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Participatory Variety Selection in Upland Rice (*Oryza Sativa L)* at Guraferda District, South West Ethiopia

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Abstract

Rice is one of the most important cereal crops in Ethiopia. The major challenges in improving food security are to develop varieties that are adapted to specific environment and farmer's needs. This study was designed to know farmers criteria to select improved upland rice varieties and rank varieties based on their selection criteria for adoption. To take the view and preference of various stakeholder's participatory variety selection approach was applied. The experiment was conducted using mother-baby trails. In the mother trail un-replicated complete block design in five farmers field were used and each farm was considered as un-replicated block. The analysis of variance revealed significant differences ($P \leq 0.05$ or $P \leq 0.01$) among varieties for all of the studied traits, except for days to 85% maturity. High grain yield was obtained from Hiddassie (5709 $kgha^{-1}$), SUPERICA-1 (5351 $kgha^{-1}$) and Fogera-1 (5313 $kgha^{-1}$). Farmers listed out many selection criteria to select varieties for production viz., grain yield, panicle length, effective tillers and disease resistance (blast and brown spot). Similarly, traders mentioned seed color, seed size and market demand as variety selection criteria. The results of direct matrix ranking showed that varieties SUPERICA-1 ranked first followed by Hiddassie and Fogera-1 on the basis of all criteria listed by the participants. Farmers will be benefited by growing varieties selected as per their selection criteria. Therefore, for the study areas these three varieties are recommended for production with their production packages

Key words: Direct matrix ranking; Participatory variety selection; Upland rice (*Oryza Sativa L.*)

Introduction

Rice is an important cereal crop in Ethiopia. In the country, five million hectares are categorized as highly suitable for upland rice cultivation. With average production of 2.84 tons ha-1 151,081 tons of rice yield were [1]. The world average was 4.6 tons ha-1 and in China it reached 7 tons ha-1 (USDA, 2019) [2].

In south region of Ethiopia, Graferda district is one of the main rice growing area [3]. Consequently, 19 kebeles are potential, of which 17 produce rice as a major crop. During the 2020 cropping season, at Guraferda 16,000 hectares of land is covered by the crop (GDOARD, 2020). In the area, the minimum average of area covered by rice is one hectare per farmers' [3]. Although the country's rice production is limited, the demand for rice has grown and is now the most sought-after teff. Farmers in Gurafarda woreda make rice their main crop and cover most of their fields. However, more than 95% of land is covered by locally grown rice. Unimproved local rice will take more than five months to reach maturity, leading to a significant reduction in yield if the rains fall earlier. There are many improved varieties of rice in the country, but there are many gaps in terms of dismission and adoption. In fact, evaluation criteria were entirely centralized by researchers. High yielder varieties in research management may not consistently perform in farmers' field besides; high yielder variety may lack a quality or other trait needed by users. This is because researchers may overlook some of very important traits needed by farmers, this will happen hence variety evaluation and selection in Ethiopia is mainly centralized on the hand of researchers alone. Thereby, at the end the dissemination and acceptance of technology in Ethiopia is very poor, and currently a very few improved varieties among many are adopted by farmers. To eliminate bottlenecks in the variety evaluation process and adoption, variety evaluation in the hands of farmers have a significant importance. The application of Participatory Variety Selection (PVS) will take the view and preferences of various stakeholders. Participatory variety selection can be used to know the farmers criteria to select varieties for adoption [4]. It also reduces research cost and increase adoption rates if farmers are allowed to participate in variety testing and selection.

Therefore, this research was initiated with the following objectives:

1. To test performance of promising upland rice varieties under farmers' growing conditions andresearcher-farmer management
2. To obtain feedback on farmers preferred traits for future breeding program

Materials and Methods

Site and Framer selection

The trial was carried out during the main cropping season of 2020 at Guraferda woreda Benchi-sheko zone. From the district three kebeles namely; Sega, Chodit and Berje were selected on the basis of their representation of the targeted ecology for upland rice production. Thirteen farmers from each kebele were selected, based on familiarity with rice production, interested to conduct the trials and some degree of literacy. During selection, both women and men farmers were involved.

Experimental Design and participatory variety selections

Mother trial

In this trail unreplicated complete block design in five farmers field were used and each farm was considered as un-replicated block. Eight improved upland rice varieties selected from the 2019 variety evaluation trials (Viz., Chewka, Fogra-1, Adet, Kokit, SUPERICA-1, NERICA-4, NERICA-12 and Hidassie were used. The plot was made up with dimensions of 5 m length and 1.5 m width (with a total area of 7.5 m^2). Each plot consisted of seven rows at 0.25m interval, out

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of which data were taken from the most middle five rows (5 m^2). As per the national recommendation seed rate i.e.,80 kg/ha, which is equivalent to 56 g of seeds per plot were hand drilled along the line of each row. Fertilizer was applied as per the national recommendation. During the growing stage, all the recommended agronomic practices for rice were applied in collaboration with farmers and researchers and the required data were collected by researchers.

