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REVIEW ARTICLE

Review on Productivity of Released Tomato *(Solanum Lycopersicum Mill.)* Varieties in Different Parts of Ethiopia

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Abstract

Tomato *(Solanum lycopersicum Mill.)* is the major horticultural crop with an estimated global production of 164 million metric tons from 4.73 million hectare of land. In Ethiopia, it is an important food ingredient in daily diet of people in almost all regions. The crop is an important cash-generating crop to small-scale farmers and provides employment in the production and processing industries. Despite its importance the productivity of tomato is very low in Ethiopia as compared to other countries. This is due to lack of adaptability study, dissemination of improved varieties to all parts of the country and due to different biotic and abiotic factors. The varieties challi and Melkasalsa performed best at most of the locations reviewed with in this document and this implies that, these two varieties have good stability to be adapted to different environments and soil conditions. Ethiopia has diverse agro-ecology that suits for the production of various types of crops. In order to diversify the crop production in different parts of the country evaluation of different varieties released at some areas in different agro-ecologies of the country is important. Different varieties have different capacity to be adapted to different agro-ecology and soil types. Due to this reason evaluation and identification of appropriate varieties for specific area is crucial to achieve the intended yield, quality and to satisfy the end users.

Keywords: Productivity: Released Tomato Varieties; Ethiopia

Introduction

Tomato *(Solanum lycopersicum Mill.)* is the major horticultural crop with an estimated global production of 164 million metric tons from 4.73 million ha of land (FAO, 2014) [1]. In Ethiopia, it is an important food ingredient in daily diet of people in almost all regions. The crop is an important cash-generating crop to small-scale farmers and provides employment in the production and processing industries [2]. A number of improved varieties and other agronomic packages have been recommended resulting in improvement of production and productivity of the crop in Ethiopia. According to MoA (2013), Ethiopian National Agricultural Research System (NARS) has released about 25 tomato varieties so far [3]. Open pollinated tomato varieties such as 'Melkashola', 'Marglobe', 'Melkasalsa', 'Heinz 1350', 'Fetan', 'Bishola', 'Eshet' and 'Metadel' had been released by the Melkassa Agricultural Research Center (MARC) and nationally recommended both for commercial and small-scale production in Ethiopia (Lemma, 2002) [4]. The total areas under tomato crop in the rainy season are estimated to be 5.05 thousand hectares with 30.7 thousand tones of harvest (CSA, 2015) [5]. However, average yield of tomato in Ethiopia is low, ranging from 6.5-24 Mt/ ha (Gemechis *et al.,* 2012) and 7.6 ton/ha (CSA, 2013) [5,6]. This is incomparable with the average yield of other countries such as China, USA, Turkey, India, Egypt, Italy and Spain with average yield of 22.67, 80.61, 35.81, 18.61, 40.00 and 76.35 ton/ha in that orders (FAOSTAT, 2010) [7].

Tomato production is faced with a number of constraints which are biotic and abiotic that resulted into low yield. Biotic factors contributing for lower yield of tomato in Ethiopia include insect pests [8]. Plant parasitic weeds are also one of the factors affecting tomato yield [9]. Drought, heat, and poor cultural practices constitute abiotic factors for lower productivity of tomato [4,10]. The shortage of varieties that are adaptable to different agro-ecologies, poor quality seeds, disease and insect pests, high post harvest loss, lack of awareness of existing improved technology and poor marketing systems are some of the major constraints associated with tomato production in Ethiopia (Lemma, 2002) [4].

Objective

To Review the Performance Evaluation of Released Tomato *(Solanum lycopersicum Mill.)* Varieties in Different Parts of Ethiopia

Literature Review

Agro-ecological Requirement of Tomato

The crop generally requires warm weathers and abundant sunshine for best growth and development. Vegetative and reproductive development at lower temperatures is very limited, and extended period of plant growth at 12 °c or less can result in chilling injury. The climatic soil conditions of Ethiopia allows cultivation of a wide range of fruit and vegetable crops including tomato, which is largely grown in eastern and central parts of mid to low land areas of the country. Large scale production of tomato takes place in the upper Awash valley under irrigated and rain fed conditions where as small scale production for fresh market is common practice around Koka, Ziway, Wondo-Genet, Guder, Bako and many other (Lemma, 2002) [4].

