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Evaluation of Tomato (*Lycopersicon esculentum* Mill.) Genotypes for Yield and Yield Components

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ABSTRACT

Owing to the limited availability of improved cultivars that are suitable for different purposes, the yield of tomato in Ethiopia is far below the world's average. The world's average was 34.84 tones/ha and the average productivity of Ethiopian was 7.57 tones/ha (FAO 2009). Hence, identification of improved tomato varieties that are adaptable, high yielding and disease resistant are necessary. Therefore, an experiment was conducted at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) to evaluate nine tomato (*Lycopersicon esculentum* Mill.) varieties for their fruit yield using a Randomized Complete Block Design (RCBD) with three replications under field conditions. Data were collected on growth parameters and yield components, including plant height, primary branch, number of flowers and fruit per cluster, number of fruit clusters per plant, days to first harvest, fruit set percentage, polar and equatorial diameter, number and yield of fruit per plant, marketable, unmarketable and total fruit yield per hectare. The study indicated that yield per plant was higher for 'H-1350', 'Eshet', 'Metadel', 'Marglobe' and 'Moneymaker' than the rest of the varieties. Total yield was highest for 'H-1350', 'Eshet', 'Metadel', 'Marglobe' and 'Moneymaker' whereas it was lowest for 'Fetan', 'Miya' and 'Jimma local'. Considering yield and yield components, variety 'H-1350' was found to be better than the rest of the varieties, while 'Eshet', 'Marglobe' and 'Jimma local' were the poorest performers for almost all parameters.

Keywords: fruit yield, growth parameters, tomato, yield components

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important edible and nutritious vegetable crops in the world. It belongs to the Solanaceae family. It ranks next to potato and sweet potato with respect to world vegetable production. It is widely cultivated in tropical, sub-tropical and temperate climates and thus ranks third in terms of world vegetable production (FAO 2006). The leading tomato-producing countries are China, the United States of America, India, Egypt, Turkey, Iran, Mexico, Brazil and Indonesia (FAO 2006). It is one of the most economically important vegetable crops and is widely cultivated in the world with a total area and production of 5,227,883 ha and 129,649,883 tones in 2008 (FAO 2009). It is the most frequently consumed vegetable in many countries, becoming the main supplier of several plant nutrients and providing an important nutritional value to the human diet (Willcox *et al*. 2003). The crop generally requires warm weather and abundant sunshine for best growth and development. Vegetative and reproductive growth at lower temperatures are very limited, and an extended period of plant growth at 12°C or less can result in chilling injury. Moreover, the plant grows best when provided with uniform moisture and well-drained soils (Gould 1992).

The 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. Large-scale production of tomato takes place in the upper Awash valley, under irrigated and rain-fed conditions whereas small-scale production for fresh market is a common practice around Koka, Ziway, Wondo-Genet, Guder, Bako and many other areas (Lemma 2002). In 2008, tomato production in Ethiopia reached about 41, 815 tones from a total harvested area of 3542 ha (FAO 2009).

The shortage of varieties and recommended information packages, poor quality seeds, poor irrigation systems, lack of information on soil fertility, disease and insect pests, high post harvest loss, lack of awareness of existing improved technology and poor marketing systems are the major constraints in Ethiopian tomato production (Lemma 2002). In Ethiopia, several tomato varieties had been released nationally and recommended by the Melkasa Agriculture Research Center (MARC) for commercial production and small-scale farming systems in Ethiopia. Varieties such as 'Melkashola' and 'Marglobe' are widely produced while 'Melkasala' and 'Heinz 1350' have limited distribution and production. On the other hand, 'Fetan', 'Bishola', 'Eshet' and 'Metadel' are being tested (Lemma 2002). Tomato production has been restricted to certain regions of the country for several reasons, including the shortage of varieties and the lack of a recommendation package regarding production. Therefore, the objective of this study was to compare the growth parameters, plant characters, yield components and fruit yield of tomato genotypes cultivated under Jimma conditions.