Baby trial

In the baby trail from the set of eight varieties, selected farmers were given two varieties weighed 200 g of seeds. In each variety bag, variety name was clearly named and name and address of the farmers who received the bag were noted. Farmers were trained to grow two improved varieties along with their local rice and finally to compare each other's and gave information about the varieties. No farmer was got more than two varieties so that they could compare new varieties from their local varieties without confusions. In this trail a total of 39 farmers were involved.

Participatory variety selections

In PVS work, the researchers together with district agricultural workers select farmers from both sexes. Accordingly, twelve farmers and six traders who were interested to participate on variety selection were selected. The then, participants were exposed to select a set of traits which they are considered important. At early maturity variety selection by farmers were done and then after harvest seeds from each entry was given to traders to select varieties based on their market preference. Direct matrix ranking methods were used to rank varieties, in matrix ranking farmers are ordered to rate the performance of each varieties with respect to each selection criteria as: (1=very poor, 2=poor, 3=good, 4=very good, 5=excellent) and they gave rating on the relative weight of selection criteria as:(3=very important, 2=important and 1=less important based on consensus where differences were solved by discussion [5]. Scoring was done by major vote/hand by group of farmers participated in the selection.

Data Collections

Data collection was done according to the Standard Evaluation System for Rice (SES) (IRRI, 2013). To get comment from farmers on varieties household level questioners were applied and farmers feedback were documented.

Plant height (PH, cm): Height of the plant in centimeter from the base of the main stem to the tip of the panicle was recorded as the average of five randomly taken plants in the middle five rows of each plot.

Panicle length (PL, cm): Length of the panicle in centimeter was measured from the node, where the first panicle branch starts, to the tip of the panicle as the average of five randomly taken plants in the middle five rows of each plot.

Days to 85% maturity (MD, days): Number of days from the date of sowing to the date when 85% of the crop stems, leaves, and floral bracts in a plot changed to light yellow color was recorded.

Thousand grain weight (TGW, g): Weight in gram of 1000 grains from bulked grains, which were collected at central rows of each plot was recorded after cleaned and adjusted to14% moisture content level.

Grain yield per hectare (GY, q/ha): Grain yield (paddy) in gram obtained from each plot of the middle five rows at physiological maturity were converted to quintal per hectare, after cleaned and adjusted to14% moisture content level (Figure 1).

Results and Discussion

Analysis of variance: The analysis of variance revealed significant differences ($P \leq 0.05$ or $P \leq 0.01$) among varieties for all of the studied traits, except for days to 85% maturity (Table 1). This might be due to the presence of different genetic composition among varieties and/or environmental effects, for that matter the studied traits exhibited dissimilar response among each other's. In this study the maturity range of the studied eight varieties was 117 to 130 days after sowing (Table 2). This is in similar with the results obtained and reported by [6]. on 13 upland rice varieties tested at Guraferda district. The presence of such medium class matured varieties will benefit farmers of the area as a drought escape mechanism when the rains fall earlier. According to Yoshida (1981) [7], varieties under this maturity class (120-138 days from seeding) in the tropics are expected to furnish high yield if soil fertility is not a problem. Plant height also varied significantly among varieties with a range of 84 to 116.5 cm and most of the varieties have height <90cm. This implied that the height of the studied varieties is mainly grouped under the class of semi-dwarf varieties. According to Yoshida (1981) [7], a short and intermediate height along with stiffness culm makes the rice plant more lodging-resistant and this is most responsible for high yields.

In this study, grain yield also differed significantly among varieties. High grain yield was obtained from Hiddassie, SUPERICA-1 and Fogera-1. Similarly, high grain yield was obtained from those varieties from research filed [4]. However Chewaka variety which yielded better in research fields during 2019 adaption trials, gave lower yield during this experiment. This was due to the fact that, in this trail we clearly observed poor field performance of Chewaka at Berji kebele associated with rains shortfall during the grain filling period. During the study, it was noted that this variety matured lately among others which tooks138 days after sowing and is reflected for stress caused by water shortage if rains stopped before the mid-September.

Farmers Participatory evaluation and selection criteria for the tested rice varieties: Participatory variety selection in this study clearly showed which varieties by which criteria are preferred by farmers (Table 3). Farmers listed out many selection criteria to select varieties for production viz., grain yield, panicle length, effective tillers and disease resistance. Similarly, traders cited seed color, seed size and market demand as selection criteria.