Performance of Tomato varieties at Teppi, South Western Part of Ethiopia

Treatment	Days to 50% Flowering	Days to 50% Fruit setting	Number of Fruits/ cluster	Number of cluster/plant	Total yield Kg/ plot	Total yield Tone/hectare	Average fruit weight (Kg).
Metadel	63.667^{b}	75.00^{abc}	2.93^{c}	12.067^{d}	18.30^{ab}	23.46^{ab}	0.15^{bc}
Miya	54.33^{c}	77.67^{ab}	2.93^{c}	17.60^{a}	16.87^{abcd}	21.62^{abcd}	0.09^{e}
Cochoro	63.33^{b}	74.67^{bc}	2.53^{def}	14.67^{bc}	17.28^{abc}	22.16^{abc}	0.15^{ab}
Bishola	83.67^{a}	75.00^{abc}	2.33^{efg}	11.53^{d}	13.17^{d}	6.82^{d}	0.17^{a}
Challi	68.00^{b}	73.33^{bc}	2.13^{g}	8.27^{e}	20.13^{a}	25.05^{ab}	0.12^{d}
Fetan	65.33^{b}	73.67^{bc}	2.2^{fg}	8.77^{e}	19.82^{a}	24.09^{ab}	0.13^{d}
Melka Salsa	63.33^{b}	73.67^{bc}	5.00^{a}	17.60^{a}	19.98^{a}	25.62^{a}	0.04^{g}
Melka Shola	61.67^{bc}	72.33^{c}	4.13^{b}	15.07^{b}	15.68^{bcd}	20.11^{bcd}	0.06^{f}
Eshet	65.00^{b}	80.00^{a}	2.73^{cd}	12.4^{cd}	14.22^{cd}	18.23^{cd}	0.12^{d}
ARP	59.67^{bc}	72.67^{bc}	2.60^{cde}	10.67^{de}	16.57^{abcd}	21.24^{abcd}	0.13^{cd}
Cv	11.88	5.85	10.65	16.71	18.81	19.87	11.84
Lsd	8.94	5.08	0.36	2.49	3.75	50.41	16.1

Source: (Alo *et al.*, 2017) [2]

Means with the same letters are not significantly different from each other. CV= coefficient of variation, Lsd= least significant difference

Table 1: Summary of mean yield (t/ha) and other parameters of varieties

The mean yield was ranged from 16.82 for Bishola to 25.62 t/ha for melka salsa.Based on mean yield, Melka salsa, Challi, Fetan, Metadel, Cochoro and Miya gave highest yield. The mean days to 50% flowering were ranged 54.33 for Miya to 83.67 days for Bishola. The mean days to 50% fruit setting was ranged 72.33 for Melkashola to 80 days for Eshet. The mean number of fruits per cluster was ranged 2.13 for Challi to 2.93 for Metadel and Miya. The mean number of cluster per plant was ranged 8.27 for Fetan to 17.6 for Melka salsa. The mean total yield kg/plot ranged from 13.12 for Bishola to 20.11 for Challi. The mean Average fruit weight was ranged from 0.04 Kg for Melka salsa to 0.17 Kg for Bishola. All varieties showed significant difference for 50% flowering, 50% fruit setting, number of fruit per cluster, number of cluster per plant, total yield tone/hectare and average fruit weight. Melkasalsa, Challi, Fetan, Metadel, Miya and Cochoro, gave highest yield followed by Melka shola, Eshet and Bishola respectively. Melkssalsa have highest number of fruits per cluster followed by Melkashola. Miya and Melkasalsa have highest number of cluster per plant followed by Melka shola and Cochoro. Melkasalsa and Challi gave highest yield quintal per hectare. Bishola and Cochoro have highest average fruit weight followed by Metadel and Challi. Fruit yield per hectare showed significant difference among the varieties. The highest marketable yield was obtained by Melka salsa and the least yield was recorded by Bishola. (Alo *et al.*, 2017) and Chernet and Zibelo (2014) [2,11].

