Austin Journal of Plant Biology

Open Access

Austin Publishing Group

Rapid Communication

Participatory Bread Wheat Variety Selection at High Land of Guji Zone, Southern Ethiopia

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Received: February 14, 2025;
Accepted: March 10, 2025;
Published: March 13, 2025;

Abstract

Many enhanced varieties of bread wheat have been evaluated for adaptation and are suggested for the Guji Zone's high land agro-ecologies. Some of these kinds, however, were not being cultivated. This is due to the appearance of new rust races and breakdown of resistivity of the crop as highland of Guji is hotspot of wheat rusts. As a result, evaluating newly released wheat varieties by participating farmers to select according to the user's desires. Consequently, a study was carried out in the 2020 cropping season at two highland districts of the Guji Zone (Bore and Ana Sora) in order to select and recommend improved bread wheat varieties through participatory variety selection that are high yielding, early maturing, and disease resistant. Treatments consisted of one local check and five improved bread wheat types. The treatments were set up in a randomized complete block design, with farmers serving as the replication for the baby's trials and three replications for the mother trial. With the exception of days to number of tillers per plant, the agronomic data analysis result shows that there is significant variation across the tested varieties for the majority of the features examined. Varieties Sinja, Wane and Lemu were highest yielding and relatively resistant to diseases than the local check. Using their own standards, farmers participated in the variety selection process as well. As a result, farmers chose two varieties: Sinja and Wane. Similar results have been noted from the two methods of study. Thus, in order to draw conclusions from the study, it is necessary to take into account and respect the farmers' choice rather than the trial's results. Thus, Sinja and Wane were suggested for the researched areas and comparable agro-ecologies of Guji Zone based on both methods of finding variations.

Keywords: Rust; Participatory; Variety; Selection

Introduction

Diversity of foods, population growth in developing countries and their high consumption in the advanced countries have led to an increase in the global demand for food to an unprecedented level in the history [1]. With this regard, the use of more productive, profitable agricultural production in fostering food security, generating local employment, raising local incomes, and thus alleviating poverty particularly in developing world, where it serve as an economic source is incomparable [2]. Given this, boosting the yield of cereal crops is crucial because they have been a major source of nutrition for humans from the prehistoric era, about 8000 B.C. [3]. Roughly half of the world's crop area is used to cultivate cereals, which provide around two thirds of the energy consumed by humans [4]. 99% of the world's cereal production is currently produced by eight cereal crops: wheat, rice, corn, barley, oats, rye, sorghum, and millets [5]. This is also true for Ethiopia, where the proportion of farmed land and production that goes toward the main cereal crops tef, maize, wheat, sorghum, and barley is highest [6]. During the 2012–2013 cropping season, cereals occupied 81.39% (10.5 million hectares) of the total grain crop area. In terms of production, cereals contributed 88.36% which is about 302.05 million quintals of the grain production. This may be due to the significant importance of these crops in sustaining food security. Because, the lively hoods of the Ethiopian people are directly or indirectly dependant on these crops. Among cereals, wheat accounts 16.91% (57.8 million quintals) grain [6]. The productivity of the crop remains low (1.8 ton ha^{-1}) in the country as compared the world average yield (3.19 ton/ha) [5]. Participatory variety selection has been used in Ethiopia to create and disseminate a variety of improved agricultural varieties in diverse regions [7, 8, 9, and 10]. Unfortunately, the farmers' selection criteria from all throughout the country, particularly in the Guji Zone in the Oromia area, were not sufficiently evaluated and documented for these crops. This enhanced bread wheat variety adaption trial has been going on at Bore Agricultural Research Center for the past three to four years. Many technologies that were tested for adaptability at multiple locations, including farmers' fields and stations, were recommended to users based on the activities that were carried out. This process also takes time, so before farmers need to be contacted, the variety's resistivity breaks down. Farmers who didn't address their preferences have provided feedback on the benefits and drawbacks of the advertised technology, which might be used as a fundamental research tool. These outputs showed that a gap was created during the course of these actions. Farmers in the region were not heavily involved in the selection and recommendation of technologies for their particular location through the provision of their indigenous expertise in earlier research

Citation: Tesfaye Y, Alemu S, Kedir A, Kebede K. Participatory Bread Wheat Variety Selection at High Land of Guji Zone, Southern Ethiopia. Austin J Plant Biol. 2025; 11(1): 1058.

