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Full Length Research Paper

Adaptability and Performance Evaluation of Recently Released Tomato (*Lycopersicon esculentum* Mill. L.) Varieties at West and Kellem Wollega Zones under Supplementary Irrigation

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Tomato (Lycopersicon esculentum Mill.) is one of the most important edible and nutritious vegetable crops in the world. A field experiment was conducted at Meti and Kombolcha sub sites of Kellem Wollega, and Inango of West Wollega zones in Western Ethiopia, during the 2016/2017 and 2017/2018 cropping season under supplementary irrigation. A total of 11 tomato varieties collected from Melkasa Agricultural Research Center (MARC) of the Ethiopian Institute of Agricultural Research (EIAR) and one local check variety were used as planting materials. The combined analysis of variance (ANOVA) for fruit yield and other agronomic traits of 12 tomato varieties grown at five locations in 2016/2017 and 2017/2018 revealed significant varietal difference for all considered traits except for unmarketable yield and number of branches per plant. In the present experiment, Melka shola, Melka salsa, Fetene and Miya varieties were found superior in terms of economic yield (marketable yield) and other parameters and thus they are recommended for popularization and wider production in test locations and similar agro-ecologies in the Western Oromia in particular and tomato producing regions of Ethiopia under supplementary irrigation in general.

Keywords: Fetene, Irrigation, Melka salsa,Melka shola, Tomato, Yield

INTRODUCTION

Tomato (*Lycopersiconesculentum* Mill.) is one of the most important edible and nutritious vegetable crops in the world. It ranks next to potato and sweet potato with respect to world vegetable production. It is widely cultivated in tropical, subtropical and temperate climates and thus ranks third in terms of world vegetable production (FAO, 2006). Nowadays, its importance is increasing in Ethiopia. It is widely accepted and commonly used in a variety of dishes as raw, cooked or processed products more than any other vegetables (Lemma, 2002). It is one of the important cash-generating crop to small scale farmers and provides employment opportunity in the production and processing industries. It is also an important source of vitamin A and C as well as minerals. Such diverse uses made tomato an important vegetable in irrigated areas of agriculture in the country. It is a seasonal climbing plant of the family S*olanaceae*. It is grown as an annual produce for its fruits. It is one of the most popular and important vegetables for fresh consumption as well as processing. The plant requires a warm and dry climate. The optimum mean day temperature for growth of tomato lies between 21^{oC} and 26^{oC} and temperature above 32^{oC} during fruit development inhibit the formation of red color (MOA, 2012). The leading tomato producing countries are China, the United State of America, India, Egypt, Turkey, Iran, Mexico, Brazil and Indonesia (FAO, 2006). A total of 9,524.42 hectares of land was used for

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cultivating tomato in the country and yielding about 591,563.36 quintals of tomato production in Ethiopia (CSA, 2016) with the production of 62.11quintals per hectare.

Tomato is an essential ingredient in the diet of the people and often used in almost every household. It is used in preparing soups, sauces, stews, salads and other dishes, and used in large quantities as compared to other vegetables (Ellis, 1998). The fruit is fairly nutritious and contains high amount of vitamins A and C (AVRDC, 2004). Such diverse uses make tomato an important vegetable in irrigated agriculture in Ethiopia and the production is rapidly increasing in many parts of the country. In Ethiopia, tomato is one of the most important and widely grown vegetable crops, both during the rainy and dry seasons for its fruit by smallholder farmers, commercial state and private farms (Gemechis *et al*., 2012; Emana *et al*., 2014).

Seed yield and quality of tomato is mainly dependent on the variety selected for seed production (George, 1999). A number of improved varieties and other agronomic packages have been recommended to the users to overcome the low productivity and quality of tomato in the country. According to MoA (2013), however, due to lack of sound seed multiplication and distribution system, the varieties had not reached farmers. Thus tomato production has been restricted to certain regions of the country for several reasons, including the shortage of varieties and the lack of recommended package regarding production.

The shortage 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 (Lemma, 2002). In Ethiopia, some tomato varieties had been released nationally and recommended by MARC for commercial production and small scale farming systems. Varieties such as 'Melkashola' and Marglobe' are widely produced while 'Melkasalsa' and 'Heinz 1350' have limited distribution and production. On the other hand, 'Fetane', 'Bishola', 'Eshete' and 'Matedel' are being tested (Lemma, 2002). In Western part of Ethiopia, particularly in West and Kellem Wollega zones farmers produce locally known tomato variety on their gardens which is very small in size and low fruit yield.

