

Full Length Research Paper

# Participatory varietal selection of maize (*Zea Mays* L.) in Pawe and Guangua districts, North Western Ethiopia

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Maize (*Zea mays* L.) plays a critical role in smallholder farmers for food security in Ethiopia. So far, maize variety selection was done without much consideration of farmers' interest. However, farmers have indigenous knowledge to select best performing varieties which suit their environments. This study was aimed to identify more number of preferred maize varieties by farmers in a shorter time (than the conventional system), in accelerating their dissemination and increasing cultivar diversity in Pawe and Guangua district. Ten materials including standard check were evaluated using randomized complete block design (RCBD) design with two replication of two row plot on station and non-replicated three row plots on two farmers' field at Pawe and Guangua district in 2013 cropping season. Both men and women participated in the selection process. At silking, farmers put termite resistance, striga resistance, disease resistance, uniformity, vigority, lodging and earliness as criteria during evaluation. In the overall, the top three genotypes were entry 7 (CML395/CML202//CML464), entry 10 (BH547) and entry 4 (DE-78-Z-126-3-2-2-11(g)/CML312//ILOOE-1-9-1-1-1-1-1). The evaluations mean score value for each genotype ranged from 3.6 to 4.9. Entry 7 (4.9) scored the highest value and the lowest was scored by entry 1 (3.6) and 5 (3.6). The genotypes did not show any significant varied stand count at harvest. On the other hand, significant difference was observed among genotypes for plant height, plant aspect, ear aspect, number of cobs and yield. The results revealed that farmers' preferences in some cases coincide with the breeders' selection. However, farmers have shown their own skill in selecting a variety for their localities. Hence, it is a paramount importance to include farmers in a variety of selection process.

**Key words:** Maize, participatory, varietal selection.

## INTRODUCTION

Maize is one of the world's three primary cereal crops. It occupies an important position in world economy and trade as a food, feed and industrial grain crop. Maize consumption is projected to increase by 50% globally and by 93% in sub Saharan Africa from 1995 to 2020 (IFPRI).

Though much of the global increase in use of maize is for animal feed, human consumption is increasing and accounts for about 70% of all maize consumption in sub Saharan Africa (Aquino et al., 2001). It is also one of the major crops grown by smallholder farmers in the semi-

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**Table 1.** List of maize varieties tested.

Entry	Variety name
1	X1264DW-1-2-1-1-1/F7215//CML312
2	SC22/124-b(109)//Gibe-1-91-1-1-1-1
3	kuleni-320-2-3-1-1-1DE-78-Z-126-3-2-2-1-1(g)//CML312
4	DE-78-Z-126-3-2-2-1-1(g)//CML312//ILOOE-1-9-1-1-1-1-1
5	DE-78-Z-126-3-2-2-1-1purple/Gibe-1-91-1-1-1//CML395
6	CML395/CML202//DE-78-Z-126-3-2-2-1-1 green
7	CML395/CML202//CML464
8 (Check 1)	BH543
9 (Check 2)	BH546
10 (Check 3)	BH547

arid low rainfall areas of Ethiopia. Some reports of diagnostic surveys indicated that 93% of the farmers in the lowlands of Ethiopia are maize growers. Maize grain is used for food, for sale and for marketing local brewery, and the Stover is used for construction, animal feed and domestic fuel (De Groote et al., 2002). Varietal selections of maize in Ethiopia have usually been dominantly based on grain yield. Large numbers of breeding lines have been developed at various research stations and their performance evaluated across multi-location tests over several years and only a few varieties are so far identified. Varietal evaluation and decisions were made only by researchers but, this did not speed up the variety releasing process as expected, or their dissemination afterwards.

Participatory plant breeding/selection has shown success in identifying more number of preferred varieties by farmers in shorter time (than the conventional system), in accelerating their dissemination and increasing cultivar diversity (Joshi et al., 1997). By adding information on farmers' perspectives of the plant and grain trait preferences, it is possible to maximize the variety selection process. Research demands a great deal of money and resources. In PVS, we can overcome this problem and adoption rates increased if the farmers are allowed to participate in variety selection process (Tilahun and Teshom, 1987). Therefore, this experiment was aimed to select promising maize varieties using farmers' input and feedback on the selection of varieties.

## MATERIALS AND METHODS

The experiment was conducted at Pawe and Guangua district in 2013/2014 cropping season using 10 maize materials including pipe lines and standard check (Table 1). Randomized complete block design was employed with two replication of two row plot on station and unreplicated three row plots on two farmers' field. Planting was done with 75 cm between rows and 30 cm between plants and all recommended fertilizer rate and cultural practices were applied.

A field day was organized at two stages of the plant that is, silking and maturity and farmers were invited to evaluate the new

maize pipeline genotypes with standard checks assisted by district agricultural experts from the Pawe and Guangua district agricultural office and researchers from Pawe Agricultural Research Center. Farmers were grouped and set different criteria for evaluation of maize varieties such as lodging resistance, number of ear/plant, ear size, disease resistance, termite resistance, husk cover, vigorosity, plant height, earliness and seed color. Farmers were discussed and these criteria were put in the order of its importance for selecting a given variety at a particular development stage. These criteria were ranked and top ones were used. Each criterion was scored from 1 to 5 rating scale (1 = very good, 2 = good, 3 = average, 4 = poor and 5 = very poor) for each variety.

