

Pre-Extension Demonstration and Evaluation of Adapted Tomato Technologies Under Irrigation in Kelem and West Wolega Zones

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To cite this article:

Kibiru Kena, Dameksa Umer, Alemayehu Latera. Pre-Extension Demonstration and Evaluation of Adapted Tomato Technologies Under Irrigation in Kelem and West Wolega Zones. *American Journal of Plant Biology*. Vol. 8, No. 3, 2023, pp. 65-70.

doi: 10.11648/j.ajpb.20230803.13

Received: June 2, 2023; **Accepted:** June 25, 2023; **Published:** July 11, 2023

Abstract: Tomato is among the major horticultural crops cultivated under irrigated areas of Ethiopia now days. Considering this pre-extension demonstration and evaluation of adapted tomato technologies under irrigation was conducted through selecting few districts of Kelem and West Wolega Zones with the objective of demonstrating and evaluating the best performed tomato technologies. Two varieties of tomato (Melka Shola and Melka Salsa) were used for the demonstration and evaluation on farmers' field under their management condition. Essential data were collected from demonstration plots and were analyzed using simple descriptive statistical tools. The result indicates that Melka Salsa provided average yield of 389.5qt/ha while Melka Shola and local varieties provided 339.25qt/ha and 301.75qt/ha, respectively. The yield advantage of 29.08% and 12.43% were obtained from Melka Salsa and Melka Shola over the local variety, respectively. Participatory variety evaluation and selection techniques were used. During PVES farmers' preferences feedbacks were collected and analyzed using pair wise and matrix rankings. FRG members and the trial farmers were invited in the demonstration field to evaluate the performance of the varieties setting their own criteria. In the ranking, Melka Salsa variety was selected as the best performed variety than both the local and Melka Shola varieties. Accordingly, Melka Salsa variety was preferred and selected firstly by farmers for its high yielder, medium fruit size, fruit shape, plant canopy cover, early maturity, number of fruit per plant, number of fruit per pod and marketing quality. On the other hand, Melka Shola was selected secondly for its disease tolerance, large fruit size and medium yielder. Thus, Melka Salsa and Melka Shola varieties were recommended for scaling up in West and Kelem Wolega zones and similar agro-ecologies. Therefore, the offices of agriculture, cooperatives, unions and NGOs should multiply and provide the selected and recommended tomato varieties for those thirsty farmers in the study areas.

Keywords: Fruit Per Plant, Melka Salsa, Melka Shola, Tomato Variety

1. Background and Justification

Tomato (*Lycopersicon esculentum* Mill. L.) is one of the most widely grown vegetable crops in the world [9, 13]. It is a seasonal climbing plant of the family solanaceae. It is among the most important vegetables in Asia and Africa and these constituents account for more than 65% of global tomato production. Tomato is rich in nutrients such as vitamins, minerals, and antioxidants, which are important to well balance human diet [10]. It is grown as annual and produced for its fruits and also one of the most popular and

important vegetables for fresh consumption as well as for processing [8]. The plant requires a warm and dry climate. The optimum mean day temperature for growth of tomato lies between 21°C and 26°C and temperature above 32°C during fruit development inhibit the formation of red color. Tomato should be cultivated at an altitude below 2000m preferably; It is one of the most important edible and nutritious vegetable crops in the world [3]. Tomato is widely cultivated in all parts of the world and it is the largest in volume of production after potato and sweet potato. 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 [12].

Tomato 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. It is also important source of vitamin A and C as well as minerals. It is widely consumed in every household in different modes including raw, as an ingredient in many dishes, sauce, salads and drinks [11]. According to Tola Mebratu [14] tomatoes can make people healthier and decrease the risk of conditions such as cancer, osteoporosis and cardio vascular disease. People who ate tomatoes regularly have reduced risk of contracting cancer diseases such as lung, prostate, stomach, cervical, breast, oral, colorectal, esophageal, pancreatic, and many other types of cancer. The result showed that tomatoes and garlic should be taken together at the same time to have its cancer preventive effects.