Tomato generally requires warm weather and abundant sunshine for best growth and development. The diverse climatic soil conditions of Ethiopia allow cultivation of a wide range of fruit and vegetable crops including tomato, which is largely grown in the eastern and central parts of the mid to low land areas of the country. However, local production of tomato in West and Kelem Wellega zones is not able to meet the domestic demand due to lack of improved variety and new technological packages for tomato.

Therefore, it is important to evaluate different tomato varieties under irrigation during off season to recommend high fruit yielding variety or verities for the study area. Thus, the objective of this study was to evaluate the performance of tomato varieties under supplemental irrigation and recommend the best performed variety for production in the studied areas and similar agrological zones.

MATERIALS AND METHODS

Experimental Sites, Designs and Experimental Materials

A field experiment was conducted at Meti and Kombolcha subsites of Kellem Wollega and Inango of West Wollega zones in Western Ethiopia, during the 2016/2017 and 2017/2018 under supplemental irrigation. A total of 11 varieties viz., Chali, Cochoro, Fetane, Melka Shola, Melka Salsa, Bishola, Metadel, Eshete, Miya, Galilama and Arp Tomato D2 collected from MARC were used in this study. Among these varieties six of them (Chali, Bishola, Melka Shola, Melka Salsa, Fetane, and ARP Tomato D2) are determinate in growing habit, while the other five varieties are indeterminate (Miya, Eshete, Metadel, Galilama, Cochoro). The experiment was laid out in a randomized complete block design with three replications and with plot size of 4m length and 3m width. All other crop management practices and recommendations were used uniformly to all varieties as recommended for the crop. The recommended spacing 100cm between rows and 30cm between plants were used.

Data collection and statistical analysis

Data are collected in plot and plant basis. Some of the data taken were days to 50% flowering, days to 90% maturity, number of fruits per plant, number of cluster per plant, plant height, number of branches per plant, fruits weight, marketable yield, unmarketable yield and total yield. The collected data were subjected to analysis of variance using GenStat computer software (Gen Stat, 2016) and Least Significant Differences (LSD) was used to compared the varieties using the procedures of Fishers protected at the 5% level of significance

RESULTS AND DISCUSSION

The combined analysis of variance (ANOVA) for fruit yield and other agronomic traits of 12 tomato varieties grown at five locations in 2016/2017 and 2017/2018 revealed significant varietal difference for all considered

Table 1. Combined analysis of variance for fruit yield and related agronomic traits of tomato varieties grown at western Oromia.

SV	DF	Mean squares											
		DFL	DIPR	DM	NBPP	PH	NCPP	NFPC	NFPP	FW	MY	UMY	TYQ/ha
Rep	2	397.94	2.39	327.56	16.178	39.93	34.35	0.31	69.4	730.2	18.083	3.9	11143
Trt	11	41.61*	0.47*	52.9*	1.845	669.59**	39.14**	1.84*	833.05**	8267.4**	19.82**	1.3	7290
Loc	1	245.44**	1.39*	0.01	159.9**	1517.4**	389.2**	12.9**	8812.5**	1206.8	4.044	1.3	7507
Yr	1	3422.2**	0.63	31358.5**	427.9**	5242.4**	25.21*	4.25*	26.27	1542.7	5986.9**	29.3	366174**
Trt*Loc	11	15.08	0.19	35.86	3.608	26.37	8.16	1.31	218.79*	1331.4	12.808*	2.8	14014**
Trt*yr	11	26.01	0.37	58.45*	1.177	143.9**	6.265	1.40	92.77	445.9	22.672**	2.3	5834
Loc*Yr	1	1586.6**	1.39*	458.67**	136.60**	406.8**	171.7**	0.05	819.40	267.7	56.267**	6.1	24493
Trt*Loc*Yr	11	15.66	0.19	24.73	1.766	14.32	3.684	0.87	161.22	832.7	7.192	1.2	4498
Error	94	16.31	0.19	20.75	3.049	32.42	5.705	0.84	77.54	606.6	4.055	1.5	4313
CV (%)		8.9	31.2	4.7	24.5	11.5	24.2	31.2	30.1	26.7	14.6	109.8	20.9