MATERIALS AND METHODS

The study site, Jimma University College of Agriculture and Veterinary Medicine (JUCAVM), is located at the Southwestern part of Ethiopia in Oromia Regional State at mid-altitude sub humid Zone and 346 km Southwest of Addis Ababa, at 7° 42′ N latitude and 36° 50′ E longitude with an altitude of 1710 m above sea level. The area receives an average annual rainfall of 1530 mm. The area has average maximum and minimum temperatures of 26.2°C and 11.3°C, respectively and average maximum and minimum relative humidity of 91.40 and 37.92%, respectively (BPEDORS 2000).

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Nine tomato varieties were used in the experiment, four of which are determinate ('Bishola', 'Fetan', 'H-1350', and 'Miya') while another four are indeterminate types ('Metadel', 'Marglobe', 'Eshet' and 'Moneymaker'). The last cultivar is a local cultivar ('Jimma local'). The seeds of all varieties were obtained from the germplasm collections maintained at MARC.

The study was conducted under irrigation during the 2010 cropping season. Seedlings were raised in nursery beds at JUCAVM, the beds were thoroughly prepared, 2 m × 1 m in size, raised 5 cm from the soil surface to provide good drainage for the removal of surplus irrigation water. The seeds were sown in rows spaced 15 cm apart and covered lightly with fine soil before irrigation. The beds were irrigated every day until germination then twice a week. After germination, seedlings were thinned until an intra-row spacing of 3 cm was achieved.

The treatments consisted of eight improved and one 'Jimma local' tomato. The experimental plots were laid out in a randomized complete block design (RCBD) with three replications. Seedlings were carefully transplanted after 6 weeks to the experimental plots which were prepared with 2.0 m × 3.2 m dimensions to accommodate 28 plants per plot (four rows) at a recommended spacing of 100 cm between rows and 30 cm between plants (Lemma 2002). The spacing between two plots in each replication and between adjacent blocks were 0.5 m and 1 m, respectively as an aisle. Standard agronomic practices such as weeding, cultivation, irrigation, fertilizer application and staking were carried out uniformly during the growing season for all plots. Diseases were managed as per the recommendations of Lemma (2002). Fruit was harvested at the mature green stage.

Field data were collected in this experiment, including growth parameters, plant characters, yield components and fruit yield of tomato plant, as indicated next.

Plant height (cm): Plant height was recorded by measuring the height of randomly selected plants in each plot from the ground level to the main apex; mean values were expressed in cm.

Number of primary branches: Number of primary branches per plant were counted at the maturity stage and means were computed.

Days to 50% flowering: The number of days was noted from transplanting date to the day on which 50% of the plants in a plot flowered.

Number of flowers per flower cluster: Tomato plants were tagged from each plot for this purpose and the numbers of flowers were counted from lower, middle and upper clusters; the mean number of flowers per cluster was computed.

Number of fruit clusters per plant: The number of fruit clusters per plant was counted from the pre-tagged plants.

Number of fruits per cluster: The total number of fruits per clusters was counted from each pre-tagged plant in each plot having three labels hung on lower, middle and upper parts.

Fruit set percentage (%): Data on fruit set percentage was obtained by dividing the number of fruits by the number of flowers per cluster and means from lower, middle and upper part were calculated.

Days to first harvest: Number of days from transplanting date to first picking day was counted.

Average fruit yield per plant (kg/plant): This was measured by taking the mean weight of fruit in successive harvests per plant and expressed in kg per plant.

Average number of fruits per plant: The mean number of fruits per plant was calculated by counting the number of fruits of successive harvests per plant.

Marketable and unmarketable fruit yield per hectare (tones/ha): At each harvest, fruits were categorized as marketable or unmarketable fruits. Fruits with cracks, damaged by insects, diseases, birds, small fruits and those with sunburn were considered as unmarketable (Lemma 2002). Those which were free from visible damage were considered as marketable and yield was expressed in terms of tones per hectare.