Performance of Tomato varieties in Western Lowland of Tigray, Northern part of Ethiopia

Var	DFL	DFr	DM	PHT(cm)	NBR	FIPC	FrPC	FrCPP
Bishola	38^{a}	94^{a}	121^{a}	83.2^{cb}	10.7^{bac}	3.8	2.6	9.6^{c}
Challi	29^{c}	76^{cb}	103^{dc}	70.1^{c}	8.9^{dc}	3.9	2.7	17.1^{cb}
Cochoro	29^{c}	72^{cde}	102^{d}	70.4^{c}	9.3^{bdc}	4.0	3.1	24.1^{a}
Marglobe	32^{bc}	66^{f}	96^{d}	105.3^{a}	9^{dc}	4.2	2.8	17.9^{b}
Fetan	29^{c}	73^{cd}	104^{bdc}	77.6^{cd}	10.4^{bac}	3.8	2.6	12^{ed}
Melkasalsa	31^{bc}	67^{fe}	112^{bac}	76.3^{ed}	12.3^{a}	4.4	3.0	27.4^{a}
Melkashola	32^{bc}	80^{b}	117^{a}	83.5^{cb}	11^{ba}	3.9	2.5	13.3^{ced}

Var	DFL	DFr	DM	PHT(cm)	NBR	FIPC	FrPC	FrCPP
Metadel	35^{ab}	65^{f}	113^{ba}	85.2^{b}	10.6^{bac}	4.1	3.0	12.5^{cbd}
Miya	35^{ab}	68^{fe}	96^{d}	62.1^{f}	8.3^{d}	4.0	3.1	16.2^{cb}
SEM	0.68	1.76	3.85	2.38	0.29	0.08	0.09	1.11
CV (%)	7.3	4.37	5	4.6	11.04	8.23	15.36	14.15

Source: Chernet and Zibelo (2014) [11]

DFL= Days of 50% flowering, DFr = Days of 50% fruiting, DM= Days to maturity, PHT= Plant height, NBR=Number of branches, FIPC=Number of flowers per cluster, FrPC=Number of fruits per cluster, FrCPP=Number of clusters per plant, SEM=Standard error of the mean, CV= Coefficient of variation. Means in the same column connected with the same letter are not significantly different

Table 2: Response of tomato varieties for different growth and yield components

Varieties	FrWt(Kg)	FDP(mm)	ED(mm)	MYLD(t/ha)	UnMYLD(t/ha)
Bishola	86.40^{a}	48.50^{bc}	53.30^{a}	17.89^{e}	1.11^{c}
Challi	66.20^{bc}	55.70^{ba}	45.10^{b}	49.28^{ab}	1.97^{bc}
Cochoro	77.90^{ba}	61.50^{a}	49.00^{ba}	48.26^{ab}	1.33^{c}
Marglobe	58.80^{c}	39.10^{c}	45.90^{ba}	36.52^{bc}	3.43^{a}
Fetan	66.40^{bc}	54.50^{ba}	45.50^{b}	21.78^{de}	1.38^{c}
Melkasalsa	40.40^{d}	56.90^{ba}	31.20^{c}	56.07^{a}	2.81^{ab}
Melkashola	53.43^{c}	59.90^{ba}	36.60^{c}	32.25^{cd}	1.34^{c}
Metadel	55.50^{c}	42.50^{c}	47.10^{ba}	26.06^{cde}	1.78^{bc}
Miya	57.20^{c}	49.00^{bc}	45.50^{b}	39.66^{bc}	1.62^{c}
SEM	2.77	1.77	1.38	12.4	18.9
CV(%)	12.03	12.98	9.76	2.615	0.2

Source: Chernet and Zibelo (2014) [11]

FrWt: single fruit weight, FDP: Fruit polar diameter, ED: Equatorial diameter, MYLD: Marketable yield, UnMYLD: Un Marketable yield, t/ha: Tone per hectare, SEM: Standard error of the mean, CV: Coefficient of variation, means in the same column connected with the same letter are not significantly different

Table 3: Response of tomato varieties to yield components, fruit yield and fruit characteristics

