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Performance and Participatory Evaluation of Improved Tomato (*Solanum lycopersicum* L.) Varieties in North-Gondar Zone, Gondar, Ethiopia

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ABSTRACT

The experiment was conducted from December to March during 2020 and 2021 cropping irrigation season at Metema and Belesa, Ethiopia to evaluate tomato varieties' adaptability, yield potential, and farmer preferences. The performance evaluation and farmer preferences of ten tomato varieties were conducted on farmers and research fields in two locations in the north Gondar zone, Gondar-Ethiopia, over two off seasons. Agronomic data, as well as farmer preferences for the varieties, were collected and analyzed using R statistical software, Agricola. R Package, Version, 1–2, and pair-wise ranking, respectively. The performance of varieties had shown significant variation between varieties and across locations. The results in the Metema district revealed that there was a significant ($p \leq 0.001$)) difference between the varieties in all agronomic parameters except the number of fruits cluster^{-1}. Woyeno (30.60 t ha^{-1}), Roma VF (30.37 t ha^{-1}), Chali (29.31 t ha^{-1}), and Cochoro (29.02 t ha^{-1}) varieties produced significantly more marketable fruit. In a pair-wise ranking of farmer preferences, Chali (56), Cochoro (50), were chosen first and second, respectively. In the Belesa district, the non-significant difference in mean marketable fruit yield of tomato varieties ranged from 22.76 to 25.28 t ha^{-1}. However, a pair-wise ranking of farmers' preferences revealed that ARP tomato (96) and Cochoro (96) ranked first and second, respectively. As a result of the agronomic data and farmer preferences, Cochoro and Chali varieties for Metema Districts and Cochoro and ARP tomato varieties for Belesa district will recommended for further scale-out the tested areas and similar agro-ecological areas.

KEYWORDS: Tomato, PVS, yield, farmers' preference, North Gondar

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1. INTRODUCTION

Tomato (*Lycopersicum esculentum* Mill.) is the most widely grown vegetable in the world, and it is known for being high in vitamins and minerals (Bihon et al., 2022). In terms of production the cultivated tomato is the world's third most important vegetable after potatoes and sweet potatoes while as a processing crop, it ranks first among all vegetables ((Massimi, 2021, Panno, 2021). It has been globally cultivated in tropical, subtropical and temperature regions due to high yielding potential, wider adaptability and multipurpose usage (Sirba, 2022). China, India, Turkey, The United States and Italy are the world's leading tomato producers, with 67,636,725 t, 21,181,000 t, 13,095, 258 t, 10,475, 265 t and 6,644,790 t production respectively, while in Africa, Egypt, Nigeria and Algeria are the highest tomato producer countries with production of 6,245,787 t, 3,575,968 t and 1,641,636 t respectively (Anonymous, 2021). Ethiopia is the world's 84th largest tomato producer, with a total of 6,754 ha of land under tomato cultivation in the country, approximately 42,181 t of tomato production (Anonymous, 2021). The national average yield was 6.2 t ha^{-1}, which is much lower than the world average of 34.84 t ha^{-1} (Regassa et al., 2016), which is incomparable with the average yield of other countries.

Tomato is one of the most important edible nutritious and economically important vegetable crops in the country, and it ranks second in off-season production after onion in the North Gondar zone. The plant requires a warm and dry climate with an optimum mean day temperature between 21°C and 26°C; temperatures above 32°C during fruit development inhibit the formation of red color; and tomato should be cultivated in a range of 700 to 2200 meters above sea level, with 700 to over 1400 mm annual rain fall, in different soils, under different weather conditions, and at different levels of technology (Birhanu and Ketema, 2010). Its production is carried out on a small scale by farmers in many parts of the country, including the Amhara region. Its production has become a major cash source for farmers in many areas of the country, as well as other actors in the value chain such as retailers, middlemen, and transporters and wholesalers. Nonetheless, the average tomato yield in Ethiopia is low. This is because tomato production is severely constrained by a number of factors, including the type of tomato varieties used, lack of improved varieties of desirable traits (such as high yield and quality, tolerance to biotic and abiotic stresses, and high shelf-life), failure to adopt a full agronomic package, and a lack of integrated diseases and pest management Yebirzaf et al. (2016). Commonly, participatory variety selection is employed to characterize farmers' needs and preferences in plant breeding to ensure that new varieties fulfil the needs and expectations of end-users (Magaisa, 2021).

