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Pre-Extension Demonstration of Improved Bread Wheat Technology in Selected Districts of East and Horro Guduru Wollega Zones

Effa Wolteji*, Berhanu Soboka, Dubiso Gacheno

Agricultural Research,
Southern Agricultural Research Institute (SARI)
Awasa, Ethiopia
*Corresponding author: E-mail: bashalemayehu2008@gmail.com
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ABSTRACT

This activity was conducted in Jarte Jardaga, Jimma Geneti, Jimma Rare, Guduru and Gida Ayana districts of western Oromia with the objective of demonstrating the recently released Bread Wheat varieties, Senate and Liban to the farming community in these districts. These districts were purposively selected based on potentiality for bread wheat production; and two potential PAs from each district were selected on the basis of accessibility and potentiality. After selecting and establishing FRG unit in each PA training was provided. Then after, two varieties of bread wheat, Liban as a recently released variety along with Senate; as standard check were planted on 20m*10m adjacent plots on 20 farmers' fields. All recommended agronomic practices were equally applied to all the plots and the fields were closely supervised and were managed well. At maturity, the varieties were jointly evaluated with a team composed of researchers, Farmers and DAs. Despite the slight variability in criteria set by farmers at the respective locations, yield ,disease tolerance, seed color, plant height, pest resistance, tillering capacity, seed size, lodging resistant, early maturity, spike length, thrash ability were the common selection criteria across all locations. In almost all the locations Senate beat Liban both in yield and the criteria set for evaluation; except seed color, and impressing the farmers; especially number of spike length, number of seeds per plant and tillering capacity. With regard to yield, 57.90 qt/ha and 52.40 qt/ha were obtained from Senate and Liban; respectively putting Senate on the first rank.. Besides; Senate has 10.50 % yield advantage over Liban and this implies that Senate has higher yield advantage than Liban. Further; statistically ANOVA table and mean yield comparison (t-test) results of on farm yield performances showed that as there is highly significant difference at ($p<0.05$) between the varieties demonstrated. Furthermore; in terms of

profitability, financial analysis result of the study also showed that using Senate variety can make more profitable than Liban. Therefore; as the variety has met the intended criteria of the farmers the pre-scaling up activity should follow next season.

Keywords: Bread wheat, FRG unit, Participatory evaluation and selection, Yield Advantage, Senate, Liban

INTRODUCTION

Ethiopia is one of the largest grain producers in Africa, and the second largest wheat producer in Sub-Saharan Africa, after South Africa. Wheat production in Sub-Saharan Africa is at 10 to 25% of its potential and the region could easily grow more to improve food security. Farmers in Sub Saharan Africa produce 44% of the wheat consumed locally and import the rest from international markets, making the region highly vulnerable to global market and supply shocks. In Ethiopia, both the bread and durum wheat are widely cultivated in the highlands of the country largely in the areas like South East, Central and North West parts. According to (MoARD, 2005), it is estimated that 1.4 million hectare of land is covered with wheat and more than 2.18 million tons are produced annually. In terms of area cultivated and annual production, wheat is the third most important cereal crop in Ethiopia following maize and teff (CSA, 2012).

Wheat is a major crop in Ethiopian high lands. It the fourth most important cereal that covers more than 1.7 Million ha with annual production of 3.1-3.4 metric ton, mostly produced by small holders. Regarding the volume of production, it is placed in the second place while ranked third with regard to area coverage (CSA, 2014). In developing countries like Ethiopia it is believed to cover up to about 25 % calorie requirements of the population. Despite its greater economic and nutritional contribution to our population, the national average does not exceed 2.2t/ha. Shortage improved seed, disease, limited use of necessary inputs are among the factors that contribute to the low productivity of the crop. It is extensively grown in most parts of the country, with the major production areas concentrated at altitude of 2000 to 2900 m.s.l. Further; during 2016/17 cropping season 1,664,564.62 ha of land was covered by wheat (bread and durum) and over 42,192,572.23quintals was harvested with the average yield of 25.35 quintals per hectare at national level (CSA, 2016). Similarly, the land covered by wheat production in East and Horro Guduru Wollega Zones in 2016/17 Maher production season was 120,067.9 and 143,971.78 hectares; respectively CSA, 2016). Even though, most agro-ecologies of East and Horro Guduru Wollega Zones are the potential areas for wheat production, the yield obtained by farming communities was below the potential. According to (EAAPP, 2014), this is mainly due to technological and natural factors (disease, weed and insects), grain quality, lack of varieties for specific growing conditions, lack of improved seed supply for the best variety and low use of recommended full packages are among the constraints that lowered the productivity. To tackle such a challenge, BARC has been conducting intensive research work on the crop and has recently released bread wheat varieties that have better disease tolerance than the previous varieties. To this end, actually BARC has recently released variety; Liban with potential yield of 60 qt/ha on farmers'

