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Full Length Research Paper

Evaluation of improved tomato (*Lycopersicon esculentum* Mill.) varieties through participatory approach in South Ethiopia

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Participatory on farm evaluation of seven improved varieties of tomato was carried out on forty farmers' fields in major growing areas of Bolososore (Areka) and Goffa districts of Wolayita and Gamo-Goffa zones of Southern Ethiopia. The purpose of the study was to test the adaptability and acceptability of tomato technologies, create awareness to farmers and evaluate the yield potential of the technologies by farmers evaluation criteria. The performance of improved varieties have showed significant amount of variability among the traits in Areka and non significant difference at Goffa districts. For instance, mean total yield and fruit number plant^{-1} of tomato varied from 15.853-33.028t/ha and 26.52-72.58, in Areka, 76.58- 97.28t/ha and 38.25-53.45 in Goffa districts respectively. Based on the overall pair-wise comparisons by farmers'; varieties Melka-salsa, Marglobe improved and Melka-shola took the first and the second places in both tested districts and thus can be safely suggested for scale-up of the crop in both tested districts.

Keywords: Evaluation, farmers' preferences, participatory tomato

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most widely grown vegetable crops in the world (Mersha, 2008). It is widely cultivated in all parts of the world and it is the largest in volume of production after potato and sweet potato (Dorjee, 2000). Currently, tomato mainly 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).

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. It is used as home consumption (fresh) and as a market commodity in many areas of the country (CSA, 2006). Tomato is a high value commodity which has the potential for improving the incomes and livelihoods of thousands of smallholder farmers in Ethiopia and diversifying and increasing Ethiopia's agricultural export exchange earnings (Lemma, 2001). 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). To address those problems, technology introduction, development, promotion and evaluation with farmers as participatory approach could have a marvelous impact sustainable production and improved the livelihoods of rural households. Therefore, this study was designed to test the adaptability and acceptability of improved tomato technologies with farmers for further scaling up; create awareness to farmers and evaluate the yield potential of the varieties by their evaluation criteria in major tomato growing areas of Bolososore (Areka) and Goffa districts of southern Ethiopia.

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MATERIALS AND METHODS

Description of the Study Area

The study was conducted at Bolososore (Areka) and Goffa districts of Wolayta and Gamo-Goffa zones of Southern Ethiopia in 2007. Areka is located at 06° 19"241""N' latitude and 037° 22"18.6""E' longitude with an altitude of 1860 m.a.s.l. It has a humid climate with an average maximum and minimum temperature of 32.4℃ and 17.63℃ respectively, and an average annual precipitation of about 1438.95 mm. The soil is sandy loam with a pH of 5.81. Goffa is located at 06°22'335'' N' latitude and 036°58'306'' E' longitude with 1297 m.a.s.l. It receives 1338.95 mm mean annual rainfall with average maximum and minimum temperatures of 29.40 ℃ and 17.63 ℃ (Agedew, 2006).

Planting, Data collection and Statistical Analysis

Seed viability was determined by germinating scarified seed on moist filter paper in petri-dishes. In this study, approximately 87.0% of tomato seeds were germinated and the seeding rate was adjusted to give similar numbers of viable seeds per plots before sowing. After adjusting the seed rate, the seed was sown in rows over the entire seed beds (10.0 x 1.0 m of each variety) and all management practices like mulching were carried out for each bed. Fourteen days after planting the mulch was removed from seed beds and 100 g Urea was used to fertilize each bed. This was done due to enable the seedlings to become good stands as this would ease transplanting in the main fields. Forty five days after planting, the seedlings were transplanted in the main farmers' fields. The plot size was 4 x 4 m for each variety and the distance between plants and rows 40 and 60 cm respectively. The experimental plots were fertilized using 100 kg DAP/ha and 50 kg Urea/ha at transplanting, and the remaining 50kg of Urea was applied as side dressing three weeks after transplanting the seedlings. The plantation of all materials was considered as Randomized Complete Block Design (RCBD) with 20 replications in each district. Fifty plants were randomly selected from each plot to collect mean quantitative data at maturity. Total number of fruit plant^{-1}, marketable and total yield was expressed as ton/ha. Finally the analysis of these traits was performed using SAS statistical software packages.

