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Full Length Research Paper

Range of improved varieties of Tomato (Lycopersicon esculentum Mill.) under Borana condition iin Ethiopia

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Tomato is one of the most important vegetable in Ethiopia as well as in the world in irrigated regions. It can be produced in a wide range of climatic conditions and many types of soils. Borana zone has potential to produce the crop, but not well done due to technical (production technology) and socio-economic problems. Among technical problem unavailability of seeds of adapted and improved tomato varieties is the most limiting factor. Therefore, the objective of this research is to test a range of improved varieties under Borana condition to identify genotypes with relatively better performance. To this effect, four improved and recommended varieties of tomato, namely: Fetan, Melkashola, Miya and Cochoro introduced from Melkassa Agricultural Research Center and one variety called CAL-J introduced from Kenya were tried for their adaptation at Yabello under irrigation using tap water in the year 2014. The experiment was single factor (varieties) single season experiment in RCBD with three replications. Parameters like Plant height, number of primary branch, days to 50% flowering, days to first harvest, Total fruit yield (ton/ha), marketable fruit yield (ton/ha), unmarketable fruit yield (ton/ha), fruits number per plant and single fruit weight (gram) were collected and analyzed. The result showed that there was significant (P ≤ 0.05) variation among the varieties for parameters including Plant height, number of primary branch, Total fruit yield (ton/ha), marketable fruit yield (ton/ha), unmarketable fruit yield (ton/ha) and single fruit weight (gram), but there was no significant variation for parameters days to 50% flowering, days to first harvest and fruit number per plant. Variety Miya gave significantly higher marketable fruit yield (22.95 ton/ha) and higher average of single fruit weight (85.84 gram) than other varieties. The least fruit marketable yield was obtained from the variety Fetan (11.61 ton/ha). Based on the result of the experiment, Variety Miya was recommended for further popularization in Yabello district under irrigation.

Key words: Tomato, variety introduction, variety evaluation, yield components, fruit yield.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most widely grown vegetable crops in the world, second to potato. It originally came from tropical area from Mexico to Peru (Maerere et al., 2006; FAO, 2005).

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Table 1. Soil physical and chemical properties at Yabello YPDARC research site, southern Ethiopia in 2014.

% OC	EC mmhos/cm at 25ºC	pH	Av.P in ppm	CEC in meq/100g soil	texture			
					% sand	% clay	% silt	classes
2.262	0.112	7.03	15.36	20.400	46	36	18	sandy

Its use as a food originated in Mexico, and spread throughout the world following the Spanish colonization of the Americas (Wikipedia, 2016). In Ethiopia, there is no exact information as to when tomato was first introduced; however, the crop is cultivated in different major growing areas of the country. In 2015 cropping calendar, tomato production in Ethiopia was about 22,788 tons from harvested area of 3,677 ha (CSA 2015). It is used as canned vegetable having multiple uses and supplies essential nutrients in human diets (Choudhury, 1979). It is popularly used for both commercial and home use purposes. The fresh produce is sliced and used as salad. It is also cooked for making local saucer (‘watt’). The processed products like tomato paste, tomato juice, tomato catch-up and whole peel-tomato are produced in the country for local market and export. It was recognized as quality product for both local and export markets and providing a route out of poverty for small scale producers who live in developing countries in general and in Ethiopia in particular (Tewodros and Asfaw, 2013).Despite the importance of this crop, the production and productivity is constrained by different biophysical and socio-economic reasons, such as lack of adapted and improved tomato technologies, land shortage, inadequate knowledge on production and management (processing) systems, poor extension services, poor marketing system and proper utilization of the crop are a few to mention (Mersha, 2008).