endeavors. Technologies are brought to a demonstration during that time after being assessed solely by researchers. Consequently, it has been noted that farmers from a variety of perspectives did not adopt all of the suggested technology. This demonstrates the gaps created by excluding farmers from the variety selection and recommendation process; thus, it is a traditional research strategy that restricts farmer participation in research at specific phases. Mismatches arise between what breeders supply and what farmers want because of strict release restrictions and unrepresentative testing conditions [11]. Therefore, it follows that farmer involvement is crucial in the selection and promotion of improved agricultural technologies in order to address such issues. Only one participatory varietal selection was done in Guji zone. But these varieties were not performing good due to break of disease resistivity and yield decrease since highland of Guji is hot spot for wheat rusts. Thus it is important to introduce, evaluate and select by participating farmers newly released varieties.

In developing nation agriculture, participatory varietal selection refers to the presence of significant cropping systems in the margins where the adoption of contemporary better varieties is minimal or nonexistent [12]. Thus, the best way to carefully collaborate with farmers by incorporating their traditional knowledge into variety selection is to involve them in research, particularly in convectional research. As a result, the following goals were aimed at with this effort.

Objective

- To choose and promote improved bread wheat varieties in order to increase the study area's profitability and output.
- To assess and suggest, enhanced bread wheat varieties that are resistant to diseases and have high yields via PVS.
- To determine the key elements for any further bread wheat development efforts in the region.

Materials and Methods

Description of the Study Area

The experiment was conducted at two high land districts of Guji Zone (Bore and Anna Sora) to select and recommend high yielding, early maturing and diseases resistant improved bread wheat varieties through PVS. The climatic condition of both districts comprises an annual rain fall of 1250mm and 1750mm/annual, mean temperature of 15-24 and 17.5-28°c respectively. The two districts are selected for this experiment based on their potentiality for the production of bread wheat. Five improved bread wheat varieties with one local check were used as treatments.

Randomized completed block design with three replications for mother trial (planted on station) for treatments where as farmers were used as replication for baby trials. For this purpose, one farmer field was used as replication for baby trials in which selected farmers plant materials in one replication and the other host farmers were planted the two non-replicated trials. At both trial sites, the materials were planted on a plot size of 2.5mX1.2m with 20 cm between rows consisting 6 rows. In puts (seeds, fertilizers) and management practices were applied as recommended for wheat production. Data was collected in two ways: agronomic data & farmer's data. For agronomic data phenological, Growth, yield and it's component were collected following their own principles.

Data collected from mother trials was subjected to GenStat (18th edition) software [13] to evaluate the variability of the tested varieties. This was done through computing analysis of variance for all characters studied according to the method given by Gomez and Gomez [14]. For data's collected from baby trials, matrix ranking suggested by De Boef *et al* [15] was employed.

Result & Discussion

Days to Maturity

The result of analysis for agronomic data indicated presence of significant variance among the tested varieties for most of the characters studied except number of tiller per plant. Result of the study indicated, early maturity was revealed by variety Sinja (149.7days) and Wane (155days) whereas late maturity was depicted by Lemu (160.3 days).

Plant Height

Wane showed the longest height (84.17) among the tested varieties, where as shortest height (69.16) was from variety Obora. Similar bto this finding, Asaye *et al*., [8] reported significance difference among the tested varieties for plant height. Considering this character for variety evaluation is very crucial as it help for selecting varieties able to withstand lodging problems.

Spike Length

As the result of study revealed, significant difference was observed among the tested varieties for spike length which was ranged from 6.27 to 7.66. Accordingly, variety Dambal followed by Wane showed maximum spike length whereas variety Obora followed by Lemu showed minimum spike length.

Tillers per Plant

The result of study revealed, there was no significant difference observed among the tested variety for number of tillers per plant. Even though there was no statistical difference between the varieties, the highest tiller/plant was revealed by Wane where as the lowest was showed by variety Lemu (Table 2).

Grain Yield (GY)

Tested varieties showed significant variability for grain yield kg/ha, that ranged from 2542 to 5569 kg/ha with the mean value of 3887 kg/ha. The highest grain yield (5569) was recorded for Sinja followed by Wane (4972 kg/ha). But, low yield of 2542 kg/ha was obtained from Dambal followed by Huluka/local (2611 kg/ha) (table1). Asaye *et al.,* [8]. also reported highly significant among tested bread wheat varieties for grain yield under grandmother trial.