The North Gondar administrative zone is one of the Amhara region's administrative zones, and its agro ecology is suitable for production as well as the introduction of this crop. As a result, if we consider the significance of the participatory varietal selection (PVS) approach, farmers take an active role in evaluating and selecting varieties. When compared to the conventional system, PVS has been shown to be more efficient in selecting farmers' preferred varieties of less time, speeding up their dissemination, and increasing cultivar diversity (Joshi and Witcombe, 1996).

As a result, the introduction, evaluation, and selection of improved tomato varieties that are high yielding and farmers' preferred variety would aid in improving crop production and productivity in the study area. The study was designed to test the adaptability of improved tomato varieties of the study area using participatory variety selection and to ensure farmer acceptance.

2. MATERIALS AND METHODS

2.1. Description of the study area

The research was carried out during the off-seasons from December to March 2020 and 2021 at Metema and Belesa districts of the North Gondar Zone, Gondar, Ethiopia. Metema is located at 120 46 45.26 N latitude and 360 24 20.68 E longitude, with an altitude of 745 m.a.s.l. Maximum annual temperatures range from 22–43°C, while minimum annual temperatures range from 22°C to 28°C. During the months of March to May, the daily temperature rises to as high as 43°C, and the soil is Vertisol.

The Belesa site is located at 13.133 N latitude and 37.900 E longitude, with an altitude of 1100–1680 m.a.s.l., a temperature range of 13°C to 28°C, and Vertisol soil.

2.2. Experimentation, data collection, and analysis

Ten tomato varieties, namely: - Chali, ARP tomato, Woyno, Mersa, Sirika-1, Melkasholla, Miya, RomaVF, Cochoro, and Eshet, released from national and regional agricultural research centers, were evaluated on farm at Belesa in all sites and research filed at Metema sites using Randomized Complete Block Design (RCBD) with three replications. Plot size 4×3 m^2 with 1 m and 0.3 m spacing between rows and plant respectively, a total of four rows and three meters in length. In both locations and seasons, seedlings of each variety were raised on seedbeds measuring 1×1.5 m^2. After four weeks, uniform and vigorous seedlings of each variety were selected and transplanted to a well-prepared field in both locations and season during the first week of January. Each variety received 40 seedlings plot^{-1} the middle two rows were used for data collection, while the remaining two rows served as a border. Fertilized with 200 kg DAP

ha^{-1} at transplant and 100 kg UERA ha^{-1} half at transplant and the other half 30 days later. All agronomic practices were carried out in accordance with the recommendations of tomato production (Naikas et al., 2005).

The following parameters were collected as data: plant height (cm), days to maturity, fruit count $cluster^{-1}$, cluster count $plant^{-1}$, average fruit weight (gm), and yield (kg $plot^{-1}$). Plant height, fruit diameter, number of clusters $plant^{-1}$, number of fruits $cluster^{-1}$ and single fruit weight were recorded by measuring the 5 randomly selected plants in each plot from the ground to the main apex. Days to the first harvest was the number of days from transplanting to the first picking day and fruit yield was sum of fruit weight $center^{-1}$ harvested two rows plot from successive harvest (kg) was taken and converted to t ha^{-1}.

The data was collected from the middle rows and analyzed using the R statistical software, Package 'agricolae'. R Package, Version, 1–2. (De Mendiburu et al., 2019), and treatment means were compared using Fisher's List Significance Difference (LSD) at a 5% probability.

2.3. Farmers' selection and participatory evaluation of the varieties

To improve tomato production and productivity in the districts of Metema, and Belesa, research organizations must engage in participatory potential-based variety development. We agree in the farmer's participatory work breeder's prediction about wider adapted varieties before doing the analysis was not accepted. Farmers should be evaluating the number of varieties for performance-based criteria adapting to their agro-ecosystems without breeder's interference. When farmers choose a variety based on their own criteria, the newly generated technology becomes familiar to their farming activity and increases technology utilization. As a result, participatory variety selection was used in this study to identify farmers' selection criteria and acceptable varieties to adapt and assimilate into the production system in these areas, as expected.

Farmers' variety evaluation and criteria selection were carried out through the organization of a field day at the horticultural maturity stage. Farmers Research and Extension Group was formed, with farmers as members. To evaluate the performance of the varieties, a multidisciplinary team of researchers from breeder, pathology, and extension were involved. Training on tomato production and management under irrigation conditions was organized for FREG members' agricultural experts, agricultural organization staffs working on urban agriculture development, and development agents. Following training and during field day, participating farmers and development agents visited the experiment.