Average total yield per hectare (tones/ha): The mean total yield per hectare was obtained by adding marketable and unmarketable fruit yield and was expressed in tones.

Average fruit polar diameter (cm): Randomly picked sample fruits were used to determine the polar (steam to blossom end) diameter of the fruits using a vernier caliper; values were expressed in cm.

Average equatorial diameter (cm): The same fruit which was used for polar diameter was measured for their equatorial (transverse diameter) diameter; values were expressed in cm.

Average fruit shape index: The mean fruit shape index was calculated by dividing the mean polar diameter by the mean equatorial diameter of the fruit (Ching 1998).

The data were analyzed according to Montgomery (2005) using SAS statistical software package and the mean values were compared using the procedure of Ryan-Einot-Gabriel-Welsch Multiple Range Test (REGWQ) (SAS 2003) at the 5% level of significance. Pearson's correlation within growth parameters and yield components were also evaluated.

RESULTS AND DISCUSSION

Growth parameters and plant characters

Plant height was significantly ($P \leq 0.001$) different among the varieties (**Table 1**). The mean value lay between 40.20 and 107.00 cm. The tallest plant was 'Eshet' (107.00 cm) followed by 'H-1350' (78.93 cm) while the shortest were 'Miya', 'Bishola' and 'Fetan' (**Table 4**). This finding was in agreement with other researchers (Khokhar *et al.* 2001; Mohanty and Prusti 2001; Khah *et al.* 2006; Fayaz *et al.* 2007; Eshteshabul *et al.* 2010; Kaushik *et al.* 2011) obtained tomato with plant height in the range of 36.80-126.50 cm. The number of primary branches per plant lay between 3.33 and 5.26. The same number of primary branches was obtained in all varieties (**Table 4**). Several researchers (Khokhar *et al.* 2001; Mohanty and Prusti 2001; Fayaz *et al.* 2007) found a range for number of primary branches per plant between 3.10 and 12.63.

Days to flowering and maturity were significantly ($P \leq 0.001$) different among the varieties (**Table 1**). The period between transplanting and flowering ranged from 38 to 49 days. Among the different varieties, 'Miya', 'H-1350' and 'Fetan' showed earliest flowering whereas 'Bishola' and 'Jimma local' showed statistically late flowering. Peires (2002), Abrar *et al.* (2011) and Falak *et al.* (2011) indicated that the period from transplanting to flowering of tomato varieties ranged between 40 and 49 days. 'Jimma local' was late by about 5 days to first harvest compared to 'Bishola' and 'Moneymaker'. Likewise, 'Bishola' and 'Moneymaker' were late by 8 days compared with 'Eshet' and 'H-1350', which had similar days to first harvest. Other studies (Bohner and Bangerth 1988; Lemma 2002; Fayaz *et al.* 2007; Abrar *et al.* 2011; Falak *et al.* 2011) showed that the time from transplanting to first harvest for tomato varieties ranged between 70 and 120 days. Moraru *et al.* (2004) also indicated a wide range of variability in days to first harvest.

Yield components and fruit yield

The numbers of flowers per cluster were significantly ($P \leq 0.001$) different among the varieties (**Table 2**). Except for 'Jimma local', all the tomato varieties tested achieved the maximum number of flowers per cluster. Despite this, fruit set percentage was not significantly different among the varieties: 'Eshet' (70.67%) had the highest while 'Fetan' (62.33%) had the lowest fruit set percentage. Three studies (Agong *et al.* 2001; Khah *et al.* 2006; Abrar *et al.* 2011) indicated that average values lay between 2.27-5.89 and 36.90-98.50% for number of flowers per cluster and fruit set percentage, respectively.

