ISSN: 2224-0616
Int. J. Agril. Res. Innov. Tech. 12(1): 129-136, June 2022 Available online at https://ijarit.webs.com
DOI: https://doi.org/10.3329/ijarit.v12i1.61042 https://www.banglajol.info/index.php/IJARIT

Participatory variety selection of improved finger millet [*Eleusine coracana* (L.) Gaertn.] varieties at Debube Ari District, South Omo Zone, Southern Ethiopia

Temesgen Jerjero[1]*, Awoke Tadesse[2], Anteneh Tadesse[3], Tekle Yosef[4] and Muhaba Sultan[5]

Received 04 February 2022, Revised 10 June 2022, Accepted 25 June 2022, Published online 30 June 2022

A B S T R A C T

Finger millet is staple food crop in drought-prone areas of the world and often considered as a component of food security strategies in Ethiopia. However, its yield is low in South Omo zone due to different production problems such as lack of improved varieties, lodging, and moisture stress in dry areas. A participatory finger millet variety selection was conducted at Kaysa, Baytesimal and Alga kebeles of Debube Ari District, South Omo Zone during the 2019-cropping season to identify high yielding finger millet variety/varieties .The field experiments was laid out in a randomized complete block design with three replications. The combined analysis's of variance results revealed that there were significant ($p<0.05$) differences among varieties based on the recorded parameters except the harvest index. The maximum combined mean grain yield obtained to the varieties: Tadesse, Tesema and Kako-1 were 3746.75 kg ha^{-1}, 3691.94 kg ha^{-1}, and 3593.42 kg ha^{-1}, respectively. While the minimum grain yield was recorded to variety, BKFM-0010 was 1341.18 kg ha^{-1}. Regarding farmers' preferences, variety Kako-1 and Tesema had higher grain yield followed by variety Tadesse. Based on data from researchers and farmers, varieties Tadesse, Tesema, and Kako-1 were the best varieties for the test agro-ecologies. Therefore; varieties; Tadesse, Tesema and Kako-1 could be recommended and popularized for use in the test areas and similar agro-ecologies.

Keywords: Farmers rank, Finger millet, Grain yield, Participatory, Varieties

Southern Agricultural Research Institute, Jinka Agricultural Research Center, P.O. Box 96, Jinka, Ethiopia

*Corresponding author's email: temejer@gmail.com (Temesgen Jerjero)

Cite this article as: Jerjero, T., Tadesse, A., Tadesse, A., Yosef, T. and Sultan, M. 2022. Participatory variety selection of improved finger millet (*Eleusine coracana* (L.) Gaertn.) varieties at Debube Ari woreda, South Omo Zone, Ethiopia. *Int. J. Agril. Res. Innov. Tech.* 12(1): 129-136. https://doi.org/10.3329/ijarit.v12i1.61042

Introduction

Finger millet [*Eleusine coracana* (L.) Gaertn.] is a small seeded cereal grown in low rainfall areas of the semi-arid tropics of the world. It is a hardy crop capable of providing reasonable grain yield under circumstances where most crops give negligible yield. Finger millet is a staple food crop in drought-prone areas of the world and often considered as a component of food security strategies. Among millets, it ranks third in importance after sorghum and pearl millets. Its wide adaptability to diverse environments and cultural conditions makes it a potential food crop (FAOSTAT, 2015). Finger millet is a dietary staple food crop in potentially drought-exposed regions of the world, and it is immensely considered as an important component in assuring food security. The crops grain posse's excellent storage quality, which can be preserved without any harm for years, confers it a perfect food grain quality. Crop leftovers are an excellent source of dry matter for the livestock, especially in dry seasons. After harvesting, the crop's residue makes good animal feeds and consists of up to 61% total digestible nutrients (Weir, 1996).

Finger millet straw is used for livestock feed in many countries; however, it is mainly grown for food (Upadhyaya *et al.*, 2006) and for the brewing of gluten-free beverages (Bano *et al.*, 2015). Finger millet grain is nutritionally rich as it contains high levels of protein and minerals (Upadhyaya *et al.*, 2006). As suggested by David *et al.* (2014) the proximate composition of finger millet moisture (6.99%), ash (2.37%), crude protein (10.28%), crude fiber (3.10%), crude lipid (0.83%), carbohydrate (76.43%) and mineral-like potassium (14.19 mg/g), sodium (6.86 mg/g), copper (0.10 mg/g), calcium (1.13 mg/g), magnesium (6.25 mg/g), zinc (0.22 mg/g), manganese (0.32 mg/g), iron (0.11 mg/g) and lead (0.001 mg/g). It contains an appreciable amount of the essential amino acid methionine, which is lacking in most food (Mamo *et al.*, 2018).