Thus, during the 2016 cropping season, a total of 30 farmers (7 females and 23 males) participated in Metema district and 27 (6 female and 21 male) in Belesa district. During the evaluation and selection, all farmers (men and women) were participated equally, being encouraged to explain their choices and select varieties that represent their conditions with their trait of interest. As a result of field observation and focus group discussions, members seat their own selection criteria and weight them based on their importance. The participating farmers were given their own selection criteria for each location and were asked to provide a result for each one. Farmers set the following selection criteria at Metema:- number of fruits $plant^{-1}$ $yield^{-1}$ performance, disease pest $tolerant^{-1}$, branch, fruit size and shape and medium plant height and at Belesa:- number of fruits $plant^{-1}$ $yield^{-1}$ performance, disease pest $tolerant^{-1}$, branch, and early maturity, marketable demand and fruit size and shape. Farmers' selection data were analyzed using a simple ranking method based on a value range of 1 to 5. (Boef and Thijssen, 2007). That is, 5=excellent, 4=very good, 3=good, 2=poor, and 1=bad.

3. RESULTS AND DISCUSSION

3.1. Agronomic data

Plant height (cm), number of clusters $plant^{-1}$, number of fruits $clusters^{-1}$, average fruit weight (g), unmarketable fruit yield (t ha^{-1}), marketable fruit yield (t ha^{-1}) and total fruit yield were all subjected to analysis of variance (ANOVA). Each location's data from the previous 2 years, as well as the combined data from all locations, were analyzed, and each location was recommended because of the ANOVA table results by locations revealed a significant difference in yield and yield-related parameters. As yearly and combined data were analyzed, each location's yield and yield-related traits performed similarly. As a result, it is preferable for each location to combined and analyze yearly data (Table 1 and 2).

The ANOVA results showed that there was highly significant ($p\leq0.001$) variation among the varieties at the Metema location over 2 years for all parameters except number of fruits $cluster^{-1}$ (Table 1). There was a significant difference in plant height between the varieties. Srinika-1 (109.70 cm) was the tallest variety, while ARP tomato was the shortest (70.93 cm). Similar studies Girma et al. (2023) plant height also obtained variety Sirinka-1 (92 cm), Weyno (110 cm), Melka shola (67.4 cm), Chochoro (69.16 cm) and Miya (79.06 cm). There was no significant plant height difference between the tomato varieties ARP, Cochoro, Chali, Roma VF, and Miya (Table 1). Fufa et al. (2025), (Bekele et al., 2024) and Gezahegn et al. (2023) his finding also similar with my result significant difference yield and yield related traits of tomato varieties. Fruit diameter differed statistically between varieties. The largest

Table 1: Combined analysis of mean yield and yield related traits of ten tomato varieties tested at Metema

Variety	PH (cm)	DIM	NCPP	NFPC	Fwg (g)	MY t ha^{-1}	UnYt ha^{-1}	TY t ha^{-1}
Eshet	104.33	5.46	10.67	2.93	173.6	10.11	1.95	12.06
Miya	73.10	4.07	19.03	2.97	79.83	28.17	3.78	31.95
Woyno	91.43	3.95	17.93	3.07	79.93	30.66	5.44	36.10
Cochoro	74.90	4.67	15.00	2.33	106.50	29.02	9.47	33.50
Mersa	103.80	3.42	21.43	3.13	80.43	23.76	8.78	32.54
Sirinka 1	109.07	4.63	16.67	3.20	90.53	15.67	3.90	19.58
ARP tomato	70.93	4.70	16.03	2.70	107.40	16.74	8.87	25.61
Chali	72.47	4.60	14.77	2.60	99.50	29.31	6.54	35.85
Melka shoal	81.17	3.75	22.87	3.00	69.90	21.53	6.91	28.44
Roma VF	75.47	3.59	19.93	2.70	74.47	30.37	4.33	34.67
Mean	85.66	5.46	17.43	2.86	96.21	23.03	5.00	29.03
CV (%)	9.02	4.07	20.28	18.84	24.75	32.43	36.48	28.20
LSD (5%)	9.03	0.44	4.13	0.63	27.83	8.73/10.69	2.56	9.56
Variety	***	****	***	NS	****	***	****	***
Year*variety	NS	NS	*	NS	NS	NS	**	NS

*CV: Coefficient of variance; LSD: Least significant difference; *; **, ***: Significant at (*p*=0.05), (*p*=0.01) and (*p*=0.001) probability level respectively; NS: Non-significant; MD: Maturity date; PH: Plant height; DIM: Dimeter; NFPP: Number of fruit $plant^{-1}$; NCPC: Number of cluster $plant^{-1}$; Fwg: Average fruit weight; MY: Marketable yield; UmY: Unmarketable yield; TY: Total yield