Table 1: Mean squares of ANOVA for growth parameters of bread wheat at highland of Guji.

Mean squares								
Source of variation	DF	DTM	DTH	TKW(g)	GY(kg/ha)	PH	SL	NTPP
Rep	2	8.00	1.05	73.77	1904032	24.78	0.34	0.07
Variety	5	38.26*	89.15*	73.40*	4718846**	79.39*	0.83*	0.09ns
Error	10	8.66	0.72	18.62	589564	13.46	0.21	0.15
CV (%)	-	1.9	1.1	12.1	19.8	4.8	7.0	17.7

Keys: DTH: Days to heading, DTM: Days to maturity, PH: plant height, SL: spike length, NTPP: number of tillers per plant, TSW: thousand seed weight, Gy: grain yield.

Table 2: Mean separation of different agronomic characters for six BWV evaluated in mother trial (Bore on station).

Variety	GY(kg/ha)	TKW(g)	DTH	DTM	PH	SL	NTPP	YR	SR
Wane	4972 a	37.73 ab	74.67 c	155 ab	84.17 a	6.773 b	2.497	15MR	10MS
Lemu	4264 ab	39.07 ab	82.67 a	160.3 a	75.72 bc	6.33 b	1.94	20MS	25S
Dambal	2542 c	31.6 bc	76.33 b	155.3 a	77.16 b	7.663 a	2.217	40S	10MS
Huluka	2611 c	27.6 c	81.67 a	155.7 a	73.24 bc	6.66 b	2.163	55S	10MS
Sinja	5569 a	40.53 a	69 d	149.7 b	79.33 ab	6.33 b	2.163	10MR	5R
Obora	3361 bc	36.8 ab	82.33 a	158 a	69.16 c	6.273 b	2.217	30MS	40S
Mean	3887	35.60	77.78	155.67	76.46	6.67	2.19		
LSD (%)	1396.90	7.85	1.54	5.35	6.67	0.85	NS		
CV (%)	19.80	12.10	1.1	1.9	4.80	7.0	17.7		

Keys: DTH: Days to heading, DTM: Days to maturity, PH: plant height, SL: spike length, NTPP: number of tillers per plant, TSW: thousand seed weight, Gy: grain yield,YR-yellow rust, SR-stem rust.

Table 3: Farmers' preference scores and ranking on baby trial.

Variety name	Farmers selection criteria										
	1	2	3	4	5	6	7	8	Total	Average	Rank
Wane	165	65	137	125	154	156	110	164	1076	134.5	1
Lemu	156	106	88	134	140	104	113	124	965	120.6	3
Dambal	66	69	72	131	90	124	164	62	778	97.25	4
Sinja	159	163	166	137	53	114	128	103	1023	127.9	2
Obora	94	39	56	100	160	100	62	55	666	83.25	5
Huluka	34	33	33	54	69	83	88	35	429	53.63	6

Key: 1=grain yield, 2=disease, 3=seed color, 4=spike length, 5=tiller, 6=uniformity, 7=plant height, 8=seed size.

Thousand Kernels Weight

The analysis of variance revealed that the main effect of variety significantly ($P < 0.05$) affect thousand kernels weight of wheat. The thousand kernels weight (40.52 g) was recorded from Sinja where as the lowest kernels weight (27.6g) obtained from Huluka (table 2).

Farmers' Variety Selection Criteria's

Farmers were allowed to evaluate the varieties using their own criteria. Before selecting varieties, they were informed to set criteria for selecting best bread wheat according to their area. This was done by making group discussion among the farmers which comprises elders, women and men. After setting the criteria they were informed to prioritize the criteria according to their interest. By doing this, farmers were allowed to select varieties by giving their own value. The following table 3 indicated the results obtained from farmers' evaluation. Accordingly, variety Wane and Sinja were selected by farmers due to their best performance for their own criteria.

Conclusion

Released technologies are not immediately reach farmer in remote areas like Guji Zone of Southern Oromia. This due to lack of setting appropriate research method; like farmer participation and long extension process. In such case, Participatory variety selection is an effective tool in facilitating the adoption and fast extension of the improved technologies. Because, the users are allowed to participate in selecting appropriate technologies by employing their own indigenous knowledge. As the result, the current study was also verified that farmers were able to participate in selecting improved bread wheat varieties through employing their own selection criteria. Thereby, two improved bread wheat varieties (Wane and Sinja) were selected by the farmers and recommended for the study areas and similar agro-ecologies.

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