field (MoARD, 2015), to reverse the scenario and alleviate the problem of low productivity as well as co-related challenges sustainably. Consequently; this calls for demonstrating, validating and disseminating of the released high yielding, disease tolerant and quality bread wheat varieties that can make producers competitive in the today's competing markets. Therefore; keeping this fact in view BARC extension team initiated this on farm improved bread wheat technologies demonstration and evaluation activity with these underlying objectives [1].

Objectives

- To demonstrate and evaluate improved bread wheat technologies
- To evaluate the productivity and profitability of the technology under farmers' condition
- To create awareness on the importance of the technologies
- To collect feedbacks from the participants for further research design and the way

MATERIALS AND METHODS

Description of study areas

Four districts were selected based on AGP-II criteria, potentiality and accessibility for supervision. One representative PA from the each district was selected based on the aforementioned criteria. In each PA one FRG members comprising of 15 farmers was established and managed. Gender and youth balance in each FRG member was strictly considered. A total of 16 hosting farmers were participated

Provision of training

After established of the farmers research group (FRG) theoretical and practical training were given to farmers, Development agent and district experts. Training provided on the following areas; such as, wheat technology transfer approaches, production management, breeding aspect, post harvesting (seed quality). The aim of training was to create awareness of farmers', Development agent [2].

Input distribution and Planting

All necessary input (seed, fertilizers) was delivered to the farmers. The plots were properly ploughed and made ready for planting ahead of the planting date. Planting was made on the farmers' field by BARC researchers, TAs as well as FRG farmers.

Field design and management

Two improved bread wheat varieties; Liban (as recently released) and Senate (as standard check) were planted side by side on adjacent plots of 200m2.The demo plots were replicated by hosting farmers. All the necessary recommended agronomic practices were equally applied for all of the plots.

Accordingly; spacing of 20cm between rows was used for the demonstration. Besides; the recommended 150 kg/ha seed and fertilizer rate of 100 kg/ha of NPS and 100 kg/ha of UREA were used. The Plots were managed jointly by the researcher, extension workers and hosting farmers. All other recommended agronomic practices were maintained equally for all plots.

Data collected

Both qualitative and quantitative data were collected. The collected data were: yield data, type and number of stakeholders participated by gender in training, field visits, farmers perception on the attribute of technology, costs and income gained [3].

Data analysis

The collected qualitative data was analyzed using descriptive statistics such as mean, frequencies, tables and percentages. Also quantitative data collected were subjected to SPSS software to analyse mean, standard deviation, t-test and ANOVA table. Besides; ranking scale was used to evaluate and select best bet variety/ies and to rank their criteria according to real situation of the area. According to (Sumai et.al., 2000) technology gap and technology were calculated using the following formula.

Technology gap = Potential yield qt/ha – demonstration yield

Technology index = Potential yield- demonstration yield * 100

Potential yield

RESULT AND DISCUSSION

Participatory variety evaluation and selection

At maturity, the varieties were then be evaluated based on the farmers' selection criteria. At this juncture, the farmers were assisted to jot their own evaluation criteria, which then be ordered using score ranking technique. Each variety was then be evaluated against the criteria ordered based on the weight attached to each parameter. At the end of the evaluation process, result of the evaluation was displayed to the evaluators, and discussion was made on the way ahead. To this end; FRG farmers scored each variety for individual traits considered important by them and ranking of varieties were done on a scale of 1-5, 1being very poor and 5 being the highest score representing superiority.Accordingly; yield, disease tolerant, tillering capacity, seed color, early maturing and other traits were considered as the most selection criteria for each bread wheat variety. Based on overall mean score the best preferred variety/ies was/ were evaluated and ranked. Therefore; Senate was selected by all its traits including yield except its color then followed by Liban and since the varieties were promising and preferred by farmers' at large will be proposed for further scaling up in the coming

seasons (Table 1).

Table 1: Score ranking of bread wheat varieties by FRG farmers across the districts.