Selection of Participating Households

Forty households from different social groups (young, men, women and wealth status) were selected from the study areas based on consultation with district agricultural offices and key informants. The objectives were to determine the adaptability and the growth performances of seven improved tomato varieties namely Money-maker, Marglove, H-1350, Roma-VF, Melka salsa, Melka-shola and Marglobe improved. From each district twenty individual farmers were considered from four groups. Five farmers were considered as a sub-group and this process was repeated for all possible sub-groups until four feasible groups have been made for each district. An aggregation was then made of the scores for each group over the farmers participating in the exercise to represent the district score. The ranking of these scores provides the position of each variety in the district. The same process was applied in the remaining district.

Participatory evaluation of the technologies with farmers

In this study, individual and group discussions (different social groups), field visits and questionnaire were used for evaluation of the technologies and data collected. During frequent discussions, we reiterated our engagement to ground the research on farmers' knowledge and preferences. Our relationship with farmers and key informants developed into a sort of contract based on mutual benefit. Such contracts with farmers appear as pre-requisites for joint learning and platform generation and form the frames on which the research trial and activities were developed. Through focus group and individual discussions with farmers and key informants in two districts; a total of eight different major criteria were identified to farmer's selection and preferences before and after harvested the technologies. These criteria used for further evaluation with the group of farmers in each district.

The interviews are later extended to group participatory debates with selected farmers in two clusters from each district. Group debates were made to carefully build on and seriously observe derived information from individual farmers of different clusters. It was also done deliberately to clear contradictory ideas on issue like farmers' preferences of the varieties, adaptability, frequency of harvest, the yield potential, marketing value, fruit color, fruit shape, resistant to disease and insect pests and the way of promote the technologies in the next season. Focus group interviews and key informants were used to be aware the principal factors affecting farmers' decisions to promote and sustainable utilization of improved tomato technologies on farmers' fields. Information gathered from the discussions, interviews (individual households and group discussion) and from the key informants was used to obtain a broad understanding on promotion and continual utilization of the technologies in the areas. Finally, the tested farmers from each district were evaluated and gave its ranking of selected varieties based on their

Table 1. The mean data of fruit number, marketable and total yield (t/ha) of tomato at Bolososore (Areka) and Goffa districts.

Varieties	Areka			Goffa		
	Fruit number	Marketable yield (tha^{-1})	Total yield (tha^{-1})	Fruit number	Marketable yield (tha^{-1})	Total Yield (t ha^{-1})
Money maker	40.63	25.623	28.123	49.35	78.83	87.06
Marglove	30.48	22.928	25.428	38.25	84.75	97.28
H.1350	26.50	19.178	21.678	39.75	67.68	76.58
Roma-VF	67.79	22.150	24.650	53.45	68.09	78.09
Melka-salsa	64.80	33.028	35.528	47.30	69.50	82.71
Melka-shola	72.58	19.283	21.783	50.07	67.75	80.35
Marglobe improved	26.52	15.853	18.353	43.15	74.25	85.60
F-test	***	**	**	ns	ns	ns
LSD	21.374	8.162	8.162	28.38	28.33	31.80
CV(%)	31.1	24.3	21.9	19.3	26.1	25.4

evaluation criteria.

The pair-wise ranking (Russell, 1997) method was used to analyze the position of each of variety in tested districts. A matrix table of varieties in each district was constructed. Farmers were asked to contrast each variety to the other ones with regards to the values based on identified criteria and the priority each farmer gives to the variety. Each variety was compared in turn with each of the other varieties. The procedure was repeated for all varieties until all possible comparisons had been made. The number of times of each variety was found to be more imperative was counted for each individual farmer. This value represented the individual score for the variety. An aggregation was then made of the scores. This aggregated score summed up the district score. The ranking of these scores provided the position of the varieties in the local market. The same procedure was applied in the other district.

