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Participatory On-Farm Variety Selection of Improved Finger Millet (Eleusine coracana) Varieties in North Western Amhara Region of Ethiopia

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Abstract
Participatory variety selection (PVS) was conducted to select varieties of improved finger millet with the participation of farmers and their selection criteria. Eight varieties (Necho, Degu, Gute, Wama, Dibate, Mecha, Bareda and Farmers local) were evaluated at Adet, Merawi and Finoteselam in West Gojam, North West Ethiopia. The experiment was conducted using a RCBD design with three replications at one farmer's field in each site in the 2014 (main cropping season). The varieties were scored using the matrix ranking method based on the farmers' selection criteria. Variability for yield and other agronomic traits were also estimated. The Combined Anova results revealed that the highest yields were recorded from Wama (2449.5kg/ha) and Mecha (2368.2kg/ha), while the lowest yield was recorded from Dibate (1660.6kg/ha). Significant variation was recorded among genotypes for various agronomic traits. In general, the results indicated that there is good scope for crop diversity improvement through participatory varietal selection. In conclusion, participatory variety selection is a powerful way of involving farmers in the selection and dissemination of varieties that are adapted to their needs, system and environments.
Keywords: Participatory variety selection, Finger millet, Eliusine coracana, Farmers' preference, Varieties.

Introduction

Studies taking in to account the farmers' conditions, attitudes constraints and related socioeconomic factors supported by agronomic interpretation help in formulating technology recommendation to small scale farmers (CIMMYT, 1988). The importance of on farm research in the evaluation of the value of any new variety of technology under real farm conditions for the benefit of farmers have been found vital (Lancon et. al., 1989) and agricultural scientists of many developing countries have adopted on-farm research as a necessary tool in the development and transfer of appropriate technology (Mutsaers et.al.1997). Often there is little information available to breeders regarding farmers' circumstances that should be considered in developing new varieties. However, it is widely accepted that farmers' varietal evaluation criteria for instance go beyond yield (Ashby, 1982; Witcombe *et.*al., 1996; Tripp, 1997). As stated by Tripp, 1997, varietal development and testing had been done using criteria which were set by the breeders per se and were only partly relevant to farmers. On the other hand, stronger participation by farmers in agricultural research and extension processes is increasingly improving that helps realize the socio-economic and natural circumstances of small scale farmers, which are complex, divers and risk prone (Knipscheer et al. 1989). Such a strong participatory research partnership from problem diagnosis to fine tuning of recommendations plays several critical roles for a successful technology generation and transfer (Collin, 1991).

In Ethiopia, improved crop varieties and their production packages are developed by researchers mainly in research stations and tested on farmers' fields (verification trial) in very few locations of the potential areas, and variety recommendation is done based on average performance of the varieties without considering genotype by environment interactions and farmers' needs and preferences, and the released varieties are distributed to the growers across the country. This top-down approach has not been able to t convince the farmers to grow improved varieties particularly in marginal areas (Assefa *et. al,* 2014). The top down approach to variety selection and seed production in Sub-Saharan African countries has resulted in the release of varieties mostly not suited to farmers' climatic conditions and socio-economic circumstances (Foti *et. al*, 2008) and consequently, very few of them are adopted. Therefore, in crop improvement and other technology development processes the involvement of the end-users in the development and evaluation process may increase the adoption and dissemination of the new technology.

In participatory variety selection (PVS) farmers select the desired variety from a mixture of finished or nearly finished products (released cultivars, varieties in advanced stages of testing, and advanced non-segregating lines) from plant breeding programs in their own fields (Muchow *et. al* 1994). PVS provides an

opportunity of getting large number of varietal choices to farmers, enhances farmer's access to crop varieties and increase in diversity, increases production and ensures food security, helps to disseminate the adoption of pre and released varieties in larger areas, allows doing varietal selection in targeted areas at cost-effective way and also in a lesser time and helps seed production at community level (Yadaw et al., 2006). A very important advantage of PVS is that the adoption of new cultivars is much faster than under the formal crop improvement and also the spread of varieties from farmer-to-farmer through the local seed system can be very fast, thus guaranteeing a further good adoption (Bellon *et. al* 2002).

In Ethiopia Finger millet (*Eleusine coracana*) is mainly grown as a staple food crop in the majority of the growing areas and often considered as a component of food security crop. Sole cropping is the common practice in rotation with other annual crops, preferably legumes. The crop is produced in six regional states of the country. The Amhara region alone accounts for more than half of the total area and production of finger millet in Ethiopia (CSA 2013).

The objective of this study was to assess improved finger millet varieties with the participation of farmers using their selection criteria and compare this with the researchers' selection criteria.

Materials and Methods

Seven improved (Necho, Degu, Gute, Wama, Dibate, Mecha, Bareda) and one local finger millet variety were evaluated using randomized complete block design at three major finger millet growing locations (Adet, Merawi and Finoteselam in north western Ethiopia during the main cropping season of 2014. At each location, one farmer's field was used for the trial and neighboring farmers were encouraged to participate in the process. The experiment was conducted using a RCBD with three replications. Each variety was sown in 10m x 10m size of plot and 25 rows per plot. A seed rate of 15kg/ha and fertilizer rate of 100kg/ha DAP and 50kg/ha Urea were applied. DAP was applied at planting while Urea was applied at tillering or after first weeding. Weeding was done three times in the cropping season starting from 30-35 days after planting and depending on the weed infestation.

