Cochoro (Figure 2). There was significance difference ($p < 0.05$) in primary branches number per plant among tomato varieties and growing seasons, while there was no significance difference between the two experimental sites. The highest primary branch number for all varieties recorded in the

second growing year. The variation in branches number per season may be related to the optimum weather conditions recorded in the second growing year. The results of this study agree with the findings of previous study, who reported that there is considerable difference in number of branches among tomato cultivars and an increasing trend in the number of primer branches with an increase in plant height [20]. Furthermore the results are in line with the observations of early studies who reported the primary branches of tomato ranges from 3.1 to 12.6 per plant [21]. On the other hand, varieties with highest number of primary braches in this study gave highest yield for ARP tomato d2 Variety which is

probably associated with the increased number of branches will results more number of fruit setting.

3.2. Yield and Yield Related Traits

3.2.1. Number of Clusters per Plant

The result of the current study showed that number of fruit cluster per plant significantly ($p < 0.05$) differed among tomato varieties. On the other hand, there was no significance difference in tomato fruit cluster per plant between the two growing places. There was also no significant difference between varieties in fruit cluster per plant in the first and second growing season (Table 2). At the two growing condition and growing season, variety ARP tomato d2 showed the largest number of cluster per plant among tested tomato varieties. Variety ARP Tomato d2 produced the highest (17.92) followed by variety Melka salsa (14.58) while the lowest fruit cluster (7.88) was produced by variety Melka shola (Table 2). As the number of cluster per plant is one of the indicators for number of fruit per plant, it is an important criterion to select promising variety for the yield. In the current study, the

number of cluster per plant directly proportional with plant height and primary branches per plant. Therefore, the highest number of cluster produced by ARP tomato d2 may be due to vigorous growth habit that will be related to genetic variability among tomato varieties. The current result is in line with the finding of previous researcher who evaluated eleven tomato varieties for their adaptability and found different number of fruit cluster per plant among tomato varieties [22]. Similar result was also observed, while studying yield and fruit qualities of tomato varieties and got significantly different fruit cluster per plant among tomato varieties [13].

The highest number of fruit cluster⁻¹ (32.60) and (10.25) followed by (27.70) and (10.25) presented in Table 2 were recorded in tomato variety ARP tomato d2 and melka salsa at Ambo and Toke kutaye respectively in the first growing conditions. The results are in accordance with early findings in which eleven tomato varieties tested for their adaptability and got variation in fruit cluster⁻¹ among varieties [22]. Likewise another study also found variation in number of fruit⁻¹ among different tomato varieties [23].

Table 2. Average number of cluster per plant and number of fruit per cluster of tomato varieties under Ambo and TokeKutaye Districts during thetwo growing seasons.

Varieties	Number of Fruits Cluster ⁻¹				Number of Clusters Plant ⁻¹			
	Ambo		Toke Kutaye		Ambo		Toke Kutaye	
	2017	218	2017	2018	2017	2018	2017	2018
ARP Tomato d2	32.60 ^a	4.50 ^a	0.25 ^a	4.50 ^a	16.70 ^a	17.92 ^a	13.25 ^{ab}	17.92 ^a
Fetan	12.87 ^b	4.58 ^a	7.25 ^{bc}	2.75 ^b	8.49 ^c	14.58 ^{ab}	7.00 ^c	8.42 ^c
Chali	13.85 ^b	2.75 ^b	8.75 ^{ab}	2.95 ^b	8.58 ^c	8.42 ^c	8.75 ^c	11.58 ^{bc}
Cochoro	13.61 ^b	3.25 ^b	6.75 ^c	3.25 ^b	9.92 ^{bc}	8.25 ^c	9.50 ^{bc}	8.25 ^c
Melka Shola	12.65 ^b	3.06 ^b	7.50 ^{bc}	3.06 ^b	7.88 ^c	8.50 ^c	8.75 ^c	8.50 ^c
Melka Salsa	27.70 ^a	2.94 ^b	10.2 ^{5a}	4.58 ^a	13.46 ^{ab}	11.58 ^{bc}	15.25 ^a	14.58 ^{ab}
LSD (5%)	8.76	0.99	1.85	1	4.19	3.74	4.06	3.74
CV (%)	14.52	19.24	14.52	19.24	25.85	21.93	25.86	21.94

The means followed by the same letter within the same column are not significantly different at 5% level of significance

3.2.2. Marketable and Unmarketable Yield

Tomato varieties showed significant variation ($p < 0.05$) in the average marketable yield at both sites (Table 3). However, there were no significant differences between yields from different sites. The higher yields were recorded in the second growing season at both experimental sites that will be attributed by plant height number of cluster per plant and fruit cluster⁻¹. The highest marketable yield (27.12 ton ha⁻¹) was recorded in tomato variety ARP tomato d2 at Ambo

during the second growing season while the same variety produced (22.88 ton ha⁻¹) at Toke kutaye site in the second growing season (Table 3). There was no significant difference between the two sites in the marketable yields. Similar result was obtained, by studying yield and fruit qualities of tomato varieties and got significantly different yield among different tomato varieties [13]. The early studies also found different tomato yield among different varieties in studying the adaptability of tomato varieties [22].

Table 3. Average value of Marketable and unmarketable yield of Tomato varieties under two growing condition in the two growing seasons.

Varieties	Unmarketable Yield plot ha ⁻¹				Marketable Yield toneha ⁻¹			
	Ambo		Toke Kutaye		Ambo		Toke Kutaye	
	2017	2018	2017	2018	2017	2018	2017	2018
ARP Tomato d2	27.58 ^a	11.42 ^b	33.33 ^{ab}	11.42 ^b	13.58 ^a	27.12 ^a	7.08 ^a	22.88 ^a
Fetan	19.37 ^a	16.12 ^{ab}	30.00 ^{ab}	20.22 ^{ab}	3.95 ^b	15.00 ^c	2.83 ^b	15.8b ^c
Chali	16.25 ^a	20.20 ^{ab}	21.25 ^b	11.97 ^{ab}	7.12 ^b	21.50 ^b	3.38 ^b	12.12 ^c
Cochoro	19.50 ^a	17.17 ^{ab}	22.08 ^{ab}	17.17 ^{ab}	4.28 ^b	21.07 ^b	1.68 ^b	12.28 ^c
Melka Shola	17.97 ^a	20.70 ^a	25.00 ^{ab}	20.72 ^a	4.83 ^b	14.50 ^c	2.97 ^b	12.8b ^c
Melka Salsa	18.33 ^a	11.95 ^{ab}	39.58 ^a	16.13 ^{ab}	7.20 ^b	15.05 ^c	6.38 ^a	16.3 ^{bc}
LSD (5%)	8.62	5.31	10.52	5.31	2.57	3.29	1.59	3.57
CV (%)	40.74	35.78	40.74	35.79	43.40	25.31	43.39	25.32

The means followed by the same letter within the same column are not significantly different at 5% level of significance.

4. Conclusion and Recommendation

Tomato is one of the most popular, important edible and nutritious vegetable crops in the world. Like in most parts of the world it is produced and consumed in Ethiopia. The current study was conducted to evaluate the performance of improved tomato varieties for their adaptability and yield potential in Ambo and Toke Kutaye districts of west Shoa zone, Oromia regional state, Ethiopia. From the current study it is concluded that tomato variety ARP tomato d2 performed better in growth and yield at both experimental sites among tested varieties. There was no difference in yield between two growing sites, which may be attributed by proximity of the two sites. Therefore, variety ARP tomato d2 is promising variety is providing high yield for the test sites.

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Conflict of Interests

All authors do not have any possible conflicts of interest.

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