Finger millet is suitable to design and develop value-added nutritive food products. Woldemichael and Admasu (2017) reported that germination to be effective in starch and protein hydrolysis; while fermentation was more effective in reducing phytate, consequently increasing mineral bioavailability.

Its annual world production was about 30.5 million tons, out of these, 12.4 million tons were produced in Africa mainly eastern and southern African (FAOSTAT, 2015). In Ethiopia, finger millet is the 6th important crop after tef, wheat, maize, sorghum and barley. It comprises about 5% of the total land devoted to cereals. It is produced on 406,592 ha of land, from which 599,963 tons are obtained at the national level (CSA, 2008). It is mainly grown in North Gondar, West Gojam, some parts of Tigray and West Wollega. It is widely grown in the Amhara region, it covers 198,835 ha of land and giving 291,775 ton in the region, which is 48.62% of the total national production (CSA, 2008). The yields of finger millet are low in Ethiopia due to different production problems including lack of improved varieties, little research emphasis given to the crop, non-adoption of improved technologies, poor attitude to the crop, disease like blast which is the most serious disease, lodging and moisture stress in dry areas, threshing, lodging and milling problem are some the most serious production constraints in finger millet production in Ethiopia (Tsehaye and Kebebew, 2002; Andualem, 2008; Molla, 2010).

Some varieties of finger millet were released by the different research centers of the nation. Farmers have no sufficient information about the released varieties both agronomic practice and their economic importance because the varieties were released without the participation of farmers and the released varieties had not yet evaluated in the targeted area.

Participatory varietal evaluation and selection are being conducted in many crops like rice and barley (Ceccarelli and Grando, 2007; Fufa *et al.*, 2010). Research done by different researchers on participatory variety selection of different field crops in Ethiopia. For example, Courtois *et al.* (2001) evaluated the effect of participation of farmers by comparing only the rankings of varieties by farmers and breeders at the same locations and reported a strong concordance between farmers and breeders in environments that have been producing contrasting plant phenotypic performance in rice. Cleveland *et al.* (1999) and Danial *et al.* (2007) reported that farmer's selection criteria vary with environmental conditions, traits of interest, ease of cultural practice, processing, use marketability of the product, ceremonial and religious values. Therefore, the objectives of this study were to evaluate and select the improved finger millet varieties, which are high yielding and farmers preferred finger millet varieties in South Omo Zone.

Materials and Methods

Description of study site

The experiment was conducted during the 2019 main cropping season at Kaysa, Baytesimal, and Alga Kebles, in South Ari District, South Omo Zone. The altitudes, latitude and longitude of the study area were, 1405 m.a.s.l, 5°43′46″ N and 36°37′5″ E for Kaysa location, 1337 m.a.s.l, 5°45′7″ N and 36°32′44″ E for Baytesimal location, and 1452 m.a.s.l, 5°47′43″ N and 36°32′38″ E for Alga location, respectively. The district (woreda) area had average annual rainfall of 1343 mm and temperature ranges from 16.3°C to 27.7°C, respectively.

Experimental treatments and design

Thirteen (13) finger millet varieties were included in the study area (Tesema, Tadese, Kako-1, Bareda, Gute, Gudetu, Addis01, BKFM-0010, Boneya, Wama, Bako- 09, Diga-1 and Urji). Land preparation, the experimental field was prepared following the three (3) conventional tillage practices before planting. The trial was laid down in a randomized complete block design (RCBD) with three replications. Each experimental plot had ten rows with the spacing of 40 cm between each rows and the plot size had four-meter length and five-meter width spaced at one meter with a gross area of 20 m^2. In accordance with the design, a field layout was prepared and each treatment was assigned randomly to experimental plots within each blocks and replications. Seed rate, the seed was applied at the recommended seed rate of 10 kg ha^{-1}. Sowing, sowing season was from early March to mid of April months in belg season in mid land altitude areas. Sowing was done in row sowing by the method of hand drilling manually in a recommended seed rate of 10 kg ha^{-1} with the spacing of 40 cm between rows and made tinning between plants with the spacing of 10 cm at the time of first weeding time. Fertilizer rate, fertilizer was applied at the rate of 100 kg ha^{-1} NPSB and 100 kg urea, respectively. NPSB fertilizer was applied at the time of planting and urea fertilizer was applied in spilt form, half at the time of planting and half at the time of tillering stages. Weeding was done by hand weeding as manually. The first hand weeding was done after the emergence of the plant from twenty (20) up to twenty five (25) days after planting and thinning was done plant to plant with a distance of ten centimeter (10 cm). The second hand weeding practice was done after the emergence of the plants from forty five (45) up to fifty five (55) days after planting.