The results of direct matrix ranking (Table 3) showed that varieties SUPERICA-1 ranked first followed by Hiddassie and Fogera-1 based on the all criteria listed by the participants. Farmers were also asked to identify the positive and negative side of each varieties so that it will have a paramount importance for breeders to make new improvements. Accordingly, they told us their local variety have high market demand among the improved once because of its better injera quality. Of course, this requires confirmation via experimental procedure. They also stated that the only problems associated with their local variety are: one seed mixture and the other was susceptible to drought because it takes up to 5 months for maturity. Besides, variety like Fogera-1, Adet and NERICA-4 were not preferred by farmers because their thrashabilly is difficult as noted by farmers during threshing.

Conclusion and Recommendations

Varieties selected by researchers might not be preferred and adopted by farmers because farmers have their own selection criteria, thereby farmers involvement in selecting technologies is very pertinent. In this study three varieties SUPERICA-1, Hiddassie and Fogera-1 were preferred by farmers for future production based on

Figure 1: (a) Farmers are identifying selection criteria and preference ranking of rice varieties at physiological maturity. (b) Traders ranks seeds of each varieties based on their market preference

Table 1: Analysis of variance among upland rice varieties for the studied traits.

Traits	MSV (7)	MSE (14)	Mean	CV
Plant height	317.3**	81.1	92.4	9.7
Panicle length	4.5*	1.4	20.5	5.7
Days to 85% maturity	50.4^{ns}	20.7	121	3.8
TGW	18.6**	1.9	31.8	4.3
Grain yield (kg/ha)	4246788.7**	478398.9	4210.4	16

Where, MSV=mean square of varieties, MSE= mean square of errors, CV= coefficient of variations, and figures in the parenthesis indicates degree of freedom

Table 2: Mean performance of upland rice for five traits evaluated at Guraferda woreda under farmers researcher management.

Varieties	Plant height	Panicle length	Days to 85% maturity	Thousand grain weight (gm)	Grain yield (kg/ha)
Chewaka	116.5a	22.7a	130.3	29.9c	2645.8d
Fogra-1	85.9b	20.3bc	122.3	30.8bc	5313.2ab
Hiddassie	88.6b	21.6ab	121.3	30.2c	5709.0a
Adet	84.8b	19.7bc	120.3	30.5c	4315.1bc
Superica-1	95b	18.7c	120.0	35.5a	5350.7ab
NERICA-4	86.5b	19.9bc	118.3	29.1c	3964.7c
NERICA-12	90.7b	20.5bc	118.0	32.9b	3719.5d
Kokit	84.8b	20.4bc	117.6	35.4a	2665.5d

Where, DH= days to heading, DM= days to 85% maturity, PH= plant height, PL= panicle length, and TGW= thousand grain weight

Table 3: Evaluation of eight upland rice varieties by farmers participation using direct matrix ranking.

Relative weight / Variety	Ranking of selection criteria for each variety at Guraferda								
	Grain yield	Panicle length	Effective tillers	Disease resistance	Market demand	Seed color	Seed size	Total score	Rank
	3	2	3	3	3	2	2		
Chewaka	5(15)	5(10)	4(12)	5(15)	1(3)	3(6)	1(2)	63	4
Fogra-1	5(15)	5(10)	5(15)	5(15)	3(9)	3(6)	3(6)	70	3
Hiddassie	5(15)	5(10)	5(15)	5(15)	3(9)	4(8)	4(8)	74	2
Adet	3(9)	4(8)	4(12)	4(12)	4(12)	3(6)	4(8)	67	5
Superica-1	4(12)	5(10)	5(15)	3(9)	5(15)	5(10)	5(10)	81	1
NERICA-4	3(9)	3(6)	4(12)	3(9)	3(9)	3(6)	4(8)	59	6
NERICA-12	2(6)	3(6)	3(9)	3(9)	3(9)	4(8)	4(8)	55	7
Kokit	2(6)	3(6)	3(9)	4(12)	3(9)	2(4)	3(6)	52	8

Number of participants=18 (15=male,3 =female), rating 5=excellent, 4=very good, 3=good and 2=poor, 1=very poor. Relative weight of selection criteria: 3=very important, 2= important and 1=less important, the numbers in the parenthesis indicates the product of relative weight of selectin criterion and the performance of varieties by farmers

their selection criteria, grain yield, disease resistance, effective tillers, panicle length and market preference. Therefore, with their production packages these three varieties are recommended for production for the study areas. Guraferda local rice needs purification and improvement, based on farmers experience and intuition their local rice has high market demand associated with their better enjera quality. Therefore, rice breeders should focus on improving /maturity/ and registering this local varieties for the benefits of producers.

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