Performance of Tomato varieties in Jimma, South Western part Ethiopia

Treatments(Varieties)	Fruit diameter (cm)	Fruit weight per plant (Kg)	Fruit yield (tone/ hectare)
Local	3.96^{g}	0.89^{b}	29.65^{bc}
Arp tomato d2	5.73^{b}	0.76^{c}	25.39^{d}
Metadel	5.75^{b}	0.46^{d}	15.32^{g}
Chali	4.83^{f}	0.81^{c}	27.08^{d}
Cochoro	5.57^{c}	0.55^{d}	18.52^{ef}
Melkashola	4.10^{g}	0.57^{d}	19.14^{e}
Miya	5.19^{e}	0.14^{a}	47.55^{a}
Fetan	5.41^{d}	0.45^{d}	14.88^{g}
Melkasalsa	3.76^{h}	0.95^{b}	31.60^{b}
Bishola	6.25^{a}	0.57^{d}	18.88^{ef}
LSD	0.15	70.3	2.07
CV (%)	3.15	10.03	8.89

Source: Balcha *et al.*, 2015 [12]

Means within the same column followed by different letter are significantly different, LSD: Least significant difference, CV: Coefficient of variation

Table 4: Response of tomato varieties to yield and yield components

The highest fruit girth was observed in Bishola (6.25 cm) (Table 4). This is attributed to the fact that 'Bishola' had large fruit size than the other varieties. On the other hand, the lowest value of fruit girth (3.76 cm) was recorded in Melka salsa. The finding is in line with that reported by Chernet and Zibelo (2014), who indicated the existence of variability in terms of fruit diameter among nine tomato varieties evaluated under lowland Tigray, Northern Ethiopia condition [11]. Fruit weight per plant showed significant difference among the tomato varieties (Table 4). The highest fruit weight per plant (0.14 Kg) was obtained from Miya variety while, the lowest values of fruit weight per plant obtained from the varieties Faten (0.45Kg), followed by Metadel (0.46 Kg), Cochoro (0.55 Kg), Bishola (0.57 Kg) and Malkashola (0.57 Kg) all of which were

not statistically different from one another (Table 4). The fruit weight per plant in this study agrees with previous reports by Regassa, *et al.* (2012), who reported fruit weight per plant ranging between 1.1 and 1.7 kg [13]. The result is also in line with the findings of Saleem, *et al.* who found highest fruit yield per plant (2.48 kg) evaluating 30 tomato genotypes in Pakistan. Similarly, Chernet, *et al,.* (2013) reported the highest fruit yield per plant (2.10 kg) comparing 36 tomato genotypes [14]. Mean fruit yield of the varieties ranged from 14.88 tons per hectare in Fetan to 47.55 tons per hectare in Miya and was found to be significantly different among varieties (Table 3). The highest fruit weight per hectare (47.55 tones) was obtained from the variety 'Miya' (Table 4). The minimum fruit yield per ha was recorded by Fetan (14.88 tons per hectare) which was statistically similar with Metadel (15.32 tons per hectare) and Cochoro (18.52 tons per hectare) (Table 4).

Performance of Introduced Hybrid Tomato *(Solanum lycopersicum Mill.)* Cultivars in the Rift Valley, Ethiopia

No	Cultivar	Number of fruits per cluster	Yield (tone/ hectare)	Fruit number per plant	Unmarketable yield (%)	%TSS	Average fruit weight(Kg)
1	Monica	3.1	59.5	24.02	25.51	4	0.1
2	Barnum	7.3	63.7	31.68	25.08	4	0.622
3	Eden	6.6	73.3	23.05	39.17	3.9	0.11
4	Galilea	6.1	57.9	20.11	39.97	3.7	0.13
5	Tesha	3.6	70.3	36.17	31.02	3.1	0.08
6	Bridget 40	3.7	63.5	30.2	33.87	3	0.1
7	Venise	3.9	87.1	40.49	22.81	3	0.1
8	Awash River	5.6	60.1	23.03	39.07	3.1	0.13
9	Awassa	6.1	69.8	25.07	12.56	3.1	0.13
10	Chibli	3.8	43.4	19.27	23.25	3.9	0.11
11	Momtanz	3.8	54.8	18.16	30.23	3.8	0.11
12	Topspin	3.6	46.8	30.06	22.52	4	0.07
LSD		2.9	38.5	18	20.78	1.4	61.34
CV		12	22.7	15.2	16	13	17