The number of fruit clusters per plant and fruits per cluster were significantly ($P \leq 0.05$) different among the varieties (**Tables 1, 2**). The number of fruit clusters per plant were maximum in 'H-1350', 'Eshet', 'Marglobe' and 'Moneymaker' and minimum in 'Fetan', 'Bishola', 'Metadel', 'Miya' and 'Jimma local'. Except for 'Jimma local', all the tomato varieties tasted achieved the maximum number of fruits per cluster. The number of fruit clusters per plant was weakly related to the number of flowers and fruit per cluster ($r = 0.62$ and $r = 0.46$) (**Table 7**). This indicates

Table 1 Mean squares for plant height, number of primary branch, days to flower, days to maturity and number of cluster per plant obtained from analysis of variance.

Source of variations	Df	Mean squares				
		HT	BN	DTFL	DM	CL/P
Block	2	12.91	4.41*	4.33	5.15	5.64*
Varieties	8	1271.62***	1.16	44.25**	93.81***	7.62***
Error	16	28.86	0.48	1.50	1.48	0.75
CV (%)		8.39	15.11	2.84	1.36	8.03

Df = Degree of freedom, CV = Coefficient of variation, HT = Plant height, BN = Number of primary branches, DTFL = Days to flower, DM = Days to maturity, CL/P = Number of clusters per plant *, **, ***, are significant at P ≤ 0.05, P ≤ 0.01, P ≤ 0.001, respectively and ns = not significant at P > 0.05..

Table 2 Mean squares for number of flower per cluster, number of fruit per cluster, fruit set percentage, polar diameter, equatorial diameter, fruit shape index obtained from analysis of variance.

Source of variations	Df	Mean squares					SI
		FI/C	F/C	FP	PD	ED	
Block	2	0.73*	0.21	0.01	0.04	0.04	0.01
Varieties	8	0.97***	0.42*	0.01	0.77**	1.28**	0.03*
Error	16	0.11	0.12	30.12	0.14	0.31	0.01
CV (%)		7.46	11.74	8.27	6.64	8.89	10.65

Df = Degree of freedom, CV = Coefficient of variation, FI/C = Number of flowers per cluster, F/C = number of fruits per cluster, FP = Fruit set percentage, PD = Polar diameter, ED = Equatorial diameter, SI = Fruit shape index, *, **, ***, are significant at $P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$, respectively and ns = not significant at $P > 0.05$.

Table 3 Mean squares for fruit weight per plant, number of fruit per plant, marketable yield, unmarketable yield, total yield obtained from analysis of variance.

Source of variations	Df	Mean squares				
		W/Pl	NF/Pl	MW	UMW	TW
Block	2	0.29**	39.36**	175.00**	2.34	145.00**
Varieties	8	0.17***	29.62***	56.20*	3.49**	83.00***
Error	16	0.03	3.03	16.36	0.84	13.01
CV (%)		11.49	8.67	14.54	25.85	11.49

CV = Coefficient of variation, Df = Degree of freedom, W/PL = Fruit weight per plant, NF/PL = Number of fruits per plant, MW = Marketable yield, UNM = Unmarketable yield, TW = Total yield *, **, ***, are significant at $P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$, respectively and ns = not significant at $P > 0.05$.

Table 4 Growth parameters of tomato varieties grown at Jimma.

Varieties	Parameters				
	HT (cm)	BN (No.)	DTFL (Days)	DM (Days)	CL/P (No.)
Fetan	43.33 ef	4.80 a	38.67 ef	83.67 d	10.07 bc
Bishola	51.07 def	3.33 a	47.67 ab	94.67 b	10.63 bc
Eshet	107.00 a	3.80 a	41.67 cde	85.67 cd	12.20 ab
H-1350	78.93 b	5.26 a	40.33 def	86.33 cd	13.53 a
Metadel	55.40 de	4.73 a	42.00 cd	87.00 c	10.60 bc
Marglobe	64.47 cd	4.86 a	44.67 bc	92.67 b	11.40 ab
Moneymaker	73.07 bc	5.06 a	45.67 b	94.00 b	11.60 ab
Miya	40.20 f	4.80 a	38.33 f	83.33 d	8.53 c
Jimma Local	62.67 cd	4.73 a	49.00 a	99.00 a	8.77 c
SE(±)	3.10	0.40	0.71	0.70	0.50
CV (%)	8.39	15.11	2.84	1.36	8.03

Means within the same column followed by a common letter are not significantly different at $P \leq 0.05$(REGWQ) HT = Plant height, BN = Number of primary branches, DTFL = Days to flowering, DM = Days to maturity, CL/P = Number of fruit clusters per plant.