Even though, most agro-ecologies of West and Kelem Wollega Zones are the potential areas for tomato production, the yield obtained by farming community was below the potential [15]. This is due to lack of improved tomato varieties, low management practices, diseases and insect pest problems and use of incomplete packages. To reduce these gaps, Haro Sabu Agricultural Research Center had conducted adaptation trials of tomato varieties and recommended Melka Salsa and Melka Shola varieties which are high yielder, more disease tolerant and adaptable to the study areas for pre extension demonstration stages [7].

Thus, under taking participatory demonstration, evaluation and validation of improved tomato technologies with the participation of farmers and other stakeholders was important to familiarize the farming communities with the varieties which would facilitate the adoption process and bridge the existing productivity gap. The activity was initiated with objectives of evaluating yield performance of tomato technologies under irrigation with farmers management conditions, creating awareness on tomato technologies for different stake holders, analyzing the cost benefit ratio of demonstrated tomato varieties and assessing farmers and others stake holders feedback for further technology development.

2. Materials and Methods

2.1. Description of the Study Area

The trial was conducted selecting Hawa Gelan district from Kelem Wollega Zone and Gulliso and Bodji Dirmaji districts from West Wollega Zone. These selected districts have a potential for tomato production with optimum climatic and biotic condition suitable for tomato production [5, 6].

2.2. Site and Farmers Selection

During this activity implementation, three potential

districts were selected purposively. From each district one-two potential kebeles were selected. From each kebele one FRG (Farmer Research Group) which consisting of 12-14 farmers was established. Among the formed group 2 experimental/trial farmers were selected considering gender balance, their interests and motivation, landownership, and other important socio-economic variables. Therefore, the trial was demonstrated on a total of 8 (eight) farmers' fields serving as replication.

2.3. Experimental Design

The seedbeds were prepared starting in mid October to early November depending on availability of rainfall. Two varieties of adapted tomato were planted on equal plot size of 10mx10m with a local check. The recommended distance between rows and plants of 100cm and 30cm were used respectively.

2.4. Materials Used

Two tomato varieties viz Melka Salsa and Melka Shola were studied for their productivity and profitability under farmer's management condition with a local check in the study areas. During this activity implementation recommended fertilizers rate of 200 Kg/ha of NPS and 100 Kg/ha of UREA were applied. Additionally, the recommended seed rate of 0.3 kg/ha of tomato were used.

2.5. Data Collection and Analysis Method

Agronomic data like number of fruit per plant, number of marketable fruit per plant, fruit yield per plot, number of stakeholders participated on promotional events (training, field visit and participatory varietal selection and evaluation), cost incurred and profit gained were collected through personal observation and focused group discussion. The collected data was subjected to Microsoft excel and the results were presented using descriptive statistical tools like table and percentage. PRA tools like pair wise and matrix rankings were also applied to rank farmers' preferences of the provided technologies.

3. Result and Discussion

3.1. Composition of Farmers Research Group (FRG)

During activity implementation a total of four farmers research group (FRGs) were formed. From each FRG two hosting farmers were selected and the totals of twelve-fourteen farmers from each kebele were participated.

3.2. Training

Training is one of the components of capacity building and research-extension activities. Thus, training was given for a total of 26 farmers, six DAs, and four agricultural experts during this activity implementation on the contents of improved tomato agronomic practices needed and post harvest handling required.

Table 1. Composition of FRG Members.

No	District	Kebeles	Number of FRGs	FRGs Members		Trial farmers	
				Male	Female	Male	Female
1	Hawa Gelan	Arere	1	11	3	2	-
		Ganda18	1	10	2	2	-
2	Guliso	M/Kobara	1	12	2	2	-
3	Bodji Dirmaji	Amuma Hagalo	1	9	3	2	-
Total			4	42	10	8	-
Percentage				80.76%	19.23%	100%	-

Table 2. Training at HSARC for a total of 36 participants.