Source: Binalfew *et al,* 2016 [15]

%TSS=Total soluble solutes, LSD= Least significant difference, CV= Coefficient of variation, means in the same column connected with the same letter are not significantly different

Table 5: Yield and yield components of hybrid Tomato Varieties

According to these study varieties Venis was the highest yielding with preferable quality tomato in Ethiopia. Awassa, Monica and Tesha varieties are also good yielder tomatoes with extended shelf life with low unmarketable yield. Awassa and Awash River tomato varieties are characterized with large fruits size over the rest newly introduced tomatoes. Galilea has still equivalent fruits size with rational fruit number. The newly introduced cultivar Venise and Tesha might be chosen for export due to their reasonable fruit size and low perishable. Tomato cultivars Awassa and Awash River might have good acceptance for local fresh consumption (Table 5).

Regarding response of tomato varieties to tested locations, Koka site showed the highest of total yield (93.45 tone/ha), more than double of Melkassa area. Tomato varieties show good yield response at Debre ziet site next to Koka, 81.76 ton per ha. Total yield is non-significant between Wonji and Ziway while significantly low yield response at Melkassa. Concerning number and size of fruits, considerably high number of fruits per plant was observed at Koka, while the larger fruits size recorded at Ziway area. From this it is clearly understood that the hybrid tomato varieties are more suitable to Debre zeiet and Koka area which is relatively low temperature and high altitude areas. The low response of tomato at Melkassa might be high temperature of the area and low fertility of the soil that encouraged the disease and insect pest prevalence and forced maturity (Binalfew *et al.*, 2016)[15].

Evaluation of improved tomato *(Solanum lycopersicum Mill.)* Varieties in Southern Ethiopia

Varieties	Areka			Goffa		
	Fruit number	Marketable yield (tone per hectare)	Total yield (tone per hectare)	Fruit number	Marketable yield (tone per hectare)	Total Yield (tone per hectare)
Money maker	40.63	25.62	28.12	49.35	78.83	87.06
Marglove	30.48	22.93	25.43	38.25	84.75	97.28
H.1350	26.5	19.18	21.68	39.75	67.68	76.58

Varieties	Areka			Goffa		
	Fruit number	Marketable yield (tone per hectare)	Total yield (tone per hectare)	Fruit number	Marketable yield (tone per hectare)	Total Yield (tone per hectare)
Roma-VF	67.79	22.15	24.65	53.45	68.09	78.09
Melka-salsa	64.8	33.03	21.78	47.3	69.5	82.71
Melka-shola	72.58	19.28	21.78	50.07	67.75	80.35
Marglobe	26.52	15.85	18.35	43.15	74.25	85.6
LSD	21.374	8.16	8.16	28.38	28.33	31.8
CV (%)	31.1	24.3	21.9	193.55	26.1	25.4

Source: Mulualem and Tekeste (2014) [16]

LSD= Least significant difference, CV= Coefficient of variation. Means in the same column connected with the same letter are not significantly different

Table 6: The mean data of fruit number, marketable and total yield (t/ha) of tomato at Bolososore (Areka) and Goffa districts

Conclusion

Ethiopia has diverse agro-ecology that suits for the production of various types of crops. In order to diversify the crop production in different parts of the country evaluation of different varieties released at some areas in different agro-ecologies of the country is very important. To advance improvement of crop productivity in different localities, continual identification of the best and suitable crop technologies is essential. This can be achieved, through adaptability tests, generation of new technologies and dissemination. Different varieties have different capacity to be adapted to different agro-ecology and soil types. Due to this reason evaluation and identification of appropriate varieties for specific area is crucial to achieve the intended yield and quality and to satisfy the end users. The performance of locally released varieties is best around the rift valley areas which is characterized by lowland and low humidity as compared to the areas with high humidity like that of southern and south western part of Ethiopia. In contrast the performance of hybrid varieties was best at areas with high altitudes than low land areas. From the above results those undertaken at different parts of the country, different varieties have different performance along the different ecologies [17]. Generally varieties challi and Melkasalsa performed best at most of the locations discussed above and this implies that these two varieties have good stability to be adapted to different environments and soil conditions.