Agriculture forms the basis for livelihood and creates job opportunity for more than 85% of Ethiopian population. It accounts for 50% of the Gross Domestic Product (GDP) and 90% of the national export earnings (MoARD, 2007). Vegetables took up about 1.18% of the area under all crops at national level. Productions of vegetables contribute 2.0% of the total crops production. Holders living near to urban centers largely practice vegetable farming. In Ethiopia, tomato ranks fourth in total production (5.45%) after Ethiopian cabbage, red pepper and green pepper are third in area coverage (4.49%) next to red pepper and Ethiopian cabbage from vegetable crops cultivated. Its national mean yield is 6.2ton/ha (CSA 2015). This is by far below the world average 34.84 ton/ha (FAO 2009).This is due to shortage of varieties and recommended information packages, poor quality seed, poor irrigation systems, lack of information on soil fertility, disease and insect pests, high post harvest loss, and poor marketing system (Lemma, 2002). Tomato can be produced in a wide range of climatic conditions and many types of soils. It is mainly produced under irrigation during off season because under rainy condition, it is susceptible to a disease complex. Successful cultivation of tomato is based essentially upon the choice of suitable varieties for a particular location (Chaerani, 2006). Tomato shops are mushrooming in towns of Borana zone, and investors and farmer associations have started to produce those crops (Personal observation). There is high potential to produce tomato in the zone, but not well done due to technical (production technology) and socio-economic problems. Among technical problems, unavailability of seeds of adapted and improved tomato varieties is the most limiting factor. Therefore, the objective of this research is to test a range of improved varieties under Borana condition to identify genotypes with relatively better performance and to know the pattern and extent association among yield and yield related traits collected.

MATERIALS AND METHODS

Description of study area

The experiment was conducted at Yabello YPDARC research site, in southern Ethiopia under irrigation, using tap water. The site is located at N04.88006 and E038.14761 with altitude of 1615 m.a.s.l. The soil at the site is characterized as sandy with PH of 7.03 (Table 1). It is located at 570 km along Addis Ababa-Moyale main road. It has annual mean precipitation of 500 mm. The area is characterized by bimodal rainfall where 60% rainfall occurs during main rainy season (March to May) and the remaining 40% goes to the short rainy season (September to November). The mean annual temperature varies from 19 to 24°C. Livelihood of the people is basically Agro pastoralist. OC = organic carbon; EC = electro conductivity; Av.P = available Phosphorus; CEC = Cation Exchangeable Capacity NB: PH: in water suspension with soil to water ratio 1:2.5 by PH meter; EC: in water suspension with soil to water ratio 1:2.5 by electro Conductivity meter; % OC: Walkey and Black method; Av.P by Olsen etal; Texture by Hydometer; CEC = CationExchangable Capacity by Ammonium Acatate (1 M NH4OAC).

Planting materials and experiment methodology

Four improved and recommended varieties of tomato, namely: Fetan, Melkashola, Miya and Cochoro, introduced from Melkassa Agricultural Research Center and one variety called CAL-J introduced from Kenya, were tried for their adaptation using tap water. The experiment design was a RCBD with three replications. Six rows and six plants per row with 70 cm between rows and 30 cm between plants were used for this experiment. Four middle rows were used for data per plot leaving the two rows as border. A fertilizer rate of 200 kg/ha of Di Ammonium Phosphate (DAP) (23-46-0) and 50 kg/ha of Urea (46-0-0) were applied at transplanting

Table 2. Mean squares due to varieties and error for yield and yield components of 5 tomato varieties grown in 2014 in Borana zone at YPDARC.

Traits	Df = 4	Df = 22
	Varieties	Error
Days to 50% flowering	5.17n.s.	4.22
Days to first harvest	1.00 n.s.	5.80
Plant height (cm)	159.53***	2.07
Number of primary branch	1.70**	0.15
Marketable fruit yield (ton/ha)	56.64*	10.98
Unmarketable fruit yield (ton/ha)	0.87*	0.21
Total fruit yield (ton/ha)	71.46*	14.04
Fruit number per plant	11.59n.s.	5.28
Single fruit weight (g)	987.67**	122.72

*, **, *** = Significant at 5, 1 and 0.1% probability level respectively, Df = degree of freedom, n.s. = non- significant.

time and 50 kg/ha urea was applied at early flowering stage. The seedlings were raised on nursery bed at 10 cm distance between rows and about 2 cm between plants at thinning. The nursery bed was kept moist but not wet. Transplanting was done at 36 days after sowing when the seedlings were about 13 to 15 cm length and at 2 to 3 leaf stage. Frequency of irrigation on field was at 7 days interval using tap water and harvested rain water until the soil in the root zone (30 cm depth) is moist but not wet. All the agronomic practices were as per the recommendation from Melkasa Agriculture research center. No serious diseases were observed during this experiment, but bird attack was a potential problem so that the guard was assigned at the research site.