Variety selection procedures

Zone, Woreda and Keble agricultural and natural resource office experts and the selected farmers were participated at sowing time, field evaluation and selection of the improved finger millet varieties at the maturity stage and set their selection criteria and ranking was done based on their selection criteria.

Data collection

Days to maturity was recorded as the number of days from emergence to stage when 50% of the tillers per plot had matured ears (detected by yellowing of leaves). Plant height was recorded by measuring the height of plants from ground level to the tip of inflorescence (ear) at the dough stage. Productive tiller per plant was the number of basal tillers that bear mature fingers and recorded from five randomly taken plants of each plot at harvest. Finger length was recorded from the base of the ear to the tip of the finger at each five randomly taken plants of main tillers at the dough stage. Number of fingers per plant was recorded by counting each finger from the selected every single plant from the five randomly selected fingers of plants at harvest. Biomass yield was recorded from the weight of the aboveground parts and measured by sensitive balance at harvest after sun drying. Grain yield was determined by harvesting plants from the selected middle rows of each plot. Seeds were weighed by sensitive balance and approximately adjusted to 12.5% moisture content. Harvest index was estimated from the proportion of seed weight to the aboveground biomass weight at harvesting (GY/BM). Farmers rank their varieties by seating criteria at maturity by simply observing all the tested varieties according to their set of parameters. Researcher rank: ranking the varieties after analyzing the above-collected data's.

Data analysis

The data such as days of maturity, plant height, finger length, number of fingers per plant, productive tiller per plant, bio mass, grain yield and harvest were subjected to Analysis of Variances (ANOVA) using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS) software. Significance differences between and among treatments were delineated by using LSD (least significance difference) (5%).

Results and Discussion

The combined mean performance of finger millet varieties for growth, yield and yield -related traits

The combined analysis of variance results revealed that there were significant ($p<0.05$) differences among varieties under rain fed condition at Kaysa, Baytesimal and Alga districts on days of maturity, plant height, finger length, number of fingers per plant, productive tiller per plant except the harvest index.

Table 1. Mean square values of traits of finger millet varieties over locations.

SV	DF	PH	FL	FP	PTP	DM	BM	GY	HI
Replication	2	3.25^{ns}	0.18^{ns}	0.12^{ns}	0.15^{ns}	1.56^{ns}	9.25^{ns}	103090^{ns}	0.0120^{ns}
Variety	12	660.16^{*}	23.10^{*}	7.83^{*}	5.15^{*}	1344.10^{*}	5.85^{*}	5727812^{*}	0.0079^{*}
Location	2	10.23^{ns}	65.43^{*}	36.59^{*}	23.28^{*}	824.03^{*}	7.19^{*}	5677395^{*}	0.0100^{*}
Location x Variety	24	175.77^{*}	5.10^{*}	2.84^{*}	2.80^{*}	183.28^{*}	2.45^{*}	829954^{*}	0.0027^{ns}
Error	76	13.58	0.19	0.49	0.38	1.06	1.38	29433	0.0032

*NB: * indicates significance at ($p < 0.05$) and "ns indicates non-significant different. SV=source of variation, DF=degree of freedom, PH=plant height, FL=finger length, FP finger per plant, PTP= productive tiller per plant, DM=days of maturity, BM= bio mass, GY= grain yield, HI=harvest index*

Among the evaluated varieties, kako-1 (98 days) was early maturing were as BKFM (153 days) was late maturing variety (Table 2). The maximum plant height was recorded in BKFM-0010 (109 cm) and the minimum plant height was obtained from Bako-09 (82 cm) (Table 2). The maximum finger length was obtained from, BKFM-0010 (9.71 cm) were as the minimum finger length was obtained from Kako-1 (5.04 cm (Table 3). The maximum number of finger per plant was recorded to variety Urji (9.22) and the minimum number of finger per plant was recorded at variety Wama (5.94) (Table 3). The maximum number of productive tiller per plant was obtained from Tadesse (7.55) and the minimum number of productive tiller per plant was recorded in varieties Wama (4.65) (Table 3). Among the evaluated finger millet varieties, the maximum biomass was recorded from Tesema (34277.78 kg ha^{-1}) and the minimum biomass was recorded from variety, BKFM-0010 (27148.15 kg ha^{-1}) (Table 4). From the tested varieties, the maximum grain yield was obtained from Tadesse (3746.75 kg ha^{-1}) and the minimum grain yield was obtained from BKFM-0010 (1341.18 kg ha^{-1}) (Table 4).