Where **DF**, **DFL**, **DIPR**, **DM**, **NBPP**, **PH**, **NCPP**, **NEPC**, **NFPP**, **FW**, **MYQu/ha**, **UMYQu/ha**, **TYQ/ha** and **CV(%)** are Degree freedom of error, 50% flowering days, disease insect pest resistance, days to maturity, number of branches per plant, plant height, number of cluster per plant, number of fruits per cluster, number of fruits per plant, **FW**= weight of fruits (gm), marketable Yield, unmarketable yield, Total yield (Qu/ha) and coefficient of variation respectively.
SV=sources of variation; **Rep**=replication; **Trt**=treatment; **Loc**=location; **Yr**=year; **Trt*Loc**= interaction of treatment and location; **Trt*yr**= interaction of treatment and year; **Loc*Yr**= interaction of location and year; **Trt*Loc*Yr**= interaction of treatment, location and year

traits except for unmarketable yield and number of branches per plant (Table 1).
The current result disagrees with the findings of Desalegn *et al*. (2016) whom found that non-significant variation for days to 50% flowering, days to maturity and fruit numbers per plant. The location effect was highly significant (P < 0.05) for a number of traits considered.
The mean marketable yield of the tested tomato varieties at five environments of Western Ethiopia in general and West and Kelem Wollega in particular indicated statistically significant varietal difference across test environments and seasons (Table 1). Inconsistent performances of quantitative traits across diverse growing environments are well documented for all crops in literature.

Days to flowering and days to maturity, plant height and number of branches per plant

The main effect (of variety, location, year and their interaction revealed significant (P ≤ 0.05) on days to flowering, days to maturity, plant height, number of cluster per plant. From the tested varieties Miya variety attained the shortest days to flowering and days to maturity whereas Bishola variety attained the longest days to flowering and days to maturity which might be due their growing habit of which Miya is determinate and Bishola is indeterminate variety. This result was in agreement with the findings of Gebisa *et al.*, (2017) who stated that Eshete was characterized as taller variety. Similarly the longest plant height (58.95 cm) and the shortest plant height (39.16) were recorded from Local variety, respectively. This might be due to their growing habit which also determines number of clusters per pant. This result was inline the findings of (Meseret *et al*, 2012) who reported Miya and Bishola varieties are the earliest and latest to attain their flowering and maturity days.

Number of cluster per pant, number fruits per cluster and number of fruits per plant

The main effect of variety was highly significant ((P ≤ 0.01) over year and location on number of cluster per pant, number per fruits per cluster and number of fruits per plant (Table 1). This might be due varietal effect since such yield determining traits are genotypic factor. The highest (13.31) and lowest (7.625) number of cluster per pant was recorded from local variety and Bishola variety. Similarly the highest and the lowest number fruits per cluster and number of fruits per plant were recorded from Melka salsa and eshete variety, respectively (Table 2). This result was in line with Gebisa *et al* (2017) who reported the lowest number fruits per plant for variety Eshete.

Fruit Weight, Marketable and Unmarketable Yield and Total Yields

Average fruit weight per plant and marketable yields are significantly (P ≤ 0.01) affected by the main effect of variety, whereas unmarketable and total yield yields were non-significant. The highest (122.1) and the lowest (53.5) average fruit weight was recorded from Metadel and Melka Salsa varieties, respectively. This might be due

Table 2. Combined mean of yield and yield components of tomato varieties over location and year