Data collected and statistical analysis

Data were collected on parameters like Plant height, number of primary branch, days to 50% flowering, days to first harvest, Total fruit yield (ton/ha), marketable fruit yield (ton/ha), unmarketable fruit yield (ton/ha), fruits number per plant and single fruit weight (gram). Damaged, sunburn and fruits with a weight of less than 25 gram were recorded as unmarketable (Lemma, 2002).

1. Plant height (cm): Plant height was recorded by measuring the height of 5 randomly selected plants in each plot from the ground to the main apex.
2. Number of Primary branch: Counted at maturity from 5 randomly selected plants in each plot.
3. Days to 50% flowering: transplanting date to the day on which 50% of the plant in each plot is flowered.
4. Days to first harvest: the number of days from transplanting to the first picking day.
5. Fruit yield (ton/ha): Sum of fruit weight per plot from successive harvest (kg) was taken and converted to ton per hectare.
6. Fruit number per plant: The number of fruit in successive harvest per plant.
7. Single fruit weight (gram): Calculated by dividing fruit yield per plot to total number of fruits harvested per plot.

Analysis of variance for the collected parameters was performed as per the methods described by Gomez and Gomez (1984) using SAS computer software (SAS, 2009) for randomized complete block design and treatment mean comparison is done by Fisher's list significance difference (LSD) at 5%. Pearson's correlations among all the collected parameters were also evaluated.

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) was done for the collected parameters. The result of ANOVA showed that there was significant ($P \leq 0.05$) variation among the varieties for parameters including Plant height, number of primary branch, Total fruit yield (ton/ha), marketable fruit yield (ton/ha), unmarketable fruit yield (ton/ha) and single fruit weight (gram), but there was no significant variation for parameters like days to 50% flowering, days to first harvest and fruit number per plant (Table 2). Baliyan and Rao (2013) also found significance variability in yield produced by six tomato varieties evaluated for pest and disease and productivity in Botswana. Variety Miya gave significantly higher marketable fruit yield (22.95 tons ha^{-1}) and higher average of single marketable fruit weight (85.84 gram) than other varieties. The least mean marketable fruit yield was obtained from the variety Fetan (11.61 tons ha^{-1}) (Figure 1 and Table 3). The mean marketable fruit yield obtained (11.61 to 22.95 ton/ha) is comparable to the result of other literatures. Researchers on tomato (Palada and Allison 2001; Znidarcic etal., 2003; Lemma, 2002) got a mean marketable fruit yield between 7.21 to 48.80 ton/ha. The variety CAL-J was the tallest (52 cm) whereas the variety Cochoro is the shortest (32.24 cm) (Table 2). Eshteshabul et al. (2010) and Kaushik et al. (2011) also obtained tomato plant with plant height in the range of 36.80 to 126.50 cm.

Marketable fruit yield was significantly and positively correlated with fruit number per plant (r = 0.75) and single fruit weight (r = 0.51) (Table 4). This indicates that varieties with higher fruit number per plant and single fruit weight gives high marketable fruit yield. Marketable and unmarketable fruit yields are also highly and positively correlated (r = 0.99). Number of primary branch was negatively significantly correlated (r = 0.54) with days to first harvest indicating that late maturing varieties have more number of primary branches than early maturing

