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Original Paper

Evaluation of Banana Varieties through Farmer's Participatory Selection at Teppi, Southwestern Ethiopia

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***Abstract*— Participatory varietal selection was conducted in Southwestern part of Ethiopia to evaluate the performance of banana cultivars and to identify farmers' preference and selection criteria in the study area. Seven banana cultivars collected from Melkassa agricultural research center were evaluated in single plot in 2020-2023 main cropping season. Farmers' evaluation was made at two different stages of the crop, namely at vegetative and at maturity using both direct-matrix and pair-wise ranking methods of selection scheme. Farmers' set; plant height, disease resistance/tolerance, fruit size and yield as selection criteria to evaluate and identify their preferred cultivars. The results of analysis of variance indicated the existence of highly significant differences among cultivars for all traits measured at 5% probability level. From the previous experiments, the highest mean yield was obtained from the cultivar William I (45.32 t/ha), Dinke-1 (45.1 t/ha), Lady Finger (40.16 t/ha) and Poyo (40 t/ha). Likewise, these three cultivars (William, Dinke-1, and Lady Finger) were identified as farmers preferred cultivars from both pair-wise and direct matrix ranking evaluations. Thus, these cultivars were chosen for their performance in the field and from farmers' evaluation perspective. Moreover, this study indicated participatory varietal selection is a viable method to gain greater insight into farmers' perceptions, preferences, merits and shortcomings of banana cultivars. Therefore, based on the results of this study, William I, Dinke-1 and Lady Finger cultivars are recommended for multiplication and distribution to farmers in the area and similar agro-ecologies.**

Keywords*— *Banana, Farmers' preference, Tepi

I. INTRODUCTION

Banana is one of the most consumed tropical fruits around the world [1]. In many developing countries of rural areas, banana plays a significant role as source of economic growth, income, food security and nutrition. But the production and consumption of banana are subject to underestimation owing to extensive cultivation on small household plots, the available information nevertheless indicates that their importance in global food supply has increased significantly in recent decades [2]. Banana fruit can be utilized as a value-added supplement and is a fantastic source of nutrients for the human diet because of its important nutritional components, which include fiber, protein, minerals, and antioxidant chemicals. The nutritional value of many foods may be enhanced by adding banana fruit and flour supplements [3].

Commercially, banana is the leading fruit in global trade both by volume and value [4]; Ahmed and [5], [6]). In Ethiopia, banana covers the largest area (59.43%) of the fruit crops followed by avocados which contributed 18.94% of the area and it took up 63.30% of fruit production [7]. Farmers in the main banana-growing regions use low-yielding, poor-quality banana cultivars that are also susceptible to diseases and pests that have been under production for a long time [8]. Due to a lack of improved cultivars in the target area, small-scale farmers in south-western Ethiopia, notably in the Teppi area, were growing the local cultivar of bananas, which has a low yield.

Hence the need to introduce improved banana varieties to the target area is crucial to boost production and productivity. As a result, this study was designed to select the best performing banana varieties for the target area based on farmer's preferences. The lack of specifically adapted varieties, a lack of released varieties that match well with the majority of farmers' growing conditions, and the use of traditional and readily accessible production techniques are the possible reasons of the inadequate adoption of new varieties. In numerous crops across many different countries, Participatory Variety Selection (PVS) has been found to be quite successful in solving many of these issues. PVS could be very helpful in identifying new varieties that farmers accept, allowing farmers to avoid the restrictions that force them to grow land races or obsolete varieties [9]; [10]; [11] and [12]. Therefore, participatory varietal selection has been proposed in this research as a way to evaluate and select the best disease tolerant, high yielding, and adaptable varieties through farmer selection preferences to diversify and popularize this economically valuable crop in the study areas.