Performance of finger millet varieties at each location for growth, Yield and yield - related traits

Among the tested varieties, kako-1 (95, 100, 99.3 days), matured early compared to other varieties across locations which will be best fit the early maturing finger millet production system and variety BKFM-0010 (153, 154, 154 days) was a late mature type and best fit for late-maturing finger millet production system across locations (Table 2). The current work was disagreed for the physiological maturity for the variety Kako-1 with that of the observation by Molla (2010). Who stated that variety Boneya, matured early compared to other varieties, which were best fit the early finger millet production system and variety Bareda was late mature type and best fit for late-maturing finger millet production system. The maximum plant height BKFM-0010 and (107.67, 109.33, 110.01 cm) across location and the minimum plant height at each location was recorded from Addis-01 (73.33 cm) Gudetu (81.33 cm) and Bako-09 (69 cm) at Kaysa, Baytesimal and Alga location, respectively (Table 2). This result is in agreement with similar findings of Tarekegne *et al.* (2019), who stated there was the presence of sufficient variability, which could be attributed to the genetic potential of the varieties used among the evaluated varieties and for the traits under study (Table 2). From the tasted varieties the maximum finger length was recorded from Diga-1 (11.33 cm, 10.53 cm) at Kaysa and Baytesimal and BKFM-0010 (8.13 cm) at Alga location while the minimum finger length was recorded from Kako-1 (4.93 cm, 5.2 cm) at Kaysa and Baytesimal and Gudetu (4.1 cm) at Alga location, respectively(Table 3). This finding is similar to the finding of Tsehaye and Kebebew (2002); Fakrudin *et al.* (2004), who stated that there was a presence of genetic variability in finger length of finger millet varieties. The maximum finger per plant was recorded to variety Urji (10.43, 8.00, and 9.33) at Kaysa, Baytesimal and Alga locations, respectively and the minimum number of finger per plant was recorded from variety BKFM-0010 (6.4) Gudetu (5) and Wama (4.33) at Kaysa, Baytesimal and Alga locations, respectively (Table 3). Previously Molla (2010) reported similar results with the current findings concerning the number of fingers per plant in finger millet germplasm. From the varieties the maximum number of productive tiller per plant was recorded from Tadesse at Kaysa and Alga (8.00, and 7.66) and Kako-1 at Baytesimal (8.00) while the minimum number of productive tiller per plant was recorded from variety Wama (3.86) Diga-1 (6.33) and wama (3.86, 3.43) at Kaysa and Alga locations, respectively and Kako (3.43) at Kaysa, Baytesimal Alga location, respectively (Table 3). The current work was dis agreed for the productive tiller per plant traits for the variety Tadesse, and Kako-1 with that of the observation by Tarekegne *et al.* (2019). They stated that variety Bareda, Degu had the maximum number of productive tiller per plant compared to the other tested varieties. Among the tested finger millet varieties, the maximum biomass was recorded from variety Tesema (32,667 kg ha^{-1}, 30,000 kg ha^{-1}) at Kaysa and Baytesimal kebele and Tadesse (40,000 kg ha^{-1}) at Alga location, respectively. While the minimum biomass was recorded from variety BKFM -0010 (22000 kg ha^{-1}) at Kaysa location and Urji (24444 kg ha^{-1}, 25583 kg ha^{-1}) at Baytesimal and Alga location (Table 4). The current work was dis agreed for the bio mass traits for the variety Tadesse and Tesema with that of the observation by Tarekegne *et al.* (2019). ·They stated that variety Wama, Gute and Bareda had the maximum biomass compared to the other tested varieties. The maximum grain yield was obtained from varieties, Tadesse (3666.7 kg ha^{-1}, 3962.5 kg ha^{-1}) at Kaysa and Alga location and Kako-1 (3236.1 kg ha^{-1}) at Baytesimal location, respectively. While, the minimum grain yield was obtained from varieties, BKFM-0010 (1322.3, 1122.2 kg ha^{-1}) at Kaysa and Baytesimal location and Bared (1470.8 kg ha^{-1}) at Alga location, respectively (Table 4). This result agreed with the previous works of Andualem (2008), who reported that, the presence of a significant difference among varieties in yield-related parameters of finger millet varieties.

Table 2. The mean value of growth related traits on days of maturity and plant height at each location.