Table 2: Combined analysis of mean yield and yield related traits of ten tomato varieties tested at Belesa

Variety	PH (cm)	DIM	NCPP	NFPC	Fwg (g)	MY t ha^{-1}	UMY t ha^{-1}	TY t ha^{-1}
Eshet	86.60	4.81	8.93	2.67	92.00	18.90	7.44	26.34
Miya	52.30	3.21	14.67	3.00	54.03	22.15	5.61	27.76
Woyno	62.70	3.46	17.27	3.23	56.57	21.99	4.31	26.3
Cochoro	50.50	4.37	11.60	2.53	62.47	18.29	6.67	24.96
Mersa	79.57	2.58	16.00	3.67	52.70	20.37	3.49	23.87
Sirinka 1	88.03	4.06	13.63	3.13	77.57	18.09	4.67	22.76
ARP tomato	56.37	4.11	14.33	2.60	89.10	22.20	4.49	26.69
Chali	52.27	3.97	11.90	2.90	64.37	21.86	6.29	28.15
Melka shoal	52.45	3.07	14.30	2.87	53.50	20.66	4.39	25.05
Roma VF	54.23	3.01	17.47	3.33	48.03	25.28	5.34	30.61
Mean	63.50	3.66	14.01	2.99	65.03	20.97	5.27	26.24
CV (%)	12.78	14.19	22.08	15.47	20.05	21.15	36.62	19.11
LSD (5%)	9.48	0.60	3.61	0.63	15.24	5.18	2.25	5.86
Variety	****	****	**	*	****	NS	*	NS
Year*variety	NS	NS	NS	*	NS	*	NS	**

*CV: Coefficient of variance; LSD: Least significant difference; *; **, ***: Significant at (*p*=0.05), (*p*=0.01) and (*p*=0.001) probability level respectively; NS: Non-significant; MD: Maturity date; PH: Plant height; DIM: Dimeter; NFPP: Number of fruit $plant^{-1}$; NCPC: Number of cluster $plant^{-1}$; Fwg: Average fruit weight; MY: Marketable yield; UmY: Unmarketable yield; TY: Total yield fruit size variety was Eshet (5.46 cm), and the smallest was Mersa (3.42 cm). The number of clusters plant^{-1} difference statistically between varieties. The variety Melka shola had the highest number of clusters plant^{-1} (22.87), while Eshete had the lowest (10.67). Unlike the number of clusters plant^{-1} (NCPP), there was no significant difference between the varieties of the number of fruits cluster^{-1} (NFPC). Despite having similar fruit weights, there was a significant weight difference between fruits harvested from the varieties (Table 1). When compared to the others, Eshete provided the most fruit weight. Fruits from varieties with fewer clusters plant^{-1} are generally larger.

There was a significant difference in marketable yield between the varieties. Woyeno (30.60 t ha^{-1}), Roma VF (30.37 t ha^{-1}), Chali (29.31 t ha^{-1}) and Cochoro (29.02 t ha^{-1}) varieties produced significantly more marketable fruit. The variety Eshete produced the least mean marketable fruit yield (10.11 t ha^{-1}) (Table 1).

Girma et al., 2023 discovered a similar result significance variability in fruit yield and yield components with marketable fruit yield Chali (41.28 t ha^{-1}) and Cochoro (18.91 t ha^{-1}). Miya (26.59 t ha^{-1}), sirinka (20.7 t ha^{-1}), Weyno (25.97 t ha^{-1}) and Regassa et al. (2016) discovered significant variability in yield produced by five tomato varieties evaluated for fruit yield and yield components in Borana zone, Yabello district, southern Ethiopia, with Miya (22.95 t ha^{-1}) ranking first, Melkashola (19.11 t ha^{-1}) ranking second, and Cochoro (14.94 t ha^{-1}) ranking third. Our findings show that the varieties, Weyno, Chali, Cochoro and Miya had the highest marketable yield, with no significant difference between them (Table 1). Other researches finding Wudu et al., 2023, Geleta Ayana and Tujuba, 2020 and Lemma et al., 2024 significance variability in fruit yield and yield components on released tomato varieties.

