



Evaluation of Vegetative and Yield Performance of Tomato (*Lycopersicon esculentum* Mill.) Varieties at Abol District, Gambella Region

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Authors' contributions

This work was carried out in collaboration between both authors. Author MY designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author NA managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Tomato (*Lycopersicon esculentum* Mill.) is major fruity vegetables grown in Ethiopia next to hot pepper. Although crops grown in the country its production and productivity is very low compared to the world average. Among the reasons for low its production and productivity, shortage of improved tomato varieties is the major one. This experiment was done with the aim of evaluating tomato varieties and select high yielding cultivars. An experiment was conducted in bonga district Gambella region 2011/12 dry season under irrigated condition. Seven tomato varieties namely ARP Tomato D2, Fetan, Melkasalsa, Chali, Bishola, Gelila and Roma-VF(as local check) and were tested in randomized complete block design with 3 replications. The mean values of all parameters were subjected to two way analysis of variance using the Proc GLM procedure of SAS 9.3. Then statistical significance of the mean of each parameter was determined using F-test and Duncan multiple range test procedure was used to compare differences between treatment

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means at 5% probability level. The analysis of variance showed statistically significant differences ($p < 0.05$) among varieties in all growth and yield parameters except days to 50% flowering. Among the tested tomato cultivars, Melkasalsa produced the largest fruit. The highest fruit yield was recorded by Melkasalsa followed by Bishola. we can conclude Melkasalsa and Bishola variety were the most productive and gave larger fruit compared to others. Hence, these varieties can be used by tomato growers under irrigated condition around Bonga area.

Keywords: Tomato; varieties; growth parameter; yield component.

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is the most widely eaten vegetable in the world and ranks first as a processing vegetable [1]. It is world's second most important vegetable after potato in terms of production [2]. It is among the most important vegetables in Asia and Africa and these constituents account for more than 65% of global tomato production. Nutritionally this crop constitutes nutrients such as vitamins, minerals, and antioxidants, which are provide to balanced human diet [3]. China was the largest producer in 2017, accounting for nearly 33% followed by US America and India of global production. Next to Egypt in the whole Africa Nigeria is the largest producer of tomatoes in sub-Saharan Africa with an annual yield of 1.8 million metric ton [4].

It is not well known when tomato was first introduced in Ethiopia; however, the crop is cultivated in different major growing areas of the country. It is the 3rd most important vegetable grown in the country, next to hot pepper and Ethiopian cabbage. It covers about 7,256 hectares of land with total production of 0.82 million quintals per year [5]. Currently tomato is one of the major regional income generating vegetables of the country. The crop is produced in the range of 700 up to 2200 meter above sea level, with about 700 to over 1400 mm annual rain fall, in different areas and seasons, in different soils, under different weather conditions, but also at different levels of technology and yields [6]. The major tomato producing regions of Ethiopia are Oromia, Amhara, Tigray and S.N.N.P. The crop is cultivated under irrigation largely in the rift valley area of Awash. The crop is also produced in rain-fed condition in some regions of the country [4]. Tomato is also one of the important vegetable crop provides employment opportunity in the production and processing industries of the country.

According to CSA [7] report, the area coverage in tomato during meher season is around 4,322.31 with total production of 235,837.51millionquintal

where Oromia region being the highest in area coverage followed by S.N.N.P., Amhara and Tigray regions. Gambella region is now a day shown as a potential area for tomato production with its favorable agro ecology as well as ample amount of irrigable lands and water resources.

Tomato production is highly inhibited by several different factors especially in third world country like Ethiopia. The lack of varieties and recommended information packages, poor irrigation systems, lack of information on soil fertility, diseases and insect pests, high postharvest loss, lack of awareness of existing improved technology and poor marketing system are the major constraints in Ethiopian tomato production system [8].

Melkasa Agriculture research center is one center of excellence in conducting different researches on vegetable crops and the leading research center in developing different varieties of tomato which is national recommended In Ethiopia, some tomato varieties had been released nationally and recommended for commercial production and small scale farming systems. Varieties such as 'Melkashola', 'Marglobe', 'Melkasalsa', 'Fetane', 'Bishola', 'Eshete' and 'Matedel' cochoro are some of varieties released by the research center [9].

Although Gambella region has unexploited potential for tomato production, the production and productivity of the crop in the region is very low as compared to other region of Ethiopia. All above mentioned problems accounted for the low mean yield of Tomato in Gambella. Even though, a number of experiments had been conducted on tomato in different places in Ethiopia, there is a large gap in this region. Farmers are using for long time local variety as well as varieties from unknown source which is low yielder, and susceptible to different diseases and pests. Therefore to tackle such challenges researchers should contribute a lot. Therefore, the objective of this study was to evaluate the performance of

tomato varieties under irrigation and recommend the best performed variety for production in the studied areas and similar agrological zones.