Participants	Sex		Total
	Male	Female	
Farmers	22	4	26
DAs	6	-	6
Experts	3	1	4
Total	31	5	36
Percentage	86.11%	13.89%	100%

**Figure 1.** Photos during training.

3.3. Yield Performance of Demonstrated Varieties

As it is summarized in the following bar chart the mean yield obtained from newly demonstrated varieties and a local check were presented and compared. The mean yield of Melka Salsa variety was higher than the mean yield obtained from both Melka Shola and local varieties. Accordingly, the mean yield obtained from Melka Salsa, Melka Shola and local varieties were 389.50 qt/ha, 339.25 qt/ha and 301.75 qt/ha respectively. Similarly, the research [7] was reported the higher yield of Melka Salsa and Melka Shola tomato varieties around the

studied areas. In line with this result [1] reported substantial variance among the varieties' marketable fruit weight in which Melka Salsa had the highest marketable fruit weight (4.62 ton ha⁻¹); this indicates Melka Salsa tomato variety had a wider adaptability. Likewise Lemma, 2002 was reported that Melka Shola (Red Pear) and Melka Salsa (Serio) were found superior in yield, quality and acceptability by tomato processing industries and farmers subsequently released for production to growers. Similarly Malka Salsa and Malka Shola tomato varieties were the most highly adaptable varieties in many areas of western and eastern parts of Oromia region [4, 7].

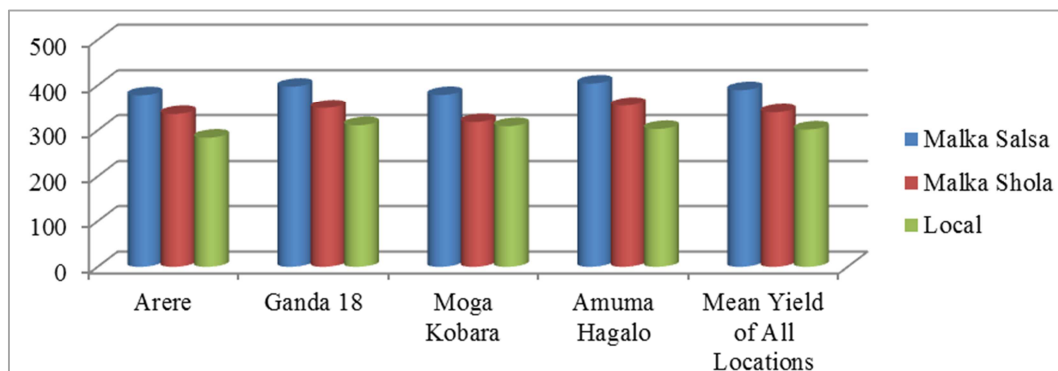
**Figure 2.** Bar chart showing yield obtained of demonstrated tomato varieties over location.



Figure 3. PED of Tomato under irrigation Hawa Galan (Ganda 18), 2021.

3.4. Yield Advantage of Varieties

Based on the demonstrated result the yield advantages of the newly demonstrated varieties were calculated using the following formula and presented in the following table. Accordingly, the result showed that the yield advantage of 29.08 % and 12.43 % were obtained from Melka Shola and Melka Salsa over the local variety respectively.

$$\text{Yield advantage} = \frac{\text{yield of new variety} - \text{yield of local variety}}{\text{yield of local variety}}$$

Table 3. Yield advantages of the Demonstrated Varieties.

Yield advantage	Percentage
Yield advantage of Melka Salsa over local	29.08%
Yield advantage of Melka Shola over local	12.43%

3.5. Technology Demonstration and Evaluation Methods

To demonstrate and evaluate the tomato technologies

training, participatory variety evaluation and selection and group discussions were among technology demonstration and evaluation techniques that were used.

3.6. Participatory Variety Evaluation and Selection

Participatory variety evaluations and selection was conducted at Ganda 18 kebele of Hawa Galan district at maturity stage of the crop. Farmers have a broad knowledge base on their environments, crops and cropping systems built up over many years and do experiments by their own and generate innovations, even though they lack control treatment for comparison and statistical tools to test the hypothesis [2]. Considering this in to account, FRG members were invited to make necessary decisions on selection criteria. Accordingly, farmers had set potential yield, seed size, seed shape, plan canopy cover, early maturity, number of fruits per plant, number of fruit per pod, disease tolerance and marketing quality as their selection criteria.

Table 4. Varieties Trait Pair Wise Ranking Matrix Result.