	DM (days of maturity)				PH (cm)			
Varieties	Kaysa	Baytesimal	Alga	Combined	Kaysa	Baytesimal	Alga	Combined
BKFM	153.00^{a}	154.00^{a}	154.00^{a}	153^{a}	107.67^{a}	109.33^{a}	110.01^{a}	109^{a}
Bako-09	122.00^{d}	125.00^{fg}	125.00^{g}	124^{e}	88.33^{de}	88.67^{f}	69.00^{f}	82^{g}
Gute	103.00^{f}	125.00^{fg}	125.00^{g}	117^{h}	99.00^{abc}	104.00^{abc}	110.00^{a}	104^{b}
Urji	112.00^{e}	127.00^{ef}	127.00^{f}	122^{f}	106.67^{a}	103.00^{bc}	90.00^{c}	99^{c}
Tesema	124.00^{d}	120.00^{h}	120.00^{i}	121^{f}	101.67^{ab}	106.00^{ab}	100.00^{b}	102^{bc}
Gudetu	121.33^{d}	134.00^{c}	134.00^{c}	130^{bc}	94.33^{cde}	81.33^{g}	89.33^{cd}	88^{e}
Boneya	113.33^{e}	123.00^{g}	123.00^{h}	119^{g}	101.00^{ab}	96.33^{de}	80.00^{e}	92^{d}
Diga-1	111.00^{e}	124.00^{g}	124.33^{g}	119^{g}	90.33^{e}	86.67^{fg}	100.00^{b}	92^{d}
Wama	98.00^{g}	139.00^{b}	139.00^{b}	125^{d}	102.00^{ab}	99.67^{cd}	110.00^{a}	103^{b}
Kako-1	95.00^{h}	100.00^{j}	99.33^{k}	98^{i}	84.33 e	90.00^{f}	86.67^{d}	87^{ef}
Bareda	137.00^{b}	128.00^{de}	128.00^{d}	131^{b}	95.67^{bcd}	91.00^{ef}	100.00^{b}	95^{d}
Addis01	128.00^{c}	130.00^{d}	130.00^{d}	129^{bc}	73.33^{f}	88.00^{f}	89.33^{cd}	83^{fg}
Tadesse	123.00^{d}	115.00^{i}	115.00^{j}	117^{h}	99.67^{b}	88.33^{f}	110.00^{a}	99^{c}
CV (%)	1.41	0.83	0.39	0.82	5.40	3.40	1.93	3.86
LSD (0.05)	2.80	1.67	0.83	0.96	8.70	5.40	3.11	3.46

NB: DM =days to maturity, PH=plant height, Note: Means with the same letters for traits are not significantly different at (p <0.05)

Table 3. The mean value of finger length, number of finger per plant and productive tiller per plant across location.

	FL (cm)				NF/P				PT/P			
Varieties	Kaysa	Baytesimal	Alga	Combined	Kaysa	Baytesimal	Alga	Combined	Kaysa	Baytesimal	Alga	Combined
BKFM	10.53^{ab}	10.46^{a}	8.13^{a}	9.71^{a}	6.40^{e}	7.66^{ab}	7.00^{c}	7.02d^{ef}	4.70^{6d}	6.66^{b}	7.00^{ab}	6.14^{d}
Bako-09	7.43^{de}	6.53^{c}	4.56^{e}	6.17^{de}	8.66^{b}	6.00^{de}	5.33^{de}	6.66^{efg}	6.60^{bc}	6.66^{b}	3.63^{f}	5.41^{f}
Gute	10.16^{b}	10.00^{a}	6.53^{c}	8.90^{b}	7.33^{d}	5.66^{ef}	6.66^{cd}	6.55^{fgh}	6.30^{bc}	6.66^{b}	3.6^{f}	5.53^{ef}
Urji	10.46^{ab}	7.53^{b}	4.66^{e}	7.55^{c}	10.43^{a}	8.00^{a}	9.33^{a}	9.22^{a}	6.26^{bc}	7.00^{ab}	5.66^{cd}	6.31^{cd}
Tesema	7.73^{de}	6.73^{c}	5.26^{d}	6.57^{d}	10.00^{a}	6.00^{de}	7.66^{bc}	7.88^{bc}	7.83^{a}	6.66^{b}	6.50^{bc}	7.00^{ab}
Gudetu	8.66^{c}	4.93^{d}	4.10^{f}	5.90^{e}	7.8.0^{bcd}	5.00^{f}	6.66^{cd}	6.48^{fgh}	7.33^{ab}	7.00^{ab}	6.00^{c}	6.77^{bc}
Boneya	7.16^{e}	5.13^{d}	5.13^{d}	5.81^{ef}	8.33^{bc}	6.33^{cde}	6.66^{cd}	7.11^{def}	7.06^{abc}	6.6^{b}	5.00^{de}	6.22^{cd}
Diga-1	11.33^{a}	10.53^{a}	6.33^{c}	9.40^{a}	10.33^{a}	7.33^{ab}	7.66b^{c}	8.44^{b}	7.33^{ab}	6.33^{b}	4.66^{e}	6.11^{de}
Wama	10.66^{ab}	7.80^{b}	5.335^{d}	7.93^{c}	7.50^{cd}	6.00^{de}	4.33^{e}	5.94^{h}	3.86^{d}	6.66^{b}	3.43^{f}	4.65^{g}
Kako-1	4.93^{g}	5.20^{d}	5.00^{de}	5.04^{g}	7.33^{d}	5.80^{de}	5.00^{e}	6.04^{gh}	6.56^{bc}	8.00^{a}	6.33^{bc}	6.96^{b}
Bareda	8.06^{cd}	10.33^{a}	8.00^{a}	8.80^{b}	7.66^{cd}	7.00^{bc}	6.66^{cd}	7.11^{def}	7.93^{a}	6.68^{b}	4.33^{ef}	6.31^{cd}
Addis-	5.73f^{g}	5.26^{d}	5.20^{d}	5.40^{fg}	8.66^{b}	6.53^{cd}	7.66^{bc}	7.62^{cd}	6.06^{c}	7.00^{ab}	6.00^{c}	6.35^{cd}
Tadesse	5.93^{f}	6.06^{c}	7.26^{b}	6.42^{d}	7.00^{de}	5.66^{ef}	9.00^{ab}	7.22^{de}	8.00^{a}	7.00^{ab}	7.66^{a}	7.55^{a}
CV (%)	6.27	6.25	4.57	6.20	6.48	7.06	13.29	9.816	10.27	10.11	9.25	9.91
LSD (5%)	0.88	0.78	0.44	0.41	0.90	0.75	1.45	0.66	1.10	1.54	1.06	0.58