Table 5 Yield components of tomato varieties grown at Jimma.

Varieties	Parameters					
	FI/C (No.)	F/C (No.)	FP (%)	PD (cm)	ED (cm)	SI
Fetan	4.63 ab	2.87 ab	62.33 a	5.88 a	5.79 ab	1.02 ab
Bishola	4.52 ab	2.97 ab	65.67 a	6.12 a	6.39 a	0.96 ab
Eshet	4.62 ab	3.27 ab	70.67 a	5.92 a	6.67 a	0.89 ab
H-1350	5.27 a	3.43 a	65.00 a	5.63 ab	6.36 a	0.89 ab
Metadel	4.18 b	2.70 ab	65.00 a	6.33 a	6.95 a	0.92 ab
Marglobe	4.70 ab	3.03 ab	64.33 a	5.35 ab	6.82 a	0.79 b
Moneymaker	4.89 ab	2.97 ab	60.67 a	4.68 b	5.97 ab	0.79 b
Miya	4.72 ab	3.47 a	73.33 a	5.32 ab	4.80 b	1.11 a
Jimma Local	3.22 c	2.27 b	70.33 a	5.01 ab	5.12 ab	0.98 ab
SE(±)	0.20	0.20	3.17	0.22	0.32	0.06
CV (%)	7.46	11.74	8.27	6.64	8.90	10.65

Means within the same column followed by a common letter are not significantly different at $P \leq 0.05$(REGWQ) FI/C = Number of flowers per cluster, F/C = Number of fruits per cluster, FP = Fruit set percentage, PD = Polar diameter, ED = Equatorial diameter, SI = Fruit shape index.

that a higher number of fruit clusters per plant give more flowers and fruits per cluster.

Equatorial (transverse diameter) and polar (steam to blossom end) diameters of the fruits were significantly ($P \leq 0.01$) different among the varieties (**Table 2**). The mean values lay between 4.68 and 6.33 cm and between 4.80 and

Table 6 Yield and yield components of tomato varieties grown at Jimma.

Varieties	Parameters				
	NF/Pl (No.)	W/Pl (kg)	MW (t/ha)	UMW (t/ha)	TW (t/ha)
Fetan	16.57 c	1.22 c	36.89 ab	3.89 bc	40.78 c
Bishola	16.83 c	1.26 bc	37.11 ab	5.00 abc	42.11 bc
Eshet	20.03 bc	1.70 ab	48.89 ab	7.78 a	56.67 ab
H-1350	20.13 bc	1.74 a	50.89 a	7.11 ab	58.00 a
Metadel	20.67 bc	1.37 abc	40.78 ab	4.89 abc	45.67 abc
Marglobe	19.80 bc	1.54 abc	44.67 ab	6.67 abc	51.33 abc
Moneymaker	23.30 ab	1.53 abc	45.89 ab	5.11 abc	51.00 abc
Miya	26.10 a	1.16 c	35.89 ab	2.78 c	38.67 c
Jimma Local	17.07 c	1.10 c	32.11 b	4.44 abc	36.56 c
SE(±)	1.01	0.09	2.34	0.53	2.08
CV (%)	8.67	11.49	14.54	25.85	11.49

Means within the same column followed by a common letter are not significantly different at $P \leq 0.05$ (REGWQ) NF/PL = Number of fruits per plant, W/PL = Fruit yield per plant, MW = Marketable yield, UNM = Unmarketable yield, TW = Total yield.

Table 7 Pearson's correlation (r) of yield parameters and its component of tomato varieties.