The ANOVA results showed that over 2 years at Belesa location, there was highly significant ($p \le 0.001$) variation among the varieties for parameters such as plant height (cm), fruit diameter (cm), and average fruit weight (g) and significant ($p \le 0.05$) number of clusters plant^{-1} and number of fruits cluster^{-1} but not for other parameters such as marketable fruit yield (t ha^{-1}) and unmarketable fruit yield (t ha^{-1}) (Table 2). Similarly, Degefa et al. (2012) the number of fruit clusters plant^{-1} and fruits cluster^{-1} were significantly among tomato varieties. Roma VF (25.28 t ha^{-1}), ARP tomato (22.20 t ha^{-1}), Miya (22.15 t ha^{-1}), Woyeno (21.99 t ha^{-1}), Chali (21.86 t ha^{-1}) and Cochoro (18.29 t ha^{-1})

Table 3: Pearson's correlation (R) of yield and other collected parameters of ten tomato varieties tested at Metema

Parameters	PH	MD	DIM	NCPP	NFPC	FW	MY	UMY
PH								
MD	0.44***							
DIM	0.24*	-0.30*						
NCPP	-0.04ns	0.08ns	-0.33**					
NFPC	0.43***	0.028ns	0.30*	0.13ns				
FW	0.33**	0.11ns	0.35**	-0.34**	0.34**			
MY	-0.34**	-0.15ns	-0.26*	0.39**	-0.30*	-0.34**		
UMY	-0.26*	0.03ns	-0.21ns	0.31*	-0.25*	-0.17ns	0.42***	
TY	-0.36**	-0.12ns	-0.28*	0.42ns	-0.33**	-0.33ns	0.96***	0.64***

Table 4: Pearson's correlation (R) of yield and other collected parameters of ten tomato varieties tested at Belesa

Parameters	PH	MD	DIM	NCPP	NFPC	FW	MY	UMY
PH								
MD	0.07ns							
DIM	0.29*	-0.01ns						
NCPP	-0.16ns	0.10ns	-0.45**					
NFPC	0.20ns	0.03ns	-0.25ns	0.41***				
FW	0.20ns	-0.03ns	0.15ns	-.029*	-0.31*			
MY	-0.24ns	-0.18ns	-0.63**	0.34**	-0.03ns	0.30*		
UMY	-0.11ns	-0.16ns	0.18ns	0.30*	-0.19ns	0.22ns	0.125ns	
TY	-0.24ns	¬-0.21ns	-0.56ns	0.23*	-0.07*	0.33**	0.98***	0.33*

produced significantly more marketable fruit than other varieties (Table 2). Similar studied Mihiretu & Asresu, 2023 at Abergelle Woreda, similar agro ecology as Belesa variety Roma VF and Cochoro had gave yield 3.88 and 3.64 t ha^{-1}, respectively, as compared to this study our result had been better yield performance of the varieties. The variety Eshete produced the lowest mean marketable fruit yield (10.11 t ha^{-1}) in a similar finding at Metema location. The obtained mean marketable fruit yield (10.11 t ha^{-1} to 30.60 t ha^{-1}) was comparable to the results of other studies, Regassa et al. (2016) obtained a mean marketable fruit yield ranging from 7.21 to 48.80 t ha^{-1}.

Marketable fruit yield had a negative correlation with plant height and fruit weight ($r=-0.34^{**}$) and a positive correlation with the number of clusters $plant^{-1}$ ($r=0.39^{**}$) at Metema location (Table 3). Shushay Chernet and Haile Zibelo (2014) discovered that the number of fruits $cluster^{-1}$ and clusters $plant^{-1}$ had a positive correlation with marketable fruit yield, while fruit weight, plant height, and day of maturity had a negative correlation.

Similarly, Regassa et al. (2016) found a positive relationship between the number of fruits $cluster^{-1}$ and the number of clusters $plant^{-1}$, while fruit weight and plant height had a negative relationship with marketable fruit yield. Belesa location Marketable fruit yield a positive correlation with the number of clusters $plant^{-1}$ ($r=0.34^{**}$) and plant height had non-significant effect (Table 4). The correlation analysis of total yield (t ha^{-1}) marketable and unmarketable yield, as well as growth characters, revealed that total yield was significantly positively correlated with mean number of clusters $plant^{-1}$ ($r=0.34^{**}$), unmarketable yield ($r=0.64^{***}$), and marketable yield ($r=0.97^{***}$) (Tables 3 and 4).

