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

Mihtretu Yonas† and Nazif Abajebel†

1Gambella University College of Agriculture and Natural Resource, Department Horticulture, P.O.Box 126, Ethiopia.

2Gambella University College of Agriculture and Natural Resource, Department Plant Science, P.O.Box 126, Ethiopia.

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.

Article Information

DOI: 10.9734/AJAHR/2020/v6i130064

(1) Dr. Paola A. Deligios, University of Sassari, Italy.

(1) Shah Newaz, Sher-e-Bangla Agricultural University, Bangladesh.

(2) Pankaj Kumar Ray, Bihar Agricultural University, India.

Complete Peer review History: [http://www.sdiarticle4.com/review-history/58155](http://www.sdiarticle4.com/review-history/58155)

Received 05 April 2020
Accepted 11 June 2020
Published 18 June 2020

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
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 235,837.51 million quintal 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', 'Eshele' and 'Matedel' cochoro are some of varities 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 Gamella 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, Gallila 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 1mx5m. Uniform and vigorous seedlings of each variety were selected and transplanted to well-prepared field on plot size of 5 mx3 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 mz 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 Tibebu [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 findingson 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 | 4.5b  | 71.7c|
| Melkasalsa        | 33.3abc | 9a  | 16.7bcd| 5.6a  | 109.3a|
| ARP tomato D2     | 29c     | 4.7b | 13d    | 4b    | 75.3 |
| Fetan             | 36.7a   | 3c  | 8.7cd  | 4b    | 54d  |
| Chali             | 30.3bc  | 3.3bc| 11.7cd | 3.7b  | 71.7c|
| Bishola           | 30.3c   | 7.7a | 20a    | 5.3b  | 89b  |
| Gelilia           | 35.0ba  | 4b  | 13.7bc | 4b    | 76   |
| 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=.05. *Significant at (P=.05), ***Significant at (P <.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        |
| Gelilia           | 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 showed 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 Gelilia 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 (30.0 t/ha). Variety Bishola was the second largest record in its 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. Similarly, 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.

ACKNOWLEDGEMENTS

Above all we would like to Thank Gambella University for funding this research. Also we would like to pass our heartfelt condolences to Bonga area Farmers for providing testing site from their farm land. On the other hand want to use this opportunity to acknowledge for all individuals for their contribution in one or another ways.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Teshome A, Amanti C, Geremew H, Taha M. Effect of seedling management on yield and quality of tomato at Adami Tulu Jiddo Kombolcha District, Central Rift Valley of Ethiopia. Afr. J. of Agril Res. 2010;5(22): 3056-3059.
2. Balcha, K., D. Belew and J. Nego. Evaluation of tomato (Lycopersicon esculentum Mill.) varieties for seed yield and yield components under Jimma condition, South Western Ethiopia. J. Agron. 2015;14:292-29.
3. Wang Y, Ren X, Song X, YU T, LU H, Wang P, Wang J, Zheng XD. Control of postharvest decay on cherry tomatoes by marine yeast Rhodosporidium paludigenum and calcium chloride. Journal of Applied Microbiology. 2010;109:651-656
4. FAOSTAT. Food and Agriculture Organization of the United Nations; 2017. Available: http://faostat.fao.org (Accessed March/08/2020)
5. Desalegn R, Wakene T, Addis S. Tomato (Lycopersicon esculentum Mill.) varieties evaluation in Borana zone, Yabello district, southern Ethiopia. J Plant Breed. Crop Sci. 2016; 8(10):2016-210.
6. Birhanu K, Ketema T. Fruit yield and quality of drip-irrigated tomato under deficit irrigation. Afr. J. Food, Agric, Nutr. Dev. 2010.
7. CSA. The Federal Democratic Republic of Ethiopia, Central Statistica Agency, Agricultural Sample Survey. Report on Area and Production of Crops, (Private Peasant Holdings, Meher Season), Addis Ababa, Ethiopia. 2019;19.
8. Regassa MD, Mohammed A, Bantte K. Evaluation of tomato (Lycopersicon esculentum Mill.) genotypes for yield and yield components. Afr. J. Plant Sci. Biotechnol. 2012;6:45-49.
9. Lemma Dessalegn. Tomatoes. Research Experience and Production Prospects. Research Report 43. Ethiopian Agricultural Research Organization Addis Ababa, Ethiopia. 2002;48.
10. Aleminew and Tibebo. Evaluation of the performance of tomato (Solanum esculentum) cultivars at Sekota, North Eastern Ethiopia. Asian J.ofn Agril Res. 2017; 11(4):116-119.
11. Regassa D, Tigre W, Shiferaw A. Tomato. (Lycopersicon esculentum Mill.) varieties evaluation in Borana zone, Yabello district, Southern Ethiopia. J. Plant Breed. Crop Sci. 2016;8:206-210.
12. Meseret Degefa, Mohammed A, Bantte K. Evaluation of Tomato (Lycopersicon esculentum Mill.) Genotypes for Yield and Yield Components. Afr. J. Plant Sci. Biotechnol. 2012;6:45-49.
13. Anwar Ali, Ijaz Hussain, Ayub Khan, Junaid Khan, Masood Ur Rehman and Aamir Riaz. Evaluation of various tomato (Lycopersicon esculentum Mill.) Cultivars
for quality, yield and yield components under agro climatic condition of peshawar. ARPN J.of Agril and Bio Sci. 2016;11(2). ISSN: 1990-6145.

14. Iqbal M, Niamatullah M, Yousaf I, Munir M, Khan MZ. Effect of nitrogen and potassium on growth, economical yield and yield components of tomato. Sarhad J. Agric. 2011;27(4):545-548

15. Meseret, D. Evaluation of tomato (Lycopersicon esculentum) varieties for fruit yield, quality and shelf life. M.Sc. Thesis presented to School of Graduate Studies, Jimma University; 2010.

16. Fayaz A, Khan O, Sarwar S, Hussain A, Sher A. Performance evaluation of tomato cultivars at high altitude. Sarhad J. Agric. 2007;23(3):581-585.

17. Davis JM, Sanders DC, Nelson PV, Lengnick L, Sperry WJ. Boron improves growth, yield, quality and nutrients contents of tomato. J. Ami. Soc. Horti. Sci. 2003;128(3):441-446.

18. Shushay C, Haile Z. Evaluation of tomato varieties for fruit yield and yield components Northern Ethiopia. Int. J. of Agri. Res. 2014;10:23-39.

19. Hussain SI, Khokhar KM, Mahmood T, Laghari MH, Mahmud MM. Yield potential of some exotic and local tomato cultivars grown for summer production. Pak. J. Biol. Sci. 2001;4:1215-1216.

20. Dufera JT. Evaluation of agronomic performance and Lycopene variation in tomato (Lycopersicon esculentum Mill.) genotypes in Mizan, Southwestern Ethiopia. World Applied Sci. J. 2013;27:1450-1454.

21. Shiberu T. Evaluation of improved tomato varieties (Lycopersicon esculentum Mill.) performance against major insect pests under open field and glasshouse conditions. Int. J. Res. Stud. Agric. Sci. 2016;2:1-7.

22. Znidarcic D, Tridan S, Zlatic E. Impact of various growing methods on tomato (Lycopersicon esculentum Mill.) Yield and sensory quality. J. Agric. Sci. 2003:37:235-243.

23. Lemma D. Tomato research experience and production prospects. Research Report-Ethiopian Agricultural Research Organization. 2002:43.

24. Baliyan SP, Rao MS. Evaluation of tomato varieties for pest and disease adaptation and productivity in Botswana. International Journal of Agricultural and Food Research. 2013;2(3):20–29.