At silking, farmers were scored each variety for earliness, vigorosity, striga resistance, termite resistance, disease resistance whereas at maturity, farmers were scored for cob size, plant height, husk cover and seed size. In both silking and maturity, farmers were asked to give an overall assessment of each variety, using the same scale. The methodology used in this study to identify farmers' criteria and to facilitate farmer evaluation of the varieties was very convenient for data collection but not for data analysis (Weltzien et al., 2003).

In addition to farmers' evaluation, all agronomic data were collected by the breeder and subjected for analysis of variance using SAS software.

## RESULT AND DISCUSSION

### Farmers' evaluation of the varieties: At silking

At silking, farmers were evaluated based on the maize varieties by considering termite resistance, striga resistance, disease resistance, uniformity, vigorosity, lodging, and earliness as criteria. Farmers were also evaluated based on the overall assessment of each genotype independently and score accordingly (Table 2).

As indicated in Table 2, the top three genotypes, entries 7, 10 and 4 were scored better. The evaluations mean score value for genotypes ranged from 3.6 to 4.9 (Table 2). Entry 7 (4.9) scored the highest value and the lowest was scored by entry 1 (3.6) and entry 5 (3.6). Entries 10 (4.7) and 4 (4.1) were ranked second and third best performing varieties by farmers view, respectively. In the evaluation process, both men and woman participated equally. One of the objectives of the partici-

**Table 2.** Overall mean value of each selection and ranking of genotypes at silking stage.

Entry	Termite resistance	Striga resistance	Disease resistance	Uniformity	Vigorosity	Lodging	Earliness	Total mean score	Rank
1	3	5	2	4	3	3	5	3.6	10
2	5	5	3	3	4	5	3	4.0	4
3	2	5	3	4	4	3	5	3.7	7
4	4	5	3	4	4	4	5	4.1	3
5	5	4	3	2	3	5	3	3.6	9
6	3	5	3	4	4	4	4	3.9	5
7	5	5	4	5	5	5	5	4.9	1
8	5	5	3	3	3	4	4	3.9	5
9	5	4	3	3	2	5	4	3.7	7
10	5	5	4	5	4	5	5	4.7	2

**Table 3.** Overall mean value of each selection and ranking of genotypes at maturity stage.

Entry	Number of ears	Cob size	Husk cover	Seed size	Plant height	Total mean score	Rank
1	3	5	3	3	4	3.6	5
2	4	3	4	4	4	3.8	4
3	3	4	4	5	5	4.2	2
4	3	3	4	3	3	3.2	7
5	2	4	3	2	5	3.2	7
6	2	3	4	3	3	3.0	8
7	5	4	2	4	5	4.0	3
8	2	3	4	3	4	3.2	7
9	3	4	3	4	3	3.4	6
10	5	4	4	5	4	4.4	1

patory breeding approach is to see how well farmer evaluations of the varieties relate to the selection procedure of the conventional breeding approaches. Therefore, a comparison was made in statistically analyzed scores of the farmer's evaluation and the breeder's analyzed data.

Farmers and researchers used different parameters and methods to evaluate the tested genotypes. Farmers have showed their ability to select well- adapted and preferred varieties under their circumstances using their own criteria. Breeder's must take into account farmers selection traits in their varietal development such as earliness, uniformity and overall field performance.

### Evaluation at maturity

From the group discussions, farmers developed the following criteria for evaluating the varieties at all the sites: number of ears, ear size, husk cover, seed size and plant height. Similarly, farmers were also made an overall assessment of the variety independently and scored accordingly.

As shown in Table 3, number of ears for entry 7 was considered better than the two check varieties but equal mean score with entry 10. In cob size, entry 1 (5) scored the highest and followed by entries 3 (4), 5 (4) and 7 (4). The lowest score were recorded by entries 2 (3), 4 (3), 6 (3) and 8 (3).

In the overall assessment, entries 10 (stand. check), 3 and 7 were the top three maize varieties based on the overall mean performance illustrated in Table 3. However, farmers can have the access to select varieties in their trait of interest such as for earliness, yield, biotic resistance etc.

In agreement with De Groote et al. (2002) there was a growing interest among farmers in the use of early maize varieties in short rainfall season and farmers have shown strong interest. Some farmers were willing in adopting the varieties since they were confident of their high yield and earliness. For future trials, sufficient resources need to be made available to assure enough high quality data for statistical analysis.