Table 5: Pair wise ranking of farmer's selection criteria for tomato variety at Metema

Criteria	1	2	3	4	5	Score	Rank	Weight
1. No. of fruit $plants^{-1}$		1	1	1	1	4	1	5
2. Fruit size and shape			3	2	2	2	3	3
3. Disease tolerance				3	3	3	2	4
4. Branch no.					4	1	4	2
5. Plant height						0	5	1

Table 6: Pair wise ranking of farmer's selection criteria for tomato variety at Belesa location

Criteria	1	2	3	4	5	6	Score	Rank	Weight
1. No. of fruit $plants^{-1}$		1	1	1	1	6	4	2	5
2. Fruit size and shape			3	2	5	6	1	5	2
3. Disease tolerance				3	3	6	3	3	4
4. Branch no.					5	6	0	6	1
5. Early maturity						6	2	4	3
6. Market demand							5	1	6

3.2. *Farmers' preference*

Farmers were also given the opportunity to compare each variety to the others in terms of the values based on the identified criteria. Pair-wise ranking was used to summarize farmers' preferences for the varieties (Boef and Thijssen, 2007). Farmers involved in the participatory and demonstration varieties is curial for boosting yield and market preference of the customers Ali et al. (2021) and Kena et al. (2023). Farmers involved in the participatory varietal evaluation selected five preferred tomato characteristics at Metema location and six at Belesa location and ranked through pair-wise matrix system as shown in (Table 5 and 6). Among those, at Belesa location market demand was ranked

Table 7: Matrix ranking of tomato varieties based on criteria selected by farmers at Metema (N=30)

Criteria	ARP tomato	Sirinka-1	Roma VF	Melka shola	Cochoro	Chali	Mersa	Woyno	Eshete	Miya
Fruit yield performance	3	1	4	3	4	4	3	3	1	1
Disease tolerance	1	4	1	2	2	3	3	3	4	4
Fruit size and shape	2	1	1	2	4	4	3	3	1	3
Branches	3	3	2	3	3	4	3	4	4	4
Medium plant height	3	3	4	3	4	4	2	3	4	4
Overall score	12	12	12	13	17	19	14	16	14	16
Average score	2.4			2.6	3.4	3.8	2.8	3.2	2.8	3.2
Rank	6	6	6	5	2	1	4	3	4	3

Table 8: Matrix ranking of tomato varieties based on criteria selected by farmers at Belesa (n=27)

Criteria	ARP tomato	Sirinka-1	Roma VF	Melka shola	Cochoro	Chali	Mersa	Woyno	Eshete	Miya
Fruit yield performance	4	1	5	3	5	4	2	3	1	5
Fruit size and shape	5	1	3	3	5	3	2	3	3	4
Disease tolerant	5	1	2	3	3	3	4	3	3	3
Branch no./plant	3	3	2	2	4	3	5	4	3	3
Early maturity	5	3	4	2	5	4	4	4	1	4
Market demand	5	1	2	1	5	5	3	3	3	3
Overall score	27	10	18	14	27	22	20	20	14	26
Average score	4.5	1.7	3	2.3	4.5	3.7	3.3	3.3	2.3	4.3
Rank	1	7	5	6	1	3	4	4	6	2

Table 9: Direct ranking matrix evaluation of tomato variety preference (score×weight) at Metema

Criteria	Weight	ARP tomato	Sirinka-1	Roma VF	Melka shola	Cochoro	Chali	Mersa	Woyno	Eshete	Miya
Fruit yield performance	5	3	1	4	3	4	4	3	3	1	1
Disease tolerant	4	1	4	1	2	2	3	3	3	4	4
Fruit size and shape	3	2	1	1	2	4	4	3	3	1	3
Branches	2	3	3	2	3	3	4	3	4	4	4
Medium plant height	1	3	3	4	3	4	4	2	3	4	4
Total score		34	33	35	38	50	56	44	47	36	42
Rank		9	10	8	6	2	1	4	3	7	5

first followed by yield performance and at Metema location yield performance was ranked first followed by disease/pest tolerant. For a specific location farmers' vision criteria were somewhat different, for example, in Belesa, early maturity is an important parameter due to water scarcity irrigation in the area, whereas in Metema, medium plant height is important due to tallest plant height in Metema location as compered as Belesa, for easy staking/support.

Farmers ranked the varieties 1–5 based on their preference and level of satisfaction, with 1 being low/bad and 5 being high/good. Farmers' preferences, overall combined direct ranking matrix results revealed that the overall mean of the ranks for all performance indicators variety ARP tomato (96), Cochoro (96), and Chali (83) were chosen first, second, and third, respectively, based on direct ranking matrix method at Belesa district (Table 8). And he overall means of the ranks for all performance indicators at Metema district, on the other hand, was for Chali (56) and Cochoro (50) to be selected first, and second (Table 7).

