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Research Article

Pre-extension Demonstration and Evaluation of Bread Wheat Technologies in West Arsi and Bale Zones

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Abstract

*Pre-extension demonstration and evaluation of recently released bread wheat varieties was carried out on 17 trial farmers' field. The new variety, Hachalu, was demonstrated against Galan and Dambal varieties in which 10m * 10m plot size was allocated for each variety. Row planting was used where the seed rate of 150 kg/ha and fertilizer rate of 100 kg/ha for both NPS and UREA was applied. Data such as yield data, number of farmers participated on training and mini filed days and farmers' feedback were collected. Descriptive statistics was used to analyze yield performance of the varieties. ANOVA was used to detect yield difference among varieties. Awareness creation was carried out for farmers and agricultural experts through training and mini field days. Accordingly, a total of 171 and 163 stakeholders were involved on training and mini field days, respectively. The result of ANOVA test indicated that Galan variety gave relatively highest mean yield of 43.33 qt/ha followed by Dambal which gave 37.23 qt/ha while 30.11 qt/ha was recorded for Hachalu variety. The yield difference among these varieties is also statistically significant at less than 1% level of significance. Farmers were encouraged to evaluate and select these varieties by setting their own selection criteria. Accordingly, group discussion was organized in which the role of the researchers was facilitating the discussion. Finally, farmers reported through their group leaders as Galan variety relatively satisfies their criteria. Hence, Galan variety is recommended for those who need to scale out in target areas.*

Keywords: *Awareness Creation, Bread wheat, farmers' criteria, Pre-extension demonstration, Yield performance.*

Introduction

Wheat (*Triticum aestivum* L.) is a strategic commodity which generates farm income and improves food security status in most Sub Saharan African Countries (Amentae *et al.*, 2017). Ethiopia ranks 31st in the world with 4.2 million quintals produced on 1.7 million hectares of land (Goshu *et al.*, 2019) and is one of the largest Sub-Saharan African wheat producers and ranks second to South Africa in terms of total wheat area coverage and the amount produced (Hei *et al.*, 2017). Wheat is produced in most highlands of the northern, central and south-eastern parts of Ethiopia. However, the majority of domestic production of wheat is grown in Oromia, Amhara and SNNPs regions (CSA, 2018). In terms of productivity, the Oromia region takes the first rank, and SNNP and Amhara region take the second and the third ranks, respectively.

Among the potential wheat growing areas of the Oromia region, Bale and Arsi Zones are known for the wheat belt of the country and even referred as the highest potential agro-ecologies in Eastern Africa. In Bale Zone, 149,115.72 ha of land was covered by wheat during main production season (Bona season) and 5,226,944.66 quintals of grain was produced with the productivity of 35.05 qt/ha. Similarly in West Arsi Zone 132,859.80 ha of land was covered by wheat by which 4,642,444.24 quintal was gained with the average productivity of 34.94 qt/ha (CSA, 2022).

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However, farmers experience a wide range of biotic, abiotic and socio-economic constraints. Wheat rusts, stem rust (Puccinia graminis Pers. f.sp. tritici Eriks and Hann), leaf rust (P. triticina Eriks) and stripe or yellow rust (P. striiformis Westend. f. sp. tritici) are the major biotic constraints in all wheat growing regions of the country (Hei *et al.*, 2017). Cognizant of this, Sinana Agricultural Research Center (SARC) exerted marvelous efforts to overcome this rust epidemic by releasing many high yielding and relatively rust tolerant bread wheat varieties in the past years. Among these varieties, Hachulu variety was recently released in July, 2020 for highlands of Bale and similar agro-ecologies. Hachalu variety of bread wheat has yield potential of 45.4-63.7 quintals per hectare with yield advantage of 8.9% and 16.4% over Sanate (standard check) and Madda Walabu (local check), respectively.

Therefore, pre-extension demonstration of Hachalu variety with the associated wheat production packages was carried out to create awareness and demand for farmers about the technology for wider scaling up.