RESULTS AND DISCUSSION

Field trials

Bolososore (Areka) district

In this district, the varieties respond significantly (P≤0.001) in number of fruits per plant (Table 1). Melka-shola recorded the highest number of fruit per plant (72.58) and is in statistical parity with Roma-VF and Melka-salsa. However, the lowest number of fruit of 26.50 was recorded at variety H-1350 (Table 1). Fruit number recorded with Melka-shola was 63.50% higher than H-1350. Similar results on number of clusters per plant and number of fruit per cluster among the different tomato varieties was also reported by Mersha (2008). Based on total and marketable yield, there was highly significant (p≤0.01) difference observed between tomato tested varieties. Melka-salsa produced the highest total and marketable fruit yield of 33.028 and 35.528 t ha^{-1} respectively. Furthermore, the total and marketable fruit yield obtained from Melka-salsa is statistically similar with that of variety Moneymaker (Table 1). The difference in yield potential of the varieties could be due their genetic makeup of the crop with associated environment. The variation in yielding ability of the tomato varieties studied could be attributed to fruit set and number of marketable fruits, which is genetically controlled and is in agreement with the findings of (Duguma, 2000; Lemma, 2001). Tigest, (2008) and Mersha (2008) indicated that non-processing tomatoes of indeterminate growth habit are low yielding because vegetative growth is favored over reproductive growth. In line with this, Balibrea et al., (1997) also described that fruit yield is a function of fruit number per plant and weight of marketable yield.

Goffa districts

The results of the field experiment in Goffa showed that the performance of all varieties are good and are strongly persistent (Table 1). In most of tested farmers fields, all improved varieties have statistically similar performance in all criteria was considered. For example, number of fruits per plant, total and marketable yield tomato (Table 1). As a result, the majority of tested farmers in this district have a good interest to scale-up these technologies. As compared to the responses of the varieties in two districts, all varieties preformed well and express fully their genetic potential and produced high yield at Goffa. Similarly, of all varieties, marglove, money maker and marglobe improved produced the highest yield under Goffa district, which is similar to the finding of Bertin et al., (2003). In addition such observation goes hand in hand with the findings of Lemma. (2001) and Duguma *et al*. (2000) too. As compared to Areka, although, some varieties produced high yield, their

Table 2. Summary of major farmers evaluation criteria of tomato at Areka and Goffa districts of Southern Ethiopia and their rankings (n= 20 farmers).

Characters	Areka							Goffa						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
Growth performance	1.0	3.0	2.0	1.0	6.0	4.0	3.0	2.0	3.0	3.0	2.0	3.0	3.0	4.0
Frequency of harvest	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	4.0
Type of Utilization	2.0	3.0	2.0	4.0	4.0	2.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0
Fruit color	2.0	2.0	2.0	3.0	4.0	4.0	3.0	3.0	2.0	2.0	3.0	3.0	3.0	4.0
Fruit shape	2.0	3.0	2.0	4.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	4.0	3.0	4.0
Fruit yield	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	4.0	3.0	4.0
Market preference	1.0	2.0	1.0	4.0	4.0	4.0	4.0	2.0	2.0	2.0	4.0	2.0	4.0	4.0
Disease resistance	3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	3.0	4.0	3.0	2.0	3.0	2.0
Over all mean	**2.12**	**2.50**	**2.25**	**3.12**	**3.75**	**3.37**	**3.00**	**2.37**	**2.37**	**2.50**	**3.00**	**3.00**	**3.12**	**3.62**
Over all rank	**7**	**5**	**6**	**3**	**1**	**2**	**4**	**5**	**5**	**4**	**3**	**3**	**2**	**1**

A= Money maker, B= Marglove, C= H-1350, D= Roma-VF, E= Melka salsa, F= Melka shola and G= Marglobe improved. Rank: 1= Best; 2= fair; 3= worst. The scoring represents farmer's evaluation criteria of tomato. This scoring reveals the degree of satisfaction provided by each variety in considering each criteria (n=20). Only farmers who held evolutional knowledge on each given technology were required to assess it

relative performance is lower than Goffa. The higher performance of the tomato varieties at Goffa might be due to the climatic conditions that fever the varieties to express their full genetic potential through improvement of growth and development.