References

1. FAO (2014) United Nation Food and Agriculture Organization Statistics Division. Crop Production data. Rome, Italy.

2. Alo Sh, Gezahegn A, Getachew W (2017) Study on Performance Evaluation of Tomato (Solanum lycopersicum Mill.) Varieties under Off-Season Condition at Teppi, South Western Part of Ethiopia. Greener J Agric Sci 7: 120-5.

3. Ministry of Agriculture (2013) Crop variety registration in Canada: Issues and options. Ministry Agric, Ababa, Ethiopia.

4. Dessalegn L (2002) Tomatoes: Research Experiences and Production Prospects. Research Report No 43Addis Ababa, Ethiopia.

5. CSA (2015) The Federal Democratic Republic of Ethiopia, Agricultural Sample Survey 2014/15 (2007 E.C) Report on Area and Production of Major Crops for Meher Season. Stat Bull No 578.

6. Gemechis AO, Struik PC, Emana B (2012) Tomato production in Ethiopia: Constraints and opportunities. Resilience agric sys against crises.

7. FAOSTAT (2010) Rom United Nations Food and Agriculture Organization.

8. Gashawbeza A, Bayeh M, Mulugeta N, Yeshitila M, Lidet S (2009) Review of Research on insect and mite pests of vegetable crops in Ethiopia. Increasing Crop Production through Improved Plant Protection. PPSE and EIAR, Addis Ababa, Ethiopia 47-67.

9. Etagegnehu G, Taye T, Girefe S (2009) Review of Vegetable Crops Weed Research in Ethiopia, in: Abraham, T. (Ed.), Proceeding of Plant Protection Society of Ethiopia. Increasing Crop Production through Improved Plant Protection. PPSE and EIAR, Addis Ababa, Ethiopia 323-34.

10. Dessalegn L, Shimels A, Ketema S, Abyote A (2008) Varietal development of major vegetables in the rift valley region: Proceedings of the First Conference of Ethiopia4n Horticulture Science Society 23-24 March 2006, Addis Ababa, Ethiopia 83-9.

11. Chernet S, Zibelo H (2014) Evaluation of tomato varieties for fruit yield and yield components in western lowland of Tigray, Northern Ethiopia. Int J Agric Res 9: 259-64.

12. Balcha K, Belew D, Nego J (2015) Evaluation of Tomato (Solanum lycopersicum Mill.) Varieties for Seed Yield and Yield Components under Jimma Condition, South Western Ethiopia. J Agron 14: 292-97.

13. Regassa MD, Mohammed A, Bantte K (2012) Evaluation of tomato (Solanum lycopersicum Mill.) genotypes for yield and yield components. Afr J Plant Sci Biotechnol, 6: 45-9.

14. Chernet S, Belew D, Abay F (2013) Genetic variability and association of characters in tomato (Solanum lycopersicum Mill.) genotypes in northern Ethiopia. Int J Agric Res 8: 67-76.

15. Binalfew T, Alemu Y, Geleto J, Wondimu G , Hinsermu M (2016) Performance of Introduced Hybrid Tomato (Solanum lycopersicum Mill.) Cultivars in the Rift Valley, Ethiopia. Int J Res Agric For 3: 25-8.

16. Tewodros M. Negasi T (2014) Evaluation of improved tomato (Solanum lycopersicum Mill.) varieties through participatory approach in South Ethiopia. Herald J Agric Food Sci Res 3: 55-60.

17. Ketema S, Geleto J, Alemu Y, Wondimu G, Hinsermu M, et al. (2017) Yield Stability and Quality Performance of Processing Tomato (Solanum lycopersicum Mill.) Varieties in the Central Rift Valley of Ethiopia. Int J Res Agric Forestry 4: 11-5.