Variety	Guduru			Jimma Rare			Jarte Jardaga			Gida Ayana			Overall
	Total Score	Mean Score	Rank	Total Score	Mean Score	Rank	Total Score	Mean Score	Rank	Total Score	Mean Score	Rank	Rank
Liban	42	4.2	2nd	33	3.3	1st	34	3.4	2nd	42	4.2	2nd	2nd
Senate	48	4.8	1st	31	3.1	2nd	38	3.8	1st	46	4.6	1st	1st

On-farm performance of the varieties

In spite of the inevitable variability in performance between and even within locations/districts; Jimma Rare, Guduru, Jarte Jardaga and Gida Ayana, where this activity was undertaken, yield performances of the varieties were still promising. Accordingly; the combined mean analysis result on yield performance of the varieties demonstrated is summarized. Accordingly; a mean yield of 52.40 ± 0.34 qt/ha and 57.90 ± 0.19 qt/ha for Liban and Senate varieties; respectively was gained across the districts (Table 2).

Table 2: Mean yield performance of bread wheat varieties across the districts.

Variety	N	Mean	SD	Min	Max
Senate	16	57.90 ± 0.19	0.76	56.69	58.96
Liban	16	52.40 ± 0.34	1.38	49.89	53.77

Besides; the below figure 1 summarizes on farm mean yield performances of the varieties across the districts (Figure 1).

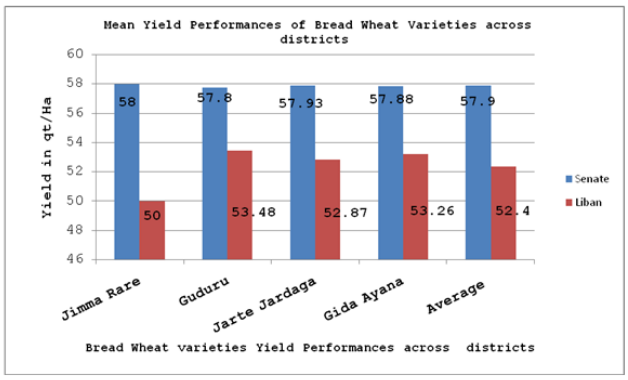

Figure 1: On farm yield performances of bread wheat varieties across districts.

Moreover, statistical result of ANOVA table summarized in below (table 3) showed that as there is highly significant difference at ($p<0.05$) between the varieties and across the districts. This means that

there is highly significant difference between the bread wheat varieties; Liban and Senate mean yield gained. Further, the statistical result also shows that as there is significant difference across the districts on mean yield performances of the varieties at ($p<0.05$) (Table 3).

Table 3: Analysis of Variance Table for Yield.

Source	DF	SS	MS	F	P
Farmer	3	0.13	0.043	0.04	0.99
District	3	10.1	3.355	3.01	0.05
Variety	1	225	224.8	201	0
Error	24	26.8	1.116		
Total	31	262			
Grand Mean		55.2			
CV		1.92			

Furthermore; mean comparison (t-test) of on farm yield performances result summarized below also verified that there exists highly significant difference between the varieties demonstrated across the districts at ($p<0.05$) (Table 4).

Table 4: Bread Wheat Varieties t-test for Yield across the districts.

Varieties t-test	Mean	Std Error	T	P value
Senate*Liban	5.3	0.44	12.01	0
Yield*Districts	52.65	0.52	101.58	0

Yield advantage

Calculating yield advantage of the varieties helps to show the extra benefit in percentage that the farmers' obtained from producing improved variety. Besides; it helps to recommend based on the relative yield advantage over other varieties. Yield advantage gained for Senate over Liban variety was 10.50 % and could be calculated using the underlying formula (Table 5).

$$\text{Yield advantage \%} = \frac{\text{Yield of new variety - Yield of standard check}}{\text{Yield of standard check}} \times 100$$

Table 5: Yield advantage of newly released bread wheat variety over the standard check.

Demonstrated Varieties	Yield obtained (qt/ha)	Yield advantage over the standard check (Senate)
Senate	57.9	0.105
Liban	52.4	

Technology gap and Technology index

Technology gap indicates that the gap in the demonstration yield over potential yield. The observed technology gap is attributed to dissimilarities in fertility, acidity, rainfall and other natural calamities (Dhaka et.al., 2010). According to Dhaka et.al., 2010, its contribution is to narrow down the gap between the yields of different varieties and to provide location specific recommendations. The yield gaps can be further categorized into technology index which is used to show the feasibility of the variety at the farmer's field. The lower the values of technology index the more the feasibility of the varieties. To this end, the technology gap and index of demonstrated varieties (Senate and Liban) were calculated using the underlying formulas and presented in below (Table 6) [4].