During the selection process, every farmer's member, both men and women, held discussions. Farmers were focusing more on yield-related preferences (fruit plant^{-1})

Table 10: Direct ranking matrix evaluation of tomato variety preference (score×weight) at Belesa

Criteria	Weight	ARP tomato	Sirinka-1	Roma VF	Melka shola	Cochoro	Chali	Mersa	Woyno	Eshete	Miya
Fruit yield performance	5	4	1	5	3	5	4	2	3	1	5
Fruit size and shape	2	5	1	3	3	5	3	2	3	3	4
Disease tolerant	4	5	1	2	3	3	3	4	3	3	3
Branch no./plant	1	3	3	2	2	4	3	5	4	3	3
Early maturity	3	5	3	4	2	5	4	4	4	1	4
Market demand	6	5	1	2	1	5	5	3	3	3	3
Total score		96	29	64.8	46.8	96	83	64.8	67	69	78
Rank		1	8	6	7	1	2	6	5	4	3

as well as other parameters (market demand and disease and pest tolerance) when selecting varieties (Table 5–10). This result clearly demonstrated that the main selection criterion for farmers in the study areas is yield-related preferences to increase tomato productivity. The Cochoro variety was chosen based on farmer preferences in two districts and overall, as shown in (Table 9–10). As a result, this demonstrates that farmers can select well-adapted and preferred varieties based on their own criteria.

Data analysis revealed that the same varieties performed better and were more stable. According to the findings of this study, farmer participation can be used effectively to identify acceptable varieties and increase the efficiency and effectiveness of a breeding program.

4. CONCLUSION

Ten tomato varieties were tested across multi-environments. A combined analysis reveals that there is a significant difference between treatments based on the location. According to the finding, Cochoro and Chali tomato varieties are recommended for larger production at the Metema location, and Cochoro and ARP tomato varieties are recommended for larger production at the Belesa location. Variety Roma VF performed well in both locations, but farmers were not selected. Therefor those varieties will be scaling out in the recommended locations and similar agro-ecological areas.

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6. REFERENCES

Ali Zeleke, A., Fikre Limeneh, D., Tsagaye Galalcha, D., Wegayehu Tilahun, G., Fufa Hunde, N., Gebretensay Mengistu, F., 2021. Performance and adaptability evaluation of improved onion varieties (*Allium cepa* L.) for bulb yield and some agronomic traits. American Journal of BioScience 9(3), 105. https://doi.org/10.11648/j.ajbio.20210903.15.

Anonymous, 2021. FAOSTAT. Statistical Database of the Food and Agriculture of the United Nations. Accessed on online data http://www.fao.org/faostat/en/#home.

Bekele, W., Atinafu, Y., Chala, M., 2024. Performance evaluation and participatory variety selection of released tomato (*Lycopersicon Esculentum* Mill.) varieties in West Shewa, Ethiopia. Plant, January. https://doi.org/10.11648/j.plant.20241201.11.

Bihon, W., Ognakossan, K.E., Tignegre, J.B., Hanson, P., Ndiaye, K., Srinivasan, R., 2022. Evaluation of different tomato (*Solanum lycopersicum* L.) entries and varieties for performance and adaptation in Mali, West Africa. Horticulturae, 8(7). https://doi.org/10.3390/horticulturae8070579.

Boef, W.S., Thijssen, M.H., 2007. Participatory tools working with crops, varieties and seeds. A guide for professionals applying participatory approaches in agro-biodiversity management, crop improvement and seed sector development. Wageningen international. Wageningen University and Research Center. The Netherlands.

Birhanu, K., Ketema, T., 2010. Fruit yield and quality of drip-irrigated tomato under deficit irrigation AJFAND Vol. 10 No. 2.

Cherent, S., Zibelo, H., 2014. Evaluation of tomato varieties for fruit yield and yield components in western lowland of Tigray, Northern Ethiopia. International Journal of Agricultural Research 9(5), 259–264.

Degefa, M., Ali, R., Kassahun, M., 2012. Evaluation of tomato (*Lycopersicon e sculentum* Mill.) genotypes for yield and yield components. The African Journal of Plant Science and Biotechnology 6(Special issue I), 45–49.

De Mendiburu, F., de Mendiburu, M.F., 2019. Package 'agricolae'. R Package, Version, 1–2.