Objectives of the Study

The study was initiated to achieve the following specific objectives. These are:

- To evaluate bread wheat technologies under farmers' condition in the study areas
- To assess farmers' feedback on bread wheat technologies for further variety development

Materials and Methods

Site and Farmer Selection

Pre-extension demonstration and evaluation of improved bread wheat technologies was carried out in 2021/22 and 2022/23 main cropping season in Dodola, Adaba, Sinana and Agarfa districts. These districts were selected purposively based on wheat production potential. Similarly, potential and accessible kebeles were also used for this activity. Consequently, it was implemented in eight kebeles in which a total of 15 trail farmers were used in two years.

Farmer selection for establishing Farmer Research Group (FRG) was carried in collaboration with DAs and the farmers themselves. One FRG, with 17-20 members, was established in each kebele. From one FRG, two trial farmers were selected by considering farm accessibility, farmers' willingness to host the trial and their prior history (model farmers got priority).

Table 1. List of FRG members by gender

District	Kebele	Adult men	Adult Women	Young men	Young women	Total
Dodola	Ketchema	15	3	2	-	20
Adaba	Ejersa	14	2	1	1	18
Sinana	Nano Robe	12	3	5	-	20
	Salka	15	1	4	-	20
Agarfa	Elani	10	2	4	1	17
	Ali	16	1	2	1	20
	Total	82	12	18	3	115

Materials and Field Design

Recently released new bread wheat variety namely Hachalu was demonstrated and compared with two commercial varieties namely Galan and Dambal varieties on plot size of 10m*10m. Recommended agronomic packages and management practices were similarly implemented for all plots. Accordingly, row planting was carried out with the spacing of 20cm. Similarly, seed rate of 150kg/ha was applied with the recommended fertilizer rate, time and frequency 100kg/ha for NPS and UREA.

Technology Demonstration and Evaluation Approaches

FRG approach was implemented for this pre-extension demonstration of improved bread wheat technologies. Mini-field days, field visit and group evaluation were used as technology demonstration and evaluation methods. Mini-field days were organized in each kebeles through which focus group discussion was carried out to encourage farmers to evaluate and select the best performing bread wheat variety by setting their own selection criteria. Before, leading farmers for variety evaluation and selection, the purpose of participatory research was introduced for the participants and finally participants were grouped in to subgroups. Each subgroup has selected respective chairperson and secretary. Finally, each group reported the result of their discussion via their representatives.

Sources and types of data

Both secondary data and primary data were collected for this activity. Secondary data were collected from published and unpublished sources such as CSA, reports and other publications; while, primary data were collected from participant farmers and experts during mini-field days, training and group discussion. Both quantitative and qualitative data types

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were used. Accordingly, quantitative data include number of farmers participated in training and mini-field days and yield obtained from each variety across location. Likewise, qualitative data type like farmers' feedback on varietal traits and variety selection criteria were identified.

Methods of data collection and Analysis

Simple interview schedule, measurements and focus group discussion (FGD) were employed as methods of data collection for this study. Quantitative data was analyzed using descriptive statistics like number, mean and standard deviation. One way ANOVA was used to test yield difference between the varieties. Furthermore, direct matrix ranking and pair wise ranking were used to analyze qualitative data.

Result and Discussion

Yield Performance of Demonstrated Bread Wheat Varieties

Combined yield evaluation for demonstrated bread wheat varieties was carried out in which the improved variety, Hachalu, performs very poor as compared to other varieties (Table 1). Accordingly, Hachalu variety gave mean grain yield of 30.11 quintals per hectare with the standard deviation of 11.68. The yield difference among the demonstrated bread wheat varieties is significant at less than 1% level of significance (Table 2). The result of combined yield performance analysis depicts that relatively highest grain yield of 43.33 quintals per hectare was recorded for Galan variety followed by Dambal (standard check) which gives 37.23 quintals per hectare.