NB: FL = number of finger per plant, NF/P= number of finger per plant, PT/P-=productive tiller per plant. Note: Means with the same letters for traits are not significantly different at (p < 0.05)

Table 4. The mean value of Bio mass, Grain yield and Harvest index across location.

	BM (kg)				GY (kg ha^{-1})				HI			
Varieties	Kaysa	Baytesimal	Alga	Combined	Kaysa	Baytesimal	Alga	Combined	Kaysa	Baytesimal	Alga	Combined
BKFM	22000^{e}	26111^{bcd}	33333^{bcd}	27148.15^{e}	1322.3^{f}	1122.2^{d}	1579.0^{g}	1341.18^{h}	0.06	0.043	0.040	0.090
Bako-09	26667^{abcd}	28611^{abcd}	29584^{d}	28287.00^{de}	2783.3^{c}	2161.1^{c}	3166.7^{d}	2703.70^{c}	0.10	0.076	0.110	0.098
Gute	25000 ^{bcde}	27222^{abcd}	31667^{cd}	27962.00^{de}	2626.7^{c}	1555.6^{d}	2441.7^{e}	2207.96^{e}	0.11	0.057	0.070	0.082
Urji	27333^{abcde}	24444^{d}	29583^{d}	27120.37^{e}	2733.3^{c}	1558.3^{d}	1641.7^{fg}	1977.77^{f}	0.10	0.063	0.050	0.073
Tesema	32667ab	30000^{ab}	42500^{a}	34277.78^{a}	3366.7^{b}	3150.0^{a}	3662.5^{b}	3691.94^{a}	0.10	0.100	0.100	0.110
Gudetu	28333^{abcd}	25000cd	37917^{abc}	30416.67^{bcde}	2630.0^{c}	2566.7^{bc}	2458.3e	2551.66^{cd}	0.09	0.100	0.060	0.086
Boneya	29667^{a}	34167^{abc}	39583^{ab}	33898.15^{ab}	3166.7^{b}	2611.1^{bc}	3570.8^{c}	3190.27^{b}	0.09	0.076	0.090	0.180
Diga-1	31000^{ab}	26389^{bcd}	32917^{bcd}	30101.85^{cde}	1276.7^{f}	14444.0^{d}	1975.0^{f}	1565.37^{g}	0.04	0.054	0.060	0.052
Wama	32000^{a}	26944^{abcd}	37917^{abc}	32287.04^{abc}	2066.7^{d}	2369.4^{c}	3104.2^{d}	2513.42^{d}	0.06	0.088	0.080	0.160
Kako-1	30333^{abc}	28333^{abcd}	32500^{bcd}	30166.67^{cde}	3363.3^{b}	3236.1^{a}	3577.5^{b}	3593.42^{a}	0.10	0.110	0.110	0.120
Bareda	28667^{abcd}	28667^{abcd}	37083^{abc}	30990.74 ^{abed}	2666.7^{c}	1419.4^{d}	1470.8^{g}	1852.31^{f}	0.09	0.053	0.030	0.062
Addis-01	23333de	25833^{cd}	32500^{bcd}	27222.20^{e}	1596.7e	2605.6^{c}	3041.7^{d}	2414.62^{d}	0.26	0.100	0.098	0.150
Tadesse	24000^{cde}	29444^{a}	40000^{ab}	32722.20^{abc}	3666.7^{a}	2633.3^{a}	3962.5^{a}	3746.75^{a}	0.15	0.08	0.07	0.120
CV (%)	13.45	8.55	12.86	12.32	5.33	6.70	6.87	6.68	8.09	8.09	6.57	4.32
LSD (0.05)	6294.70	3985.20	7616.80	3493.73	229.87	246.78	341.53	161.07	NS	NS	NS	NS

NB: BM =bio mass, GY= grain yield, HI= harvest index. Note: Means with the same letters for traits are not significantly different at (p< 0.05)

Table 5. Direct ranking of Finger millet varieties selection criteria used by farmers at three locations.