II. Experimental Materials And Methods

A. Description of the Study Area

The field experiment was conducted for three crop cycles at Teppi and Godere on farmer's field. Teppi is located in Sheka zone of southwestern Ethiopia at an elevation of 1200 meters above sea level. Teppi is located at about 611 km away from Addis Ababa in South Western Ethiopia in between 7° 3'E latitude and 35° 18'N longitude. The research center receives an annual rainfall of 1559 mm with maximum and minimum temperatures of 29.70C and 15.50C respectively. The soil of the experimental site is radish brown sandy clay loam classified as Nitosol with pH range of 5.6 to 6. Gelesha is located in Godere District, Gambella Regional State of Ethiopia. The district is located between 7□08'-7□23' latitude and 34□52'-35□25' longitude. It also has an altitude ranging from 500 to 2400 m above sea level, with the natural forest area in the range of 500-1500. The climate of the area is a hot and humid type [13], and Meteorological data obtained from National Meteorology Service Agency (Addis Ababa) indicate that Godere District receives high rainfall between mid-March to October and low rainfall from November to February. The highest annual mean rainfall of the study area within twelve years (1998-2009) is 2726.7 mm. The lowest mean monthly temperature is 13.2°C and the highest mean monthly temperature is 33.1°C with an average temperature of 22.2°C. The soil of the district is reddish brown, well drained and clay in texture [14].

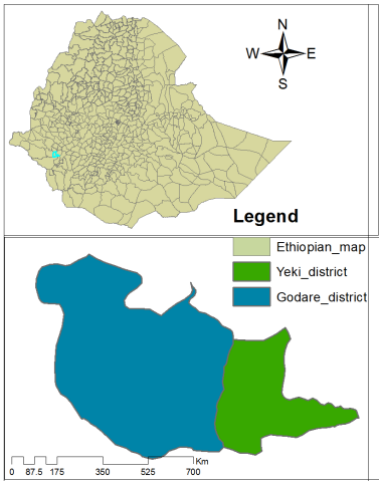

Fig. 1. Map of the study area

B. Experimental Treatment and Design

For this experiment, a total of 7 banana cultivars that were collected from the Teppi Agricultural Research Center's banana multiplication blocks were used. The experiment was set up using a single plot. The spacing of 2.5 m between rows and 2.5 m between plants were used. The planting hole with 60cm depth and 60cm width were prepared two months before planting and suckers of each cultivar were planted. De-suckering was used to remove undesirable suckers, and each pit was only allowed to support one sucker at a time. Important field management practices like sucker management, earthing up, propping and other practices were followed as per recommendation.

C. Data Collection and Farmer's Participation

Through farmers' participation, information on the agronomic performance of banana cultivars and farmer preferences for the varieties was gathered. A total of 31 banana producing households from two Woredas constituted the farmers from different kebeles were involved in the process of variety selection. Farmers' preferences were gathered and ranked by the frequency of their selections.

III. Results And Discussion

A. Farmer's Preferences of Banana Cultivars

In this study, farmers' selection criteria and acceptable varieties to adapt to and incorporate into the production system were identified via participatory variety selection. Participatory tools (direct matrix and pair-wise rankings) were used in the selection of the varieties. The selection of farmers was mostly based on their background in farming bananas, gender, and willingness in research participation. A total of 31 farmers of both sexes (male=22, female=9) participated in the study at Tepi and total of 29 farmers of both sexes (male=20, female=9) participated at Gelesha. Farmers were allowed to set their own selection criteria and then both male and female participants prioritized and jointly agreed on three characters (plant height, bunch size and disease tolerance) and five characters (morphological traits, leaf structure, bunch length, number of fingers per bunch and finger length) during flowering and physiological maturity stage of the crop, respectively.

Each selection criterion was compared with the others in a pairwise approach once they had all been tabulated in a matrix scoring table. The frequency with which each selection criterion was preferred by the group was used to assign ranks. After selecting and weighing their best selection criteria, farmers were invited to examine properly all the experimental units and select the best variety (ies) based on its/their suitability to the specified criterion appropriate to their environment. A direct matrix table was prepared for the evaluated genotypes listed in the row and traits preferred by farmers listed in the column. Scores were given to each variety based on the selection criteria (4 = Excellent, 3= very good, 2= good, 1= poor).

Farmers have given rating of importance (a relative weight) of a selection criterion ranked from 1 to 3 (3= very important, 2= important and 1= less important) and rating of performance of a variety for each trait of interest (selection criteria) was given based on their level of importance on the basis of common agreement of evaluators. Each variety's score was multiplied by the relative weight of each character to get the final score, which was then added to the scores of the other characters to get the variety's overall score. Ranking and scoring were done by consensus, and differences of opinion were resolved through discussion.