2. METHODOLOGY

2.1 Description of the Area

Field experiment was conducted during 2012 off season under irrigation conditions at Abol district of Gambella region. Gambella is located 776 Km away to west of the capital Addis Abeba. Annual mean minimum and maximum temperatures in Gambella are 25°C and 42°C, respectively. Mean annual rainfall of the area varies from 800 mm to 1500 mm with a long-term average of 1400 mm. The site is located at an altitude of 526 m.a.s.l. Most of the soils of the region are fluvisols (alluvial soil type) which have pH of 6.1 and it is slightly acidic.

2.2 Experimental Treatment and Design

The experiment used seven tomato varieties both determinate and indeterminate types, Bishola, Fetan, Melkasalsa, Chali, Galilia and Arp tomato d2) and one local variety ('Roma VF'). The seeds of all the varieties were obtained from the germplasm collections maintained at Melkasa Agricultural Research Center (MARC).

Seedlings of each variety were raised on seed bed with the size of 1m x 5m. Uniform and vigorous seedlings of each variety were selected and transplanted to well-prepared field on plot size of 5 m x 3 m (15 m²), with 100 cm and 30 cm spacing between rows and plants respectively (Tesfaye, 2008). The total experimental area was 408 m² (17 m X 24 m).

The treatments were laid down in Randomized Completed Block Design (RCBD) with three replications. The middle three rows were used for data recorded leaving the two rows as borders. The 200 kg ha⁻¹ DAP and 100 kg ha⁻¹ Urea were applied at time of sowing and two weeks after transplanting as of recommended for the crop (Desalegne, 2002). Disease was managed by application of recommended fungicides (Ridomil at m/z 63%) at a rate of 3.5 kg ha⁻¹ in seven days intervals. All agronomic practices (irrigation, cultivation, weeding and stacking) were applied uniformly for all plots.

Field data were recorded for this experiment on growth and yield components parameters. Growth data were Days to 50% flowering, Plant

height (cm) and Number of Primary branch, Where as yield data were Number of fruit clustered per plant and Number of fruit per cluster, Fruit weight/plant (gram), Fruit diameter (cm), Total Fruit yield (ton/ha).

2.3 Data Analysis

Analysis of variance (ANOVA) was done using Proc GLM procedures of SAS version 9.3, (SAS 2008). The difference between treatments means were compared using Tukey's test at 5% probability level.

3. RESULTS AND DISCUSSION

3.1 Growth parameters

Analysis of variance revealed that all growth parameters is highly significant difference ($P < .01$) among the tested tomato varieties except for days to 50% flowering (Table 1). The lowest days to reach to 50% flowering were recorded for ARP tomato D2 (29 days) the relative longest day is recorded for variety Fetan (36.7), ROMA VF (Local 35.3) and Gelila (35 days). This result agreement was reported by Aleminew and Tibebe [10] research conducted in Sekota, North Eastern Ethiopia. The same result was also reported by Regassa et al. [11] Borana zone, Yabello district, southern Ethiopia. However, this result contradicts with the work of other researcher's findings on evaluation of different tomato varieties by Meseret et al. [12], Anwar et al. [13].

There was also highly significance difference ($P > .01$) among varieties tested in their number of primary branch they have. It was ranged from 3 to 9 branch. The variety with the highest number of primary branches was Melkasalsa (9) followed by bisholan (7). The results are in line with Iqbal et al. [14], Meseret et al. [15], Anwar et al. [13], Fayaz et al. [16], Davis et al. [17] reported that number of branches was varied among different cultivars.

Table 1 indicated that number of fruit cluster per plant and Number of fruit per cluster show significance difference ($P = .05$) among the evaluated varieties. Melkasalsa was cultivar with the highest record for both parameters 16.7 and 5.6 respectively. Variety ROMA VF (Local 4) and Gelila (4) were the lowest. This result was found in agreement with similar research done by Shushay and haile [18] in western lowlands of Tigray.