	HT	BN	DM	DTFL	CL/P	F/C	FL/C	FP	MW	UNM	TW	W/PL	NF/PL	PD	ED	SI
HT	-															
BN	0.01	-														
DM	0.03	-0.17	-													
DTFL	0.08	-0.29	0.98***	-												
CL/P	0.65**	0.30	-0.17	-0.16	-											
F/C	0.24	0.25	-0.50**	-0.49**	0.46*	-										
FL/C	0.19	0.28	-0.51**	-0.52**	0.62**	0.80***	-									
FP	0.09	-0.04	-0.02	0.02	-0.25	0.37	-0.26	-								
MM	0.55**	0.53**	-0.19	-0.18	0.76***	0.51**	0.51**	0.01	-							
UNM	0.66**	-0.18	-0.02	-0.001	0.52**	0.07	0.21	-0.20	0.12	-						
TW	0.65**	0.47*	-0.19	-0.17	0.83***	0.50**	0.53**	-0.03	0.98***	0.32	-					
W/PL	0.65**	0.47*	-0.19	-0.17	0.83***	0.50**	0.53**	-0.03	0.98***	0.32	1.00***	-				
NF/PL	0.04	0.49**	-0.31	-0.35	0.17	0.52**	0.42*	0.19	0.53**	-0.35	0.43**	0.43*	-			
PD	-0.08	-0.20	-0.05	0.05	-0.13	-0.26	-0.39*	0.20	-0.17	0.08	-0.15	-0.15	-0.48*	-		
ED	0.44*	0.02	0.27*	0.35	0.46*	-0.06	-0.10	0.03	0.33	0.34	0.38*	0.38*	-0.28	0.33	-	
SI	-0.49**	-0.11	-0.34*	-0.34	-0.52**	-0.10	-0.17	0.14	-0.41*	-0.29	-0.44*	-0.44*	-0.03	0.44*	-0.70***	-

HT = plant height, BN = number of primary branches, DTFL = Days to flower, DM = Days to maturity, CL/P = Number of clusters per plant, FI/C = Number of flowers per cluster, F/C = Number of fruits per cluster, FP = Fruit set percentage, MW = Marketable yield, UNM = Unmarketable yield, TW = Total yield, NF/PL = Number of fruits per plant, W/PL = Fruit weight per plant, PD = Polar diameter, ED = Equatorial diameter, SI = Fruit shape index. *, **, ***, correlation is significant at $P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$, respectively and ns = not significant at $P > 0.05$.

6.95 cm for polar and equatorial diameter, respectively. Except for 'Moneymaker' and 'Miya', all other varieties had maximum fruit diameter and also did not differ significantly among each other. The polar diameter of the fruits in all the tomato varieties studied was smaller than the equatorial diameter. Several studies (Khokhar *et al.* 2001; Žnidarcic *et al.* 2003; Kacjanmarsic *et al.* 2005; Eshteshabul *et al.* 2010; Abrar *et al.* 2011; Kaushik *et al.* 2011) illustrated that the diameter of tomato fruits lay between 4.70 and 9.00 cm and between 3.20 and 10.67 cm for polar and equatorial diameter, respectively. Minimum fruit shape index was observed in 'Marglobe' and 'Moneymaker' while the rest of the varieties attained maximum index value but means among them were not significantly different. Viswanathan *et al.* (1997) also showed that the diameter and cross-section tend to be greater than the longitudinal diameter in non-processed tomatoes. Turhan *et al.* (2011) also pointed out that fruit shape index of tomato lay in the range of 1.19 to 1.35. Atherton and Rudich (1986) also revealed that tomato cultivars differed greatly in fruit shape, which were spherical, elongated or pear-like. Thus, measurements of longitudinal and cross-sectional diameters determine their shape.