Table 2. Yield performance of bread wheat varieties

VARIETIES	NUMBER	MEAN	STD. DEVIATION	F-VALUE
Dambal	15	37.23	9.75	5.69**
Galan	15	43.13	10.25	
Hachalu	15	30.11	11.68	

**, stands for less than 5% significant level

Awareness Creation

Training

Training was given for farmers, development agents and subject matter specialists to enhance their awareness toward improved bread wheat varieties, FRG concept, agronomic practices and wheat protection aspect. Accordingly, a total of 131 farmers and 40 agricultural experts were trained in the two years of the activity duration.

Table 3. Participants of training within two years

DISTRICT	FARMERS			DAS			SMSS		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Dodola	35	3	38	7	0	7	6	0	6
Adaba	28	2	30	6	0	6	5	0	5
Sinana	26	1	27	4	2	6	1	1	2
Agarfa	34	2	36	3	3	6	2	0	2
Total	123	8	**131**	20	5	**25**	14	1	**15**

Mini field day

Mini-field days were also organized at representative sites in which focus group discussion was carried out to identify variety/ies preferred by farmers based on their own selection criteria. During mini field days organized at representative sites, a total of 163 participants were involved from which 144 of them were farmers and the remaining 19 participants were DAs and SMSs (Table 3).

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Table 4. Number of stakeholders participated on mini field days

LOCATIONS	FARMERS			EXPERTS (DAS + SMSS)		
	Male	Female	Total	Male	Female	Total
Adaba	19	0	19	1	0	1
Dodola	24	2	26	6	0	6
Agarfa	53	3	56	4	5	9
Sinana	38	5	43	2	1	3
Total	134	10	**144**	13	6	**19**

Farmers' Preference

Finally, after fruitful discussion, farmers selected the variety/ies of their interest by setting their own selection criteria. Direct matrix scoring was used to rank varieties with farmers. Each bread wheat varieties were ranked in order of its importance. Each varietal trait was given the score of 5 to 1 in which 5 indicates highest score while 1 stands for least score.

Table 5. Farmers' matrix ranking towards bread wheat varieties

VARIETAL TRAITS	DEMONSTRATED BREAD WHEAT VARIETIES		
	Dambal	Galan	Hachalu
Number of Tillers	4	5	3
Seed/spike	4	5	4
Disease tolerance	3	2	1
Plant height	4	4	3
Seed color	4	4	4
Seed size	5	5	5
Stem strength	4	5	2
Early maturity	3	2	1
Total Score	31	32	23
Rank	II	I	III

The result of feedback assessment about the demonstrated bread wheat varieties was analyzed using pair wise ranking and revealed that farmers gave prior attention for variety which is high yielder, disease tolerant and early mature (Table 5).

Table 6. Pair wise ranking of varietal traits

Code	Varietal Traits	Code of varietal traits								Frequency	Rank
		1	2	3	4	5	6	7	8		
1	Early maturity		2	1	1	1	1	1	8	5	3rd
2	Disease Tolerance			2	2	2	2	2	8	6	2nd
3	Plant height				3	4	3	3	8	3	5th
4	Adaptation to environment					4	4	4	8	4	4th
5	Stem strength						6	7	8	0	8th
6	Seed size							7	8	1	7th
7	Seed color								8	2	6th
8	Yield									7	1st

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Conclusion and Recommendations

The newly released variety, Hachalu, was demonstrated and evaluated with two commercial bead wheat varieties namely Galan and Dambal. However, Hachalu variety poorly performed in grain yield evaluation. It is also very susceptible to stem rust. Farmers were encouraged to evaluate and select among the demonstrated bread wheat varieties by setting their own selection criteria through group discussion. Accordingly, farmers listed out different criteria to evaluate these varieties and they finally gave high score for Galan variety. They also gave prior attention for the variety which is high yielder, disease tolerant and early maturing. Therefore, while developing bread wheat varieties breeders should gave more emphasis on early maturing varieties in addition to yield performance and disease tolerant attributes. Finally, based on yield performance and farmers preference Galan variety is recommended for wider scale up in the target areas.

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Conflicts of Interest

The authors declare no conflict of interest.

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