Technology gap = Potential yield qt/ha - Demonstration yield

$$\text{Technology index} = \frac{\text{Potential yield - Demonstration yield}}{\text{Potential yield}} * 100$$

Table 6: Technology gap and technology index for bread wheat varieties across the districts**.**

Parameter	**Bread Wheat Varieties**	
	Senate	**Liban**
Technology gap (qt/ha)	2.1	7.6
Technology index (%)	3.5	12.67

As calculated in the above table the yield gap is 7.6 qt/ha and 2.1 qt/ha for Liban and Senate varieties; respectively. This indicates that the lowest gap was observed on Senate variety which in turn shows the demonstration yield is very close to the potential yield. In terms of technology index 12.67 % and 3.5 % for Liban and Senate varieties respectively. That means both varieties have an average technology index of 8.09 % and this dictates that the varieties are feasible to the farmers in the study area and other similar agro-ecologies [5].

Financial analysis

In terms of profitability the financial analysis result show that an average return of 55935.33 Birr and 49259.33 Birr per hectare can be gained from Senate and Liban varieties; respectively per production season in the areas where the activity carried out (Table 7).

Table 7: Financial analysis for bread wheat varieties across the districts.

Financial Analysis								
Location: Jimma Rare			**Location: Guduru**			**Location: Jarte Jardaga**		
Parameters	**Variety**		**Parameters**	**Variety**		**Parameters**	**Variety**	
	Senate	**Liban**		**Senate**	**Liban**		**Senate**	**Liban**
Yield qt/ha(Y)	58	50	Yield qt/ha(Y)	57.5	54	Yield qt/ha(Y)	57.88	53
Price(P) per quintal	###	###	Price(P) per quintal	1200	###	Price(P) per quintal	1200	###
Total Revenue (TR)=TR=Y*P	###	###	Total Revenue (TR)=TR=Y*P	####	###	Total Revenue (TR)=TR=Y*P	69456	###
Variable costs			Variable costs			Variable costs		
Seed cost	###	###	Seed cost	1600	###	Seed cost	1600	###
Fertilizer cost	###	###	Fertilizer cost	3150	###	Fertilizer cost	3150	###
Labor cost	###	###	Labor cost	6500	###	Labor cost	6500	###
Total Variable costs(TVC)	###	###	Total Variable costs (TVC)	####	###	Total Variable costs (TVC)	11250	###
Fixed costs			Fixed costs			Fixed costs		
Cost of land	###	###	Cost of land	2500	###	Cost of land	2000	###
Total fixed costs (TFC)	###	###	Total fixed costs (TFC)	2500	###	Total fixed costs(TFC)	2000	###
Total cost (TC) =TVC+TFC	###	###	Total cost (TC) = TVC+TFC	####	###	Total cost (TC) = TVC+TFC	13250	###
Gross Margin (GM) = TR - TVC	###	###	Gross Margin (GM) = TR-TVC	####	###	Gross Margin (GM) = TR - TVC	58206	###
Profit=GM-TFC	###	###	Profit=GM-TFC	####	###	Profit=GM-TFC	56206	###

Training of farmers, Experts and DAs

A total of 387 participants (332 farmers, 26 DAs and Supervisors and 27 agricultural experts) were participated on this training (Table 8) across the districts.

Table 8: Stakeholders training participants across the demonstration districts.

Participants	**Districts**			**Total**
	Guduru	**Jimma Rare**	**Jarte Jardaga**	
Experts	10	9	8	27
DAs and supervisors	9	10	7	26
Farmers	90	122	120	332
Total	109	139	139	387

Farmers' on Field visit event

Field visit was also arranged across the districts so as to evaluate/select best performing varieties, to enhance farmers' knowledge on bread wheat production and management and to collect feedback from all relevant stakeholders' for further way forward. On the field visit event a total of 400 participants; 350 farmers, 30 DAs and Supervisors and 20 agricultural experts were participated on this training at three districts.

Farmers' perception to wheat technology

The farmers' research groups have appreciated the new wheat technology for the following merits perceived better yielder than the standard check, perceived better resistance to yellow rust and perceived better seed size.

CONCLUSION AND RECOMMENDATION

Generally, through this participatory evaluation and demonstration process, many farmers became aware of the importance and quality of technologies as compared to the local one. The demands for the varieties were also created. Demonstration result showed that senate variety was recorded high yielder than Liban at all location. It was also preferred by participant farmers for its better agronomic performance. Based on these facts, senate variety was recommended for further scale up and scale out for demo districts and other similar areas.

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