The number of fruits per plant and fruit yield per plant were significantly ($P \leq 0.001$) different among the varieties (**Table 3**). The maximum number of fruits per plant was observed in 'Miya' (26.10) and 'Moneymaker' (23.30) while the minimum was observed in the remaining varieties (**Table 6**). This difference is probably due to the difference in the number of fruits per cluster and fruit set percentage. Several other authors (Khokhar *et al.* 2001; Eshteshabul *et al.* 2010; Turhan *et al.* 2011; Abrar *et al.* 2011; Falak *et al.* 2011) reported that the mean number of fruits per plant lay between 4.46 and 98.30, Agong *et al.* (2001) showed a value between 9.70 and 158.90 while Lemma (2002) showed a range between 26 and 62. These differences are probably due to differences in the number of fruits per cluster and fruit set percentage. Fruit yield per plant lay between 1.10 and 1.74 kg. 'H-1350', 'Eshet', 'Metadel', 'Marglobe' and 'Moneymaker' had superior fruit yield per plant than 'Fetan', 'Bishola' and 'Jimma local' which had the lowest yield (**Table 6**). Others (Khokhar *et al.* 2001; Žnidarcic *et al.* 2003; Fayaz *et al.* 2007; Abrar *et al.* 2011; Falak *et al.* 2011) reported that fruit yield per plant lay between 0.83 and 3.03 kg. This variation in yield was due to differences in the number of fruit and fruit cluster per plant that contributed to difference in the yield potential of the crop.

Marketable and unmarketable fruit yield per hectare were significantly ($P \leq 0.05$) different among the varieties (**Table 3**). The mean values of marketable yield lay between 32.11 and 50.89 t/ha. Marketable yield was the same for all tomato varieties tested (**Table 5**). Others (Palada and Allison 2001; Žnidarcic *et al.* 2003) indicated that marketable fruit yield lay between 7.21 and 43.80 t/ha. **Table 4** indicates a positive correlation between marketable yield and clusters per plant (r = 0.76), fruits per cluster (r = 0.51), total number of fruits per plant (r = 0.53) and fruit yield per plant (r = 0.98). On the other hand, unmarketable fruit yield was highest in 'Eshet' (7.78 t/ha) while the lowest was in 'Miya' (2.78 t/ha). These differences in unmarketable yield were due to cracking, sunburn, deformed and damage by birds. The fruit yield of the tomato varieties tested was comparable to the results of Lemma (2002).

Total fruit yield per hectare was significantly ($P \leq 0.001$) different among the varieties (**Table 3**). The mean values ranged between 36.56 and 58.00 t/ha. Total yield was superior in 'H-1350' (58.00 t/ha) and 'Eshet' (56.67 t/ha) while 'Fetan', 'Miya', 'Bishola' and 'Jimma local' had the

lowest yield (**Table 6**). Other tomato researchers (Palada and Allison 2001; Lemma 2002; Žnidarcic *et al.* 2003; Fayaz *et al.* 2007; Eshteshabul *et al.* 2010; Falak *et al.* 2011; Kaushik *et al.* 2011) showed that total fruit yield ranged between 6.46 and 82.50 t/ha. **Table 7** indicates that a positive correlation exists between total yield and clusters per plant (r = 0.83), fruits per cluster (r = 0.50), fruit weight per plant (r = 0.98) and total number of fruits per plant (r = 0.43). This indicates that the varieties with a higher number of fruit clusters per plant and fruit per cluster gave superior yield. The variation in yield ability of the tomato varieties studied could be attributed to differences in the number of fruits per cluster, number of fruit clusters per plant and fruit yield per plant.

CONCLUSIONS

Tomato is one of the most widely accepted fruits in the world. As more tomatoes are being consumed, growers have to grow crops with high yield and good quality adapted to their environment. Data analysis indicated that yield per plant was higher for 'H-1350', 'Eshet', 'Metadel', 'Marglobe' and 'Moneymaker' whereas the remaining varieties showed the lowest values. Marketable yield was high for all varieties except for 'Jimma local'. Total yield was higher in all varieties except for 'Fetan', 'Miya' and 'Jimma local'. 'H-1350' had better yield and yield components among all varieties while 'Eshet', 'Marglobe' and 'Jimma local' showed the poorest performance in almost all parameters.

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