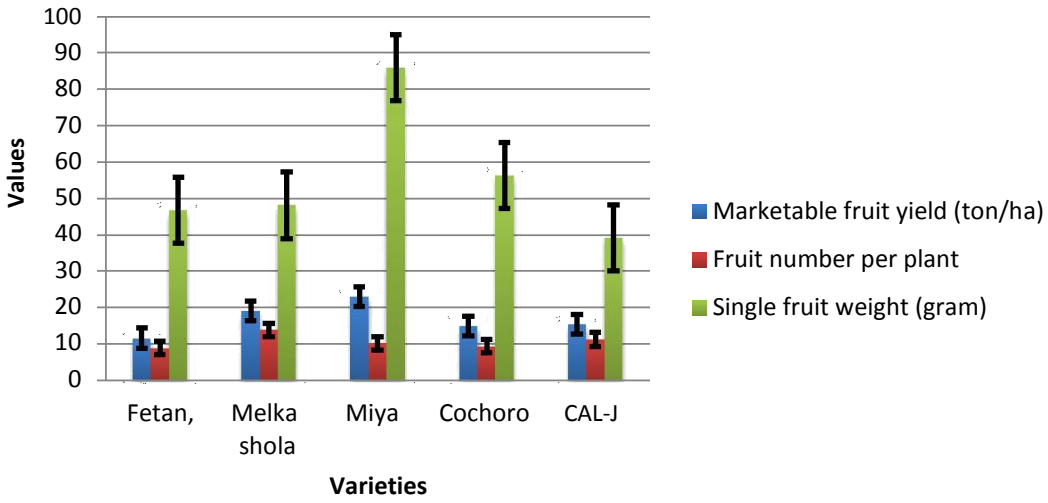

Figure 1. Value of Marketable fruit yield, Fruit number per plant and single fruit weight of 5 tomato varieties grown at Yabelloin 2014.

Table 3. Mean value of yield and yield components of 5 tomato varieties grown in 2014 in Borana zone at YPDARC.

S/N	Varieties	Dfl	Dfh	Ph	Npb	Mfy	Ufy	Tfy	Fnpp	Sfw
1	Fetan,	71.67	86.67	36.60^{d}	3.15^{b}	11.61^{c}	1.92^{c}	13.53^{c}	8.91	46.70^{b}
2	Melka shola	71.33	86.33	39.73^{c}	4.15^{a}	19.11^{ab}	2.79a^{b}	21.90^{ab}	13.85	48.14^{b}
3	Miya	71.33	86.33	44.27^{b}	3.88^{a}	22.95^{a}	3.30^{a}	26.25^{a}	10.17	85.84^{a}
4	Cochoro	74.33	87.67	33.24^{e}	2.47^{b}	14.94b^{c}	2.20b^{c}	17.14b^{c}	9.38	56.35^{b}
5	CAL-J	71.33	86.33	52.00^{a}	4.23^{a}	15.38b^{c}	2.41b^{c}	17.79b^{c}	11.27	39.24^{b}
	Varieties Mean	72.00	86.67	41.17	3.58	16.80	2.52	19.32	10.71	55.25
	CV (%)	2.85	2.78	3.50	10.67	19.73	18.27	19.39	21.44	20.05
	SED	1.68	1.97	1.18	0.31	2.71	0.38	3.06	1.88	9.05
	LSD(0.05)	n.s.	n.s.	2.71	0.72	6.24	0.87	7.05	n.s.	20.86

SED = standard error of difference; CV= coefficient variation; LSD= least significant difference; n.s.= non significant; Dfl=Days to 50% flowering, Dfh=Days to first harvest, Ph=Plant height (cm), Npb= Number of primary branch, Mfy=Marketable fruit yield (ton/ha), Ufy= Unmarketable fruit yield (ton/ha),, Tfy= Total fruit yield (ton/ha), Fnpp=Fruit number per plant, and Sfw= Single fruit weight, Varieties mean in the same column with similar letter are not significantly different from each other.

Table 4. Pearson's correlation (r) of yield and other collected parameters of 5 tomato varieties grown in 2014 in Borana zone at YPDARC.

Parameters	MFY	UFY	TFY	Fnpp	Sfw	Dfl	Dfh	Ph	Npb
MFY	-	-	-	-	-	-	-	-	-
UFY	0.98***	-	-	-	-	-	-	-	-
TFY	0.99***	0.99***	-	-	-	-	-	-	-
Fnpp	0.75***	0.74**	0.75***	-	-	-	-	-	-
Sfw	0.51*	0.48n.s.	0.51*	-0.13n.s.	-	-	-	-	-
Dfl	0.24n.s.	0.19n.s.	0.24n.s.	0.28n.s.	0.01n.s.	-	-	-	-
Dfh	0.28n.s.	0.21n.s.	0.27n.s.	0.43n.s.	-0.18n.s.	0.80***	-	-	-
Fh	0.16n.s.	0.18n.s.	0.16n.s.	0.10n.s.	-0.02n.s.	-0.43n.s.	-0.26n.s.	-	-
Npb	0.18n.s.	0.16n.s.	0.18n.s.	0.25n.s.	-0.08n.s.	-0.54*	-0.31n.s.	0.76**	-

*;**,*** = Significant at 5%, 1% and 0.1% probability level respectively n.s.= non significant; Dfl = Days to 50% flowering, Dfh=Days to first harvest, Ph=Plant height (cm), Npb= Number of primary branch, Mfy=Marketable fruit yield (ton/ha), Ufy= Unmarketable fruit yield (ton/ha),, Tfy= Total fruit yield (ton/ha), Fnpp=Fruit number per plant, and Sfw= Single fruit weight.

ones.