Variety	DFL	DIPR	DM	NBPP	PH	NCPP	NFPC	NFPP	FW	MYKQu/ha	UMYQu//ha	TYQ/ha
Arp.Tomato D2	45.42bcd	1.425a-d	96.25cd	7.229	46.29 ef	8.812cd	2.645b-e	21.83c	120.78a	287.353 a-d	22.557ab	309.91abc
Bishola	48.92a	1.417a-d	101.92a	6.729	58.95 a	7.625d	2.614b-e	19.12c	120.76a	259.997 de	24.363ab	284.36c
Chali	45.58bcd	1.767a	97.83bc	7.188	49.52 de	10.104bc	3.352ab	34.31b	84.95cd	264.485 c-e	17.245ab	281.73c
Cochoro	44.25bcd	1.333cd	98.33abc	6.854	49.07 de	9.479cd	2.553cde	25.1c	94.43bc	303.914 abc	23.286ab	327.2abc
Eshete	43.67cd	1.4bcd	97.67bc	6.354	64.9 a	7.979d	2.364e	18.98c	118.49a	291.72 b-e	31.37a	323.09abc
Fetene	47.17ab	1.167d	99.5abc	7.708	43 fg	9.229cd	2.459de	21.94c	**109.36ab**	311.573a	26.517ab	338.09ab
Galilama	46abc	1.396b-d	100.08ab	7.104	57.26 bc	10.333bc	3.279abc	33.54b	90.57bc	294.611abc	18.049ab	312.66abc
Local	43.75cd	1.192d	96.17cd	7.646	39.16 g	13.312a	3.001a-e	39.2ab	59.58e	280.903 abc	13.347b	294.25abc
Melka Salsa	46.58abc	1.308cd	96.75bcd	7.375	44.16 f	12.312a	3.49a	43.9 a	53.5e	325.884 ab	21.266ab	347.15a
Melka Shola	47.25ab	1.25d	97.75bc	7.479	52.69 cd	11.542ab	3.145a-d	35.42b	64.38e	329.101 ab	19.929ab	349.03a
Metadal	43.83cd	1.733ab	96.67bcd	7.083	46.04 ef	7.708d	2.963a-e	24.62c	122.1a	251.696e	29.974a	281.67c
Miya	42.58d	1.65abc	93.83d	6.896	45.35 ef	10.042bc	3.322ab	32.56b	66.31de	318.487ab	21.843ab	340.33a
LSD(0.50)	3.273	0.359	3.693	NS	4.615	1.936	0.741	7.138	19.96	1.632	NS	NS
CV(%)	8.9	31.2	4.7	24.5	11.5	24.2	31.2	30.1	26.7	14.6	109.8	20.9

Where **DFL**, **DIPR**, **DM**, **NBPP**, **PH**, **NCPP**, **NEPC**, **NFPP**, **FW**, **MYQu/ha**, **UMYQu/ha**, **TYQ/ha**, **LSD(0.50)** and **CV(%)** are 50% flowering days, disease insect pest resistance, days to maturity, number of branches per plant, plant height, number of cluster per plant, number of fruits per cluster, number of fruits per plant, FW= weight of fruits(gm), marketable Yield, unmarketable yield, Total yield Q/ha, least significance difference and coefficient of variation, respectively.

different fruit size and shape of varieties. This result was in line with that of Gebisa *et al* (2017) who reported that the highest fruit weight was recorded from Metadel variety due to its bigger fruit size. Similarly the highest (329.101 Qu/ha) and lowest (259.997Qu/ha) marketable yield were recorded from Melka Shola and Bishola varieties. This might be due the highest number of fruits per plant for Melka Shola variety and the lowest number of fruits per plant from Bishola variety, since number of fruits per plant determines yields per unit area. This result was in agreement with findings of Gebisa *et al.*, (2017) who stated that minimum yield was obtained from Metadal variety in their study. Similarly, Desalegn *et al*., (2016) also reported similar finding as variety Miya out yielded the rest varieties in their study.

CONCLUSION AND RECOMMENDATION

The evaluation of tomato variety was done to study the adaptability and performance of recently resealed varieties. Significant difference was shown different traits among varieties. In terms of flowering, Eshete and a local cultivar were the earliest whereas Bishola was considered as late variety. Furthermore, similar trends were observed for maturity among tested varieties. Besides, most of varieties that flowers early were characterized by short plant height than varieties flowering late. The largest fruit weight was recorded from varieties Bishola and ARP Tomato D2. Melka shola, Melka salsa, and local cultivar provided the highest fruit clusters per plant while Eshete and Bishola were the lowest. Low fruits per cluster were obtained from Eshete and Fetene while maximum number of fruits per cluster obtained from Melka salsa. The maximum marketable yield per hectare was obtained from Melka shola, Melka salsa, Fetene and Miya, respectively while the minimum was obtained from Metadal. Generally significant differences for a number of traits among the tested varieties were observed. Evaluation of varieties for adaptation is a fast truck strategic approach to develop and

promote agricultural technology. In the present experiment, Melka shola, Melka salsa, Fetene and Miya varieties were found superior in terms of economic yield (marketable yield) and other parameters, and thus they are recommended for popularization and wider production in test locations and similar agro-ecologies in Western Oromia under supplemental irrigation.

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