Survey results

Bolososore (Areka) district

Based on farmers identified criteria, farmers' who live in Areka acquired extensive knowledge on production and management of tomato. From the results of household discussion and interviews, variety Melka-salsa was the most preferred followed by Melka-shoa and Roma-VF respectively (Table 2). This result is in line with the yield obtained from the field trials conducted at Bolososore. However, variety Money maker was found to be least preferred by farmers in the area although it recorded higher fruit yield under field trials (Table 2). This indicates that farmers have their own preferences rather than the yield performances of the varieties. Besides, farmers selection criteria vary and highly dependent on the needs of individual farmers (Table 3).

Goffa district

The results of the survey conducted in Goffa district showed that many important practices that had been carried out by farmers' on vegetable production particularly on tomato. The results of the household interviews showed that 45.25, 39.00 and 37.50% of the respondents selected variety Marglobe improved, Melka-sholla and Melka-salsa respectively. Multi-harvest system is common in vegetable crops production, in this study, therefore, all varieties had the same trend of harvest until the final life stage (Maul, 1999). It is important to supply the commodity of tomato to fill seasonal food shortage in the area when other crops are not in the field and to regulate the price fluctuation of tomato in the area (Tewodros and Asfaw, 2013). Fruit color and size of the harvested product is one of the major traits that used by consumers for quality and price of market (Tigist, 2008).

Table 3. Varieties and their pair-wise ranking by 20 farmers each from Bolososore (Areka) and Goffa districts of Southern Ethiopia in 2007**.**

No.	Varieties	Districts	
		Areka	Goffa
1	Money maker	7th	5th
2	Marglove	5th	5th
3	H.1350	6th	4th
4	Roma-VF	3rd	3rd
5	Melka-salsa	1st	3rd
6	Melka-shola	2nd	2nd
7	Marglobe improved	4th	1st

In this study, most of the respondents have the same interest on Marglobe improved and Melka-sholla varieties based on pod color and size (Table 2). In line with this, the overall farmers' preferences indicated that, varieties such as Marglobe improved, Melka-sholla and Melka-salsa had high interest by farmers (Table 2). Therefore, those varieties have tremendous impact for promotion and improve the livelihood rural farmers.

Based on the pair-wise comparison of tomato varieties by farmers in Areka and Goffa districts, variety (Melka-salsa, Melka-sholla and Roma-VF) took the first, second and the third place in Areka and the second, third and third in Goffa districts respectively. The farmer's logic behind this result is that even if the supply of different varieties in tomato enables farmers to have their needs gradually satisfied over different years, there are periods improved tomato seeds cause scarcity (Table 3).

CONCLUSION AND RECOMMENDATION

The findings of the present study indicated that variety Melka-salsa was the highest yielding as well as the most preferred tomato variety at Areka. Moreover, Money maker was the least preferred variety by farmers at Areka, although it recorded high total and marketable fruit yield under field conditions. At Goffa, however, there is non-significant difference in yield potential among the different tomato varieties considered. However, Marglobe improved was the most preferred tomato variety by farmers followed by Melka-shola and Melka-salsa as well as Roma-VF respectively. Moreover, Money-maker and Marglove, were the least preferred tomato varieties at Goffa. Thus, based on the findings of the present study participatory research is paramount importance in technology promotion and scaling up. Therefore, accordingly to the farmers evaluation criteria and field trial results, Melka-salsa can be recommended for tomato growers for enhanced fruit yield and quality at Areka and its surroundings. Moreover, Marglobe improved, Melka-salsa, Melka-shola as well as Roma-VF varieties can be suggested for Goffa. Although, based on present data difficult to say any conclusions; variety Melka-salsa and Melka-shola safely recommended for promotion and scaling-up of tomato for both districts of southern Ethiopia.

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