Fikre, G., Mensa, A., Wodaje, A., 2022. Adaptability evaluation of improved tomato (*Lycopersicon esculentum* Mill.) varieties for yield and other quantitative traits in Arba Minch, Southern Ethiopia. International Journal of Agricultural Research, Innovation and Technology 12(1), 79–83. https://doi.org/10.3329/ijarit.v12i1.61035.

Fufa, N., Tsagaye, D., Limeneh, D.F., 2025. On farm participatory evaluation and demonstration of improved tomato (*Lycopersicum esculentum* Mill.) varieties under irrigation condition in South-Eastern Ethiopia. January. https://doi.org/10.56557/ajaas/2025/v8i153.

Geleta Ayana, N., Tujuba, M., 2020. Evaluation of released tomato (*Lycopersicon Esculentum* Mill.) varieties for fruit yield and quality parameters in western Ethiopia. Agricultural and Biological Sciences Journal 6(2), 100–113. http://www.aiscience.org/journal/absjhttp://creativecommons.org/licenses/by/4.0/.

Girma, N., Yassin, A., Kebede, Z., Geto, G., Firew, T., Desalegne, F., Ayele, A., Aragaw, D., Mamo, D., Ayele, T., 2023. Participatory tomato variety selection in the lowland areas of North Shewa. September, 32–39.

Kena, K., Umer, D., Latera, A., 2023. Pre-extension demonstration and evaluation of adapted tomato technologies under irrigation in Kelem and West Wolega Zones. American Journal of Plant Biology 8(3), 65–70. https://doi.org/10.11648/j.ajpb.20230803.1.

Lemma, D.T., Banjaw, D.T., Megersa, H.G., Abewoy, D., 2024. Evaluation and participatory variety selection of tomato (*Lycopersicum esculentum* Mill.) For yield and related traits. Advances in Crop Science and a Technology 2454(1), 1–5.

Naika, S., de Jeude, J.L., de Goffau, M., Hilmi, M., van Dam, B., 2005. Cultivation of tomato: production, processing and marketing. CTA, Series no 17. https://www.researchgate.net/publication/33116708.

Mihiretu, A., Asresu, M., 2023. Participatory evaluation of tomato (*Lycopersicon esculentum* Mill.) varieties under irrigation condition at Abergelle Woreda, Ethiopia. Agro Bali: Agricultural Journal 6(1), 12–20. https://doi.org/10.37637/ab.v6i1.1041.

Magaisa, A., Manjeru, P., Kamutando, C.N., Moyo, M.P., 2021. Participatory variety selection and stability of agronomic performance of advanced sorghum lines in Zimbabwe. Journal of Crop Improvement 36(3), 440–460. https://doi.org/10.1080/15427528.2021.1974635.

Massimi, M., 2021. Tomato (*Lycopersicon esculentum* Mill.) anatomical, physiological, biochemical and production responses to drought stress-A mini-review essay. International Journal of Horticultural Science 27, 40–45. https://doi.org/10.31421/ijhs/27/2021/8439.

Panno, S., Davino, S., Caruso, A.G., Bertacca, S., Crnogorac, A., Mandic, A., Noris, E., Matic, S.A., 2021. Review of the most common and economically important diseases that undermine the cultivation of tomato crop in the Mediterranean Basin. Agronomy 11, 2188. https://doi.org/10.3390/agr.11112188.

Regassa, D., Tigre, W., Shiferaw, A., 2016. Tomato (*Lycopersicon esculentum* Mill.) varieties evaluation in Borana zone, Yabello district, southern Ethiopia. Journal of Plant Breeding and Crop Science 8(10), 206–210.

Sirba, H.Y., Begna, T., Gojam, M., 2022. Evaluating performance of recently released tomato (*Lycopersicon esculentum* Mill.) varieties at highland areas of West Hararghe, Ethiopia. International Journal of Research in Agronomy 5, 18–24. https://doi.org/10.33545/2618060X.2022.v5.i2a.105.

Witcombe, J.R., Joshi, A., Joshi, K.D., Sthapit, B.R., 1996. Farmer participatory crop improvement. I. Varietal selection and breeding methods and their impact on biodiversity. Experimental Agriculture 32(4), 445–460.

Wudu, T., Ashagrie, T., Sirinka, B.K., 2023. Participatory tomato (*Lycopersicon esculentum* Mill) variety selection and evaluation for production in Eastern Amhara regional state 5(1), 35–40.

Yebirzaf, Y., Derbew, B., Kassaye, T., 2016. Tomato (*Solanum lycopersicum* L.) yield and fruit quality attributes as affected by varieties and growth conditions. World Journal of Agricultural Sciences 12(6), 404–408.