Parameters	YP	CC	EM	NFP	NPB	MP	NFPP	DT	Frequency	Rank
YP	x	YP	YP	YP	YP	MP	YP	DT	5	3 st
CC		x	CC	NFP	NPB	MP	NFPP	DT	1	7 rd
EM			x	NFP	NPB	MP	NFPP	DT	0	8 th
NFP				x	NFP	MP	NFP	NFP	5	3 st
NPB					x	MP	NPB	DT	3	5 th
MP						x	MP	DT	6	1 th
NFPP							x	DT	2	6 th
DT								x	6	1 th

Where YP, CC, EM, NFP, NPB, MP, NFPP and DT, YP= Yield Potential, DT=Disease Tolerance, CC= Canopy cover, EM= Maturity, NFP=Number of fruit per plant, NPB= number of primary branch per plant, NFPP=number of fruit per pod, MP=market preference

Table 5. Farmers' preference ranking of the demonstrated varieties based on the above criteria.

No	Varieties	Reasons for Its Selection	Varieties Rank
1	Malksa Salsa	Highest yield potential, medium fruit size, fruit shape, canopy cover, early maturity, number of fruit per plant, number of fruit per pod and marketing quality	1st
2	Melka Shola	Disease tolerance, larger fruit size and medium yielder.	2rd
3	Local	Relatively lowest yield potential, medium disease tolerance and medium maturity	3nd

As it is shown on the above table, Melka Salsa variety was preferred and selected first by farmers for its high yielder, medium fruit size, fruit shape, canopy cover, early maturity,

number of fruit per plant, number of fruit per pod and marketing quality. On the other hand, Melka Shola was selected second for its disease tolerance, larger fruit size and medium yielder.

3.7. Financial Analysis

The results of cost-benefit ratio analysis of all the three varieties are presented in the following table. As displayed clearly in the following table the financial analysis showed that the net return gained from Melka Salsa, Melka Shola and the local varieties were 566,976.5, 488,234.75, and 429,472.25 birr/ha respectively. As a result, the largest cost benefit ratio was obtained from Melka Salsa with magnitude of 8.4 following by Melka Shola with magnitude of 7.8 and by local with magnitude of 7.3. These show that both the demonstrated varieties (Melka Salsa, Melka Shola) can make

farmers more profitable than the local variety.

4. Limitation of the Study

The experiment was conducted during the outbreak of Covid-19 and serious security problems around the study areas. Thus condition was not allowed for organizing mini field days, some PVES and conducting farmer to farmer field visits during activity implementation for further experience sharing and creating effective awareness. Therefore, instead regular field visits focused group discussion and PVES were used to create awareness on tomato demonstration and evaluation.

Table 6. Cost benefit analysis of demonstrated varieties.

Variables	Unit	Demonstrated Varieties		
		Melka Salsa	Melka Shola	Local check
Yield Obtained	Qt/ha	389.5	339.25	301.75
Sale price	Birr/Qt	1667	1667	1667
Gross Return (mean yield in Qt x price)	Birr	649,296.5	565,529.75	503,017.25
Land preparation and planting costs	Birr/ha	2,470	2,470	2,470
Seed purchase cost	Birr/ha	3000	3000	3000
Fertilizer purchase cost	Birr/ha	6,900	6,900	6,900
Labor for management	Birr/ha	10000	10000	10000
Labor for Harvesting	Birr/ha	6000	6000	6000
Packing, loading and storing	Birr/ha	38,950	33,925	30,175
Total Variable Cost (TVC)	Birr/ha	67,320	62,295	58,545
Fixed cost (FC)	Birr/ha	15000	15000	15000
Total Cost (TVC + FC)	Birr/ha	82,320	77,295	73,545
Net return (GR- TC)	Birr/ha	566,976.5	488,234.75	429,472.25
Benefit cost ratio (NR/TVC)		8.4	7.8	7.3

Source: Demonstration results of 2020-2021 cropping season

5. Conclusion and Recommendation

In general, the research result showed that two varieties of tomato were demonstrated and evaluated in West Wolega and Kelem Wolega zones agro-ecologies under irrigation. Melka Salsa variety was the first preferred and selected by farmers variety for its for its high yielding, medium fruit size, fruit shape, canopy cover, early maturity, number of fruit per plant, number of fruit per pod and marketing quality. On the other hand, Melka Shola was selected next to Malka Salsa variety for its disease tolerance, large fruit size and medium yielder.