TABLE 1. FARMERS PREFERENCES FOR BANANA CULTIVARS AT TEPPI IN 2019/20-2022/23

Relative weight	**Ranking of selection criteria for each variety**								
variety	Morphological Trait	Plant height	Leaf structure	Bunch size	Number of fingers per bunch	Finger length	Disease tolerance	Total score	Rank
	2	*2*	*2*	*3*	*3*	*3*	*3*		
Butuza	1(2)	*2(4)*	*2(4)*	*1(3)*	*1(3)*	*2(6)*	*1(3)*	*25*	*7*
Giant Cavendish	2(4)	*2(4)*	*2(4)*	*2(6)*	*2(6)*	*2(6)*	*2(6)*	*36*	*5*
Dinke-1	2(4)	*3(6)*	*2(4)*	*2(6)*	*3(9)*	*3(9)*	*2(6)*	*44*	*3*
Grand Naine	2(4)	*2(4)*	*2(4)*	*2(6)*	*3(9)*	*3(9)*	*2(6)*	*42*	*4*
Poyo	2(4)	*3(6)*	*3(6)*	*1(3)*	*2(6)*	*1(3)*	*2(6)*	*34*	*6*
Lady Finger	*3(6)*	*3(6)*	*3(6)*	*3(9)*	*3(9)*	*3(9)*	*2(6)*	*51*	*2*
William-I	*3(6)*	*4(8)*	*3(6)*	*4(12)*	*3(9)*	*3(9)*	*2(6)*	*56*	*1*

Number of participants=31 (22=male, 9 =female), rating 4=excellent, 3=very good, 2=good and 1=poor. Relative weight of selection criteria: 3=very important, 2= important and 1=less important, the number in the parenthesis indicates the product of relative weight of selectin criterion and the performance of cultivars by farmers

TABLE 2. FARMERS PREFERENCES FOR BANANA CULTIVARS AT GELESHA IN 2019/20-2022/23

Relative weight	**Ranking of selection criteria for each variety**							
variety	Morphological Trait	Plant height	Bunch size	Number of fingers per bunch	Finger length	Disease tolerance	Total score	Rank
	2	*2*	*3*	*3*	*3*	*3*		
Butuza	3(6)	*2(4)*	*1(3)*	*2(6)*	*2(6)*	*2(6)*	*31*	*7*
Giant Cavendish	2(4)	*1(2)*	*3(9)*	*2(6)*	*3(9)*	*2(6)*	*36*	*5*
Dinke-1	2(4)	*4(8)*	*3(9)*	*4(12)*	*3(9)*	*2(6)*	*48*	*3*
Grand Naine	2(4)	*1(2)*	*2(6)*	*2(6)*	*3(9)*	*2(6)*	*33*	*6*
Poyo	3(6)	*2(4)*	*2(6)*	*3(9)*	*3(9)*	*2(6)*	*40*	*4*
Lady Finger	*4(8)*	*4(8)*	*3(9)*	*4(12)*	*3(9)*	*2(6)*	*52*	*1*
William-I	*3(6)*	*4(8)*	*4(12)*	*3(9)*	*3(9)*	*2(6)*	*50*	*2*

Number of participants=29 (20=male, 9 =female), rating 4=excellent, 3=very good, 2=good and 1=poor. Relative weight of selection criteria: 3=very important, 2= important and 1=less important, the number in the parenthesis indicates the product of relative weight of selectin criterion and the performance of cultivars by farmers

Fig. 2. Farmers participation during banana variety selection

IV. Conclusions

In many developing countries of rural areas, banana plays a significant role as source of economic growth, income, food security and nutrition. As a result, there is an increasing demand by farmers for production and consumption of improved banana cultivars in the study areas. In order to respond to farmer requests, participatory variety selection trial was conducted with the objective of selecting superior banana cultivars with farmer's preferred traits. The participated farmers have given a rank for the traits used for selection and evaluated the cultivars using their own selection criteria. As a result, based on their preferences William I, Lady Finger and Dinke-1 cultivars were selected as the first, second and third choices. Therefore, scaling up of these selected varieties should be done in the study area and areas with similar agro-ecologies so that producers can able to access the variety to solve the nutritional deficiency, economic problem and food insecurity.

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