CONCLUSION AND RECOMMENDATIONS

Tomato need to be cultivated in Borana zone for both commercial and home use purposes. To increases production and productivity of the crop appropriate varieties has to be looked for beside agronomic and plant protection activities. Evaluation of varieties for local adaptation continued to part of strategic approach of Oromia Agricultural Research Institute in developing and promoting appropriate crop technologies for Oromia region of Ethiopia. In the present experiment, variety Miya was found superior in economic yield (marketable yield) and other parameters that it was recommended for further popularization in Yabello district under irrigation. Other agronomic and plant protection trials should be done for the success of production and productivity of tomato in the area. Post harvest management activities also have to be researched to increase its shelf life. Since the experiment is one site one season experiment, further studies using combination of locations and seasons is required to generate more reliable information on performance of varieties across location and year.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

Chaerani R (2006). Early blight resistance in tomato: screening and genetic study. PhD Thesis, Wageningen University, Wageningen, Netherlands, P 188.

Choudhury B (1979). Vegetables 6th Revised Edn. The Director, National Book Trust, New Delhi, India, P 46.

CSA (Central Statistical Agency) (2015). Crop Production Forecast Sample Survey, 2013/14. Report on Area and Production for Major Crops (for Private Peasant Holdings 'Meher' season). Addis Ababa, Ethiopia.

Eshteshabul M, Jahangir M, Hakim MA, Amanullah ASM, Ahsanullah ASM (2010). An assessment of physiochemical properties of some tomato genotypes and varieties grown at Rangpur. Bangladesh Res. Pub. J. 4(3):135-243

FAO (2005). FAOSTAT, Available at http://faostat.fao.org, accessed on 20May 2015.

FAO (2009). Statistical bulletin. Rome, Italy. (150):1-2.

Gomez K, Gomez AA (1984). Statistical Procedures for Agricultural Research. 2nd edition. John Willey & Sons Ltd., New York, USA. P 680.

Kaushik SK, Tomar DS, Dixit Ak (2011). Genetics of fruit yield and its contributinmg characters in tomato. J. Agric. Biotechnol. Sustainable Dev. 310:209-213.

Lemma D (2002). Research experience and production prospects. Ethiopian Agricultural Research Organization (EARO), Addis Ababa, Ethiopia, pp. 20-28.

Maerere A, Sibuga KP, Mwajombe KK (2006). Baseline survey report of tomatoproduction in Mvomero district-Morogororegion, Tanzania, Sokoine University of Agriculture Faculty of Agriculture, Morogoro, pp. 1-31.

Mersha A (2008). Effects of stage and intensity of truss pruning on fruit yield and quality of tomato (Lycopersiconesculentummill.) M.Sc. Thesis. Alemaya University. pp. 10-16.

MoARD (Ministry of Agriculture and Rural Development of Ethiopia) (2007). New Agricultural extension service process description and working procedure, Addis Ababa.

Palada C, Allison M (2001). Yield performance of potato cultivarsgrown under organic management system. Proc. Caribbean Food Crop Soc. 37:154-160.

SAS (Statistical Analysis System) Software (2009). Version 9.2. Inc. Carry, North Carolina, USA.

Baliyan SP, Rao MS (2013). Evaluation of Tomato varieties for pest and disease adaptation and productivity in Botswana. Int. J. Agric. Food Res. 2(3):20-29.

Tewodros M, Asfaw K (2013). Promotion and evaluation of improved technologies through participatory approach in South Ethiopia: Experience from hot pepper. Unique Res. J. Agric. Sci. 1(4):57-62.

Wikipedia (2016). The free encyclopedia, Available at http://en.wikipedia.org, accessed on 8 August 2016.

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