	Kaysa participants						Baytesimal participants						Alga participants					
Varieties	SC	LR	FP	ERl	Total	Rank	SC	LR	FP	ERL	Total	Rank	SC	LR	FP	ERL	Total	Rank
Tesema	10	8	6	12	36	2	15	10	8	14	47	2	4	5	3	6	18	2
Tadesse	16	14	15	14	59	1	16	10	8	15	49	1	5	7	6	6	26	1
Kako-1	6	5	4	20	35	3	14	5	10	17	46	3	4	2	3	8	17	3
BKFM-	0	2	4	0	6	13	0	0	5	0	5	13	0	1	2	0	3	13
Bako-09	3	6	3	9	21	3	1	4	4	5	14	4	3	3	1	5	12	4
Gute	2	1	4	2	9	9	0	1	3	2	6	11	3	2	3	2	10	6
Urji	7	4	3	2	16	5	4	3	2	2	11	6	5	2	1	3	11	5
Gudetu	1	2	3	2	8	10	1	2	3	2	8	9	2	1	3	3	9	7
Boneya	3	3	4	5	15	5	3	2	4	4	13	5	0	2	3	3	8	8
Diga-1	2	1	1	2	4	12	2	1	1	0	4	12	2	2	1	2	7	9
Wama	2	4	3	4	13	7	2	3	2	3	10	7	2	1	2	1	6	10
Bareda	0	3	2	2	7	11	0	3	2	2	7	10	0	0	2	2	4	11
Adiss-01	3	2	2	4	11	8	3	1	2	3	9	8	2	0	1	2	5	12

NB: SC=seed color, LR=loading resistance, FP= finger per plant, ERL= earliness (maturity)

Farmers' evaluation results of tested finger millet varieties

The full participation of farmers was a key tool for the evaluation and adoption of improved varieties of different crops. Finger millet variety selection was carried out at the maturity stage by organizing a field day/field visit. Farmers' selection criteria were: lodging resistance, seed color, number of fingers per plant and early maturity. The selection criteria were the same in all locations. These may be due to the common trait of interest, ease of cultural practice, processing, and cultural value. This is in agreement with the findings of Cleveland *et al.* (1999) and Danial *et al.* (2007). They reported that farmers' criteria vary with environmental conditions, traits of interest, ease of cultural practice, processing, use and marketability of the product, ceremonial and religious values accordingly. At all three locations (Kaysa, Baytesimal and Alga) finger millet variety Tadesse, Tesema and Kako-1 were preferred for good seed color, lodging resistance and the number of fingers per plant (Table 5). Finally, farmers selected the varieties Tadesse, Tesema and Kako-1 to use them as planting material as first, second and third preferred varieties, respectively. Moreover, farmers and the respective district and staff members of Agricultural and Natural Resource Development Office requested and decided the seeds of selected varieties' to be multiplied and promoted to the end-user.

Figure 1. Picture was taken during farmers' select varieties by their criteria at field visit (field day).

Conclusion and recommendation

Participatory variety selection was done at Kaysa, Baytesimal and Alga kebeles South Ari woreda, South Omo Zone, Southern Ethiopia during the 2019 main cropping season. The analysis of variance results revealed that there were significant differences observed among the finger millet varieties for all the studied parameters. The mean grain yield value of the three locations for the studied varieties showed that varieties Tadesse, Tesema and Kako-1 were the well-adapted and preferred varieties. In these experiment trials, the farmers' preference coincided with the research findings for most of the selected varieties. Research findings and farmers' variety selection criteria are most important to consider for proper variety selections. Due to this, farmers preferred varieties were found to be well adapted and promising to the tested areas and similar agro-ecologies and thus could be demonstrated and popularized to the small scale farmers.

Conflicts of Interest

Have no conflict of interest

Acknowledgments

The authors of the researcher would like to thanks the Ethiopian Integrated seed sector development project (ISSD), for their financial support, South Agricultural Research Institute (SARI) and Jinka Agricultural Research Center for facilitation during the field experiment and report writing period.

References

Andualem, W. 2008. Characterization, evaluation and variability for grain yield and related traits of finger millet [*Eleusine coracana* (L) Gaertn] germplasm. Doctoral dissertation, Haramaya University, Ethiopia.