Therefore, Melka Salsa and Melka Shola varieties were recommended for pre-scaling up in West Wolega and Kelem Wolega zones and similar agro-ecologies. Thus, the offices of agriculture, cooperatives, unions and NGOs should multiply and provide the selected and recommended tomato varieties for those thirsty farmers in the study areas and similar agro-ecologies.

References

- [1] Ademe Mihiretu and Melaku Asresu. 2023. Participatory Evaluation of Tomato (*Lycopersicon esculentum* Mill.) Varieties Under Irrigation Condition at Abergelle Woreda, Ethiopia. *Agro Bali: Agricultural Journal*, 6 (1), pp. 12-20.
- [2] Bänziger, M.; G. O. Edmeades; D. Beck and M. Bellon. 2000. Breeding for drought and nitrogen stress tolerance in maize: From theory to practice. CIMMYT, Mexico, pp. 68.
- [3] FAO. 2006. FAO production year book, basic data unit, Statistics division, FAO, Rome Italy, No. 55, pp 125127.
- [4] Gebisa Benti, Gezu Degefa, Alemayehu Biri, Fikadu Tadesse. Performance Evaluation of Tomato (*Lycopersicon esculentum* Mill.) Varieties Under Supplemental Irrigation at Erer Valley, Babile District, Ethiopia. *Journal of Plant Sciences*. 5 (1), pp. 1-5.
- [5] Gulliso District Annual Agricultural Report of 2019. Agricultural land use system in Gulliso District.
- [6] Kelem Wolega Agricultural and Natural resource Office Annual Report. 2017. Report on land use systems of Kelem Wolega Zone. Dambi Dolo.
- [7] Kibiru Kena, Zewdu Tegenu, Ashenafi Debela, Admasu Raga. 2018. Adaptability and Performance Evaluation of Recently Released Tomato (*Lycopersicon esculentum* Mill. L.) Varieties at West and Kelem Wolega Zones under Supplementary Irrigation. *International Journal of Agricultural Science Research* 1. 7 (4), pp. 028-032.
- [8] Lemma Desalegne. 2002. Tomatoes research experiences and production prospects. Ethiopian Agricultural Research Organization. Addis Ababa, Ethiopia.
- [9] Mersha A. 2008. Effects of stage and intensity of truss pruning on fruit yield and quality of tomato (*Lycopersicon esculentum* mill). M.Sc. Thesis presented to the school of graduate studies of Haramaya University 10-16. 2.
- [10] Srinivasan R. (Ed.) 2010. Safer tomato production methods: A field guide for soil fertility and pest management. AVRDC-The world vegetable center, Shanhua, Taiwan. AVRDC publication No. 10-710.97p.

- [11] Tesfaye, T., Tesfaye, K. and Woldetsadik, K., 2011. Clay pot irrigation for tomato (*Lycopersicon esculentum* Mill) production in the north east semiarid region of Ethiopia. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, 112 (1), pp. 11-18.
- [12] Tewodros Mulualem, Kefelegn A. 2013. Promotion and evaluation of improved technologies through participatory approach in South Ethiopia: Experience from hot pepper. *Unique Research Journal of Agricultural Science*. 2013; 1 (4): 57-62.
- [13] Tewodros Mulualem and Negasi Tekeste. 2014. Evaluation of improved tomato (*Lycopersicon esculentum* Mill.) varieties through participatory approach in South Ethiopia. *Herald Journal of Agriculture and Food Science Research*; 3 (2): 55-60.
- [14] Tola Mebratu. 2014. Tomato value chain analysis in the Central Rift Valley: The case of Dugda Woreda, East Shoa Zone, Oromia National Regional State (Doctoral dissertation, MSc Thesis, Haramaya University, Haramaya, Ethiopia).
- [15] Urgessa Tilahun Bekabil. 2014. Review of challenges and prospects of agricultural production and productivity in Ethiopia. *Journal of Natural Sciences Research*, 4 (18), pp. 70-78.