These data have played a role to adjust the breeders' index in order to make it more responsive to farmers' preferences. In some cases, farmers' preference

**Table 4.** Mean value of different agronomic traits on station (PARC)

Entry	SH	Ph	PASP	EASP	CH	YLD
1	24.5ab	227.0ab	2.0cb	2.0a	34.0a	51.3abc
2	22.5ab	218.0abc	2.0cb	1.7ab	33.0a	56.5ab
3	28.5a	216.5abc	2.2abc	1.5ab	26.5a	47.7bc
4	20.5ab	186.5cd	2.25abc	1.5ab	28.0a	44.4bc
5	24.5ab	195.7bc	3.0a	1.5ab	30.0a	52.2abc
6	28.0ab	215.2abc	2.2abc	1.25b	34.5a	54.7ab
7	27.5ab	197.3abc	2.5ab	1.5ab	31.5a	53.7ab
8	25.5ab	198.2abc	2.2abc	2.0a	25.0a	37.6c
9	18.0b	227.5a	2.0cb	1.3b	31.0a	53.3abc
10	27.0ab	159.7d	1.5c	1.3b	32.0a	64.1a
CV (%)	18.82	6.8	18.4	14.9	14.36	13.68
Mean	24.6	204.19	2.2	1.55	30.55	51.57
LSD (5%)	10.47	31.55	0.9	0.5	9.9	15.9

SH = stand count at harvest (no.), PH = plant height (cm), PASP = plant aspect (no.), EASP = ear aspect (no.), CH = cob harvested (no.), YLD = yield (Qt/ha), CV = coefficient of variation, LSD = least significance difference.

**Table 5.** Analysis of variance for agronomic traits on station (PARC).

Sources of variation	d.f.	Mean squares					
		SH	PH	PASP	EASP	CH	YLD
Replication	1	12.67	7330.47	2.70	0.002	15.40	627.73
Entry	9	22.79 <sup>ns</sup>	1006.05 <sup>*</sup>	0.39 <sup>*</sup>	0.16 <sup>*</sup>	20.45 <sup>*</sup>	109.44 <sup>*</sup>
Error	9	21.44	194.53	0.16	0.05	19.27	49.82

\*Indicate significance at  $P < 0.05$ , and 'ns' indicate non-significant.

coincides with breeder's selection criteria. In general, farmers have their own indigenous knowledge and skill in selecting a variety for their localities. Hence, it is a paramount importance to include farmers in a variety selection process.

### Agronomic traits of genotype

Agronomic traits that is, stand count at harvest, plant height, plant aspect, ear aspect, number of cobs harvested, and grain yield were collected and analyzed (Table 4). The tested genotypes did not show significant variation for stand count at harvest. Stand count ranged from 18.0 to 28.5 (Table 4). Entry 3 was the highest genotype in stand count at harvest (28.5) followed by entry 6 (28.0) and 7 (27.5). The lowest genotype in stand count was entry 9 (18.0).

A significant difference ( $p < 0.05$ ) was observed among genotypes for plant height, plant aspect, ear aspect, number of cobs and yield. Plant height ranged from 159.7 to 227.5 cm and the tallest was entry 9 (227.5 cm) followed by entry 2 (218.0 cm). The shortest variety was

entry 10 (159.7 cm). Plant aspect is an important trait for maize and genotypes had shown significant variation. Entry 10 was a better genotype (1.5) followed by entry 1, entry 2 and entry 9. Significantly, variation was observed among genotype in ear aspect. Best ear aspect was recorded for entry 6 (1.25) followed by entry 9 and entry 10. The lowest was entries 1 and 8.

Number of cobs harvested ranged from 25.0 to 34.5 (Table 4). A significant difference was also observed among genotypes in grain yield performance (Table 5). Grain yield ranged from 37.6 to 64.1 q/ha with the grand mean 51.57 q/ha. The highest grain yield was recorded by entry 10 (64.1 q/ha) followed by entry 2 (56.5 q/ha); while the lowest grain yield was observed by entries 8 (37.6 q/ha) and 4 (44.4 q/ha). Hence, the result clearly showed that high yielding genotypes such as entry 10, entry 2 and entry 6 can be released.

De Groote et al. (2002) stated that, scientists like to control many factors so that they can accurately state that, under their very controlled circumstances, a limited number of traits have improved. A problem here is that these highly controlled circumstances are not often representative of farmers' conditions and the limited number

of traits might not represent farmers' preferences.

### Conclusion

It has clearly shown that a fair number of the newly pipe line genotypes were better than the two checks except entry 10 both for yield and other characteristics that farmers considered to be important. Farmers' and breeders' evaluation overlaps varieties selected by farmers as the best were also the best when actual yield was considered. Still the variety they selected for best yield was the same one breeder's selected when yield was measured. It is also interesting to note that the variety that farmers considered as overall best at silking was not selected at maturity stage because it ranked differently. Entry 7 was the first ranking at silking stage while third at maturity. The methodology has clearly shown that farmers, if included in early evaluation of germplasm, can make a valuable contribution to the breeding effort. Generally, participatory varietal selection was effective and reliable for identifying appropriate cultivars through partnership with resource – poor farmers.

### Conflict of interest

The authors have not declared any conflict of interest.

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