Bano, I., Gupta, K., Singh, A., Shahi, N., Khanchand, C. and Gangwar, V. 2015. Finger millet: A potential Source for production of gluten free beer. *Int. J. Adv. Eng. Res. Appl.* 5(7): 74-77.

Ceccarelli, S. and Grando, S. 2007. Decentralized participatory plant breeding: an example of demand driven research. *Euphyt ica* 155(3): 349-360. https://doi.org/10.1007/s10681-006-9336-8

Cleveland, D.A., Soleri, D. and Smith, S.E. 1999. Farmer plant breeding from a biological perspective: Implications for collaborative plant breeding. CIMMYT Economics Work Paper No. 10, Mexico, D.F. CIMMYT.

Courtois, B., Bartholome, B., Chaudhary, D., McLaren, G., Misra, C.H., Mandal, N.P., Pandey, S., Paris, T., Piggin, C., Prasad, K. and Roy, A.T. 2001. Comparing farmers and breeders rank ings in varietal selection for low-input environments: A case study of rain fed rice in eastern India. *Euphytica* 122(3): 537-550. https://doi.org/10.1023/a:1017994906544

CSA. 2008. Agricultural sample survey report on area and production for major crops (Private Peasant holdings meher season). The FDRE Statistical Bulletin 439, Vol.1. Addis Ababa, Ethiopia.19p.

Danial, D., Parlevliet, J., Almekinders, C. and Thiele, G. 2007. Farmers' participation and breeding for durable disease resistance in the Andean region. *Euphytica* 153(3): 385-396. https://doi.org/10.1007/s10681-006-9165-9

David, B.M., Michael, A., Doyinsola, O., Patrick, I. and Abayomi, O. 2014. Proximate composition, mineral and phytochemical constituents of *Eleusine coracana* (finger millet). *Int. J. Adv. Chem.* 2(2): 171-174. https://doi.org/10.14419/ijac.v2i2.3496

Fakrudin, B., Shashidhar, H.E., Kulkarni, R.S. and Hittalmani, S. 2004. Genetic diversity assessment of finger millet, *Eleusine coracana* (Gaertn), germplasm through RAPD analysis. *PGR Newslett.* 138: 50-54.

FAOSTAT. 2015. Agriculture Organization of the United Nations. FAO statistical database Available from: http://faostat.fao.org.

Fufa,F., Grando, S., Kafawin, O., Shakhatreh, Y. and Ceccarelli, S. 2010. Efficiency of farmers' selection in a participatory barley breeding programme in Jordan. *Plant Breed.* 129(2): 156-161. https://doi.org/10.1111/j.1439-0523.2009.01670.x

Mamo, M., Worede, F., Bezie, Y., Assefa, S. and Gebremariam, T. 2018. Adaptability and genotype-environment interaction of finger millet (*Eleusine coracana* (L.) Gaertn) varieties in North Eastern Ethiopia. *African J. Agril. Res.* 13(26): 1331-1337. https://doi.org/10.5897/ajar2018.13029

Molla, F. 2010. Genotype x Environment interaction and stability analyses of yield and yield related traits of finger millet (*Eleusine coracana* (L) Gaertn) varieties in North Western Ethiopia. Doctoral dissertation, Haramaya University, Ethiopia. 47p.

Tarekegne,W., Mekbib, F. and Dessalegn, Y. 2019. Performance and participatory variety evaluation of finger millet [*Eleusine coracana* (L.) Gaertn] varieties in West Gojam Zone, Northwest Ethiopia. *East African J. Sci.* 13(1): 27-38. https://doi.org/10.37446/jinagri/rsa/8.3.2021.46-57

Tsehaye, T. and Kebebew, F. 2002. Morphological diversity and geographic distribution of adaptive traits in finger millet [Eleusine coracana (L.) Gaertn.(Poaceae)] populations from Ethiopia. *Ethiopian J. Biol. Sci.* 1: 37-62.

Upadhyaya, H.D., Gowda, C.L.L., Pundir, R.P.S., Reddy, V.G. and Singh, S. 2006. Development of core subset of finger millet germplasm using geographical origin and data on 14 quantitative traits. *Gene. Res. Crop Evol.* 53(4): 679-685. https://doi.org/10.1007/s10722-004-3228-3

Weir, B.S. 1996. The second National Research Council report on forensic DNA e Weir, B.S., 1996. The second National Research Council report on forensic DNA evidence. *American J. Human Gene.* 59(3): 497-500.

Woldemichael, H. and Admasu, S. 2017. Effects of processing on phytonutrient and nutritional Composition of finger millet (*Eleusine coracana*): The neglected crop of Africa. *Ethiopian J. Crop Sci.* 5(1): 17-36.