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Performance of Malt Barley (*Hordeum vulgare* L.) Varieties in Selected Districts of Southern Ethiopia

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Abstract

Barley (*Hordeum vulgare L.*) is one of the major cereal crops grown in Ethiopia; and majority of the produce is used for home consumption. Although the country has considerable number of breweries, malt barley produced locally has been by far low in quantity and quality compared with the potential requirement by the factories. As to contribute to the attempts being carried out in order to narrow the gap between supply and demand of malt barley, the current study was initiated to evaluate and demonstrate four malt barley varieties namely EH1847, IBON 174/03, Holker and Bekoji in Doyogena and Soddo Zuria districts at each on six farmers' fields. Farmers evaluated and ranked the varieties using their own criteria in each district accordingly and grain yield was subjected to statistical analysis using SAS software and the analysis of variance indicated that a variety EH1847 was ranked first in Doyogena by farmers due to its better performance based on selection criteria used. The same variety had superior average grain yield, 3550 kg/ha, in the same district. However, this variety was highly depressed in Soddo Zuria. Variety IBON 174/03 gave maximum average grain yield of 1500 kg/ha in Soddo Zuria. From the current study we recommend EH1847 for further dissemination in Doyogena and the like agro-ecologies. Although all varieties didn't show potential productivity at Soddo Zuria, we recommend IBON 174/03 to this district besides assessing the other new and better varieties for the district.

Keywords: Barley; Grain yield; Farmer's preference; *Hordeum vulgare*

Introduction

Barley (*Hordeum vulgare*) is the fourth most important cereal crop in the world after wheat, maize, and rice [1]. As part of the world, Ethiopia also has diverse and suitable agro-ecologies for barley production that laid between 1800 to 3400 meters above sea level (masl); and the crop is usually grown in different seasons and production systems in the country [2,3]. Ethiopia is the second largest barley producer in Africa, next to Morocco, accounting for about 25% of the total barley production in the continent [4]. It is the most important crop with total area coverage of 0.944 million hectares and total annual production of about 1.9 million tons in main season [5].

There are two types of barley that farmers grow in Ethiopia: food barley and malt barley [2]. Although there is no clear figure in production area in Ethiopia, it is known that the majority of barley that farmers grow in the country is food barley.

Regardless of the types, both malting and food barley do have similar benefits for subsistent farmers i.e. the grain is used in different forms such as local bread called injera, porridge and roasted grain; and for preparing local alcoholic and non-alcoholic drinks; its straw is used for animal feed, thatching roofs and bedding [6]. However, unlike food barley, malt barley is the most important industrial crop and a major row material for Ethiopian breweries.

Due to low productivity from local malt barley varieties, the harvest from the crop is too low; and the situation becomes worst as farmers couldn't earn equivalent income from their products due to poor grain quality against the minimum quality required by the breweries [7]. Since the local supply is too low and also poor in grain quality, Ethiopia is importing more than 60% of malt barley seed to satisfy the breweries in the country. Thus, local farmers haven't been benefited from growing malt barley; and they are disfavored due