Table 1. Response of Varieties to Growth parameters

Trt (Variety)	50% FLW	NBR	FRCL/P	FR/CL	PH
ROMA VF (Local)	35.3ab	4.3cb	11.7cd	4.b	71.7c
Melkasalsa	33.3abc	9a	16.7bcd	5.6a	109.3a
ARP tomato D2	29c	4.7b	13d	4b	75.3 ^c
Fetan	36.7a	3c	8.7cd	4b	54d
Chali	30.3bc	3.3bc	11.7cd	3.7b	71.7c
Bishola	30.3cb	7.7a	20a	5.3b	89b
Gelila	35.0ba	4b	13.7bc	4.b	76.c
LSD	NS	1.5***	4.4**	1.2**	12.9***
CV (5%)	9.7	16.9	12.5	21.6	8.9

50% FLW: days to 50% flowering NBR: Number of Branches plant-1, FRCL/P: fruit Clusters/plant, FR/CL: Fruits/Cluster, PH: Plant height (cm). Means followed by same letters in a column are not significantly different at $P=0.05$. *Significant at ($P=0.05$), ***Significant at ($P < 0.001$)

Table 2. Response of varieties to yield components

Trt (Variety)	FD	FRW/plant	Yield (t/ha)
Roma VF (Local)	3.2b	423cd	13.4c
Melkasalsa	7.3a	902a	30.0a
ARP tomato D2	7.2a	519.0b	17.3b
Fetan	3.9b	442c	13.7c
Chali	3.4b	353d	11.8c
Bishola	6.2a	878.0a	29.3a
Gelila	3.2	490.0cb	16.3b
LSD	2.0***	69.09***	1.968***
CV (5%)	23.9	6.92	5.96

Means followed by same letters in a column are not significantly different at $p < 0.05$. *Significant at ($p < 0.05$), ***Significant at ($p < 0.001$). FD: Fruit diameter, FRW/Plant: fruit weight per plant and Yield(t/ha): Yield per hectare 11.8 t/ha respectively)

Plant height was another growth parameter in this study shows highly significant differences between the varieties. The tallest plants were recorded by Melkasalsa (109.3 cm) and Bishola (89 cm) which were statistically different from one another, followed by Gelila and ARP tomato D2 varieties. While the shortest plants were Fetan (54 cm). Hussain et al. [19] reported wide range of difference (61.6- 126.5 cm) in plant height among the 10 tomato genotypes evaluated in Pakistan. Similarly, Dufera [20] obtained wide difference (51.5-129.7 cm) for plant height in tomato. Shushay and Haile [18] also obtained wide difference (62.1-105.3 cm) among the nine tomato varieties evaluated in western lowland of Tigray, Northern Ethiopia.

3.2 Yield Parameters

Data in Table 2 shown that there was highly significance difference among varieties in their yield and yield parameters recorded during the experiments. Variety Melkasalsa was the higher record in its fruit diameter (7.3 cm), fruit weight per plant (902 g) and total yield per hectare

(30.0t/ha). Variety Bishola was the second largest record in it fruit weight per plant (878 g) and yield per hectare (29.3 t/ha). The least record was obtained from variety Chali (fruit diameter 3.4 cm, fruit weight per plant 353 g and yield per hectare 11.8 t/ha respectively).

This result was in accordance with the findings of Shiberu [21], who reported that Melkasalsa and Melkashola varieties have higher number of fruit/plant.

Similar findings of variation in the number of fruits/plant had been reported 12, 11, 10. However, the findings of Regassa et al. [11] did not show statistical variation in number of fruits/plant. Tomato cultivars showed difference in fruit weight and this result was in line with the findings of Regassan et al. [11], who reported statistical difference in fruit weight. The study revealed that existence in variation of fruit yield among tomato cultivars. In the other studies by; Znidarcic et al. [22], Lemma, [23] got a mean significance difference in fruit yield among different varieties tested (7.21 to 48.80 ton/ha). Baliyan and Rao [24] also found significance

variability in yield produced by six tomato varieties evaluated for pest and disease and productivity in Botswana.

4. CONCLUSION

The Agro-ecology of Ethiopia allow cultivation of an extensive range of fruit and vegetable crops including tomato. In Ethiopia, several tomato varieties had been released nationally for commercial production and small scale farming systems. The average yield of tomato in Ethiopia is low (8 ton ha⁻¹) compared with world average yields of 34 tonha⁻¹ (FAOSTAT, [4]).The tested cultivars showed statistical difference for number of cluster/plant, number of fruits/plant, fruit yield, fruit diameter and fruit weight while they did not show difference for days to 50% flowering. Among the tested tomato cultivars, Melkasalsa produced the largest fruit. The highest fruit yield was recorded by Melkasalsa followed by bishola. Melkasalsa and Bishola cultivars can be used by tomato growers of Bonga and similar agro-ecological areas. However, the yield of the varieties in the area was lower than their yield potential. Thus, determining optimum level of organic and/or inorganic fertilizer is of a paramount importance in increasing tomato productivity in the area.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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