Farmers of each location participated in the site selection, land preparation, during planting, selection criteria setting and variety evaluation based on their selection criteria. In addition, data on days to heading, days to maturity, plant height (cm), finger length (cm), number of ear per plant, number of fingers per ear, number of tillers per plant, lodging (%), stand (%) at harvest, severity (%), grain yields (g/plot)) were recorded for comparison with the farmers selection. The data on grain yield and other agronomic parameters were analyzed using using GenStat V.16 and inference was made based on the data and farmers selection. At maturity farmers selected the bestvariety for their environment using the following selection criteria; Finger length, tillering capacity, Grain filling, expected straw yield, heading type, seed color, disease reaction, stand establishment and lodging.

Results and Discussion

Farmers Evaluations: Farmers have different preference of varieties at different locations based on their selection criteria. Variety Necho was selected first rank at two locations (Adet and Merawi) while Bareda was selected first rank at Finoteselam location. In general, varieties Necho and Mecha were highly preferred by farmers falling from 1-3 rank in all locations (table 1).

Agronomic evaluations: The average grain yield indicated that varieties perform differently at different locations. Accordingly, varieties Mecha was high yielding at Adet followed by Wamma and Degu giving a grain yield of 3091.3, 2996.4 and 2285.6 kg/ha respectively while at Merawi the variety Wama (1964.5kg/ha) was a high yielding followed by Mecha (1956.0kg/ha) and Gute (1798.6kg/ha). Finally, Bareda (2960.6kg/ha) was high yielding followed by Gute (2827.0kg/ha) and Degu (2490.1kg/ha) at Finoteselam (table 2).

From the above two evaluations we can understand that the farmers selection is different from breeders selection which is based on agronomic data. According to the agronomic evaluation varieties Wama, Gute and Degu were in the ranks 1-3 but due to their other morphological characters like seed color, disease reaction and head architecture, farmers didn't select them. Based on the combined data over location, varieties Wama and Gute were first and third in rank in grain yield having other agronomic parameters almost similar but were not selected by farmers due to their compact head type which the farmers linked to bad feeling of leprosy while Degu was not selected by farmers because of high disease infection (table 3).

Conclusion and Recommendation

Farmers at all the three locations identified varieties Necho, Bareda and Mecha as the most preferred (ranks 1-3) varieties. At Adet, however, Gute was preferred over Bareda.

The combined data across locations revealed that on the basis of grain yield, varieties Wama, Mecha and Gute out yielded all other varieties giving 2449.5kg/ha, 2368.2kg/ha and 2251.4kg/ha, respectively. The results further indicated that variety Mecha was selected using both farmer and researchers' criteria. Seeds of this

variety should be multiplied and distributed to the farmers in the three locations in this study.

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Table 1. Farmers selection of varieties by rank per location

Priority No.	**Adet (Hanna)**	**Merawi** (Enguti)	**Finiteselam (Jiga)**	**Selection criteria** Prioritized
1	Necho	Necho	Bareda	Disease
2	Gute	Bareda	Necho	Finger number
3	Mecha	Mecha	Mecha	Finger length
4	Wama	Degu	Dibate	Tiller
5	Bareda	Wama	Wama	Plant height
6	Dibate	Gute	Gute	Lodging
7	Local	Local	Degu	Stand establishment
8	Degu	Dibate	Local	Seed color

Table 2. Mean grain yield (kg/ha) of improved finger millet varieties on farmers' fields

No.	**Variety**	**Experimental Locations**			
		Adet	**Merawi**	**Finoteselam**	**Mean**
1	Necho	2173.0(1)	1601.1(1)	2322.1(2)	2032.1
2	Degu	2285.6(8)	1362.2(4)	2490.1(7)	2046.0
3	Gute	2128.5(2)	1798.6(6)	2827.0(6)	2251.4
4	Wama	2996.4(4)	1964.5(5)	2387.5(5)	2449.5
5	Dibate	1579.1(6)	1181.4(8)	2221.2(4)	1660.6
6	Mecha	3091.3(3)	1956.0(3)	2057.3(3)	2368.2
7	Bareda	2228.9(5)	1193.8(2)	2960.6(1)	2127.8
8	Local	2119.2(7)	1067.2(7)	1850.5(8)	1679.0
	Mean	2325.3	1515.6	2139.5	2076.8
	LSD(5%)	1045.5	512.8	665.0	
	CV%	25.5	19.3	17.7	

NB: Numbers in bracket indicates farmers' selection rank

Table 3. Agronomic performance of finger millet varieties across locations

No.	Variety	Plant height (cm)	No. of Fingers per Ear	Finger length (cm)	Grain Yield ($kgha^{-1}$)	Blast severity (1-5scale)	Seed color	Head type
1	Necho	80.33	7	11.6	2032.1	3.3	Chalky white	Loose
2	Degu	81.87	6	10.9	2046.0	4.2	Black	Loose
3	Gute	77.45	5	8.5	2251.4	2.5	Red	Compact
4	Wama	77.82	5	8.3	2449.5	2.2	Red	Compact
5	Dibate	57.77	7	5.8	1660.6	1.0	Red	Compact
6	Mecha	77.72	5	8.4	2368.2	2.0	Red	Loose
7	Bareda	76.47	6	9.3	2127.8	1.5	Cream white	Loose
8	Local	85.58	7	10.7	1679.0	4.2	Black	Loose
	Mean	76.87	6	9.2	1993.5	2.6		
	LSD (5%)	3.34	0.6	0.7	363.4	0.72		
	CV%	5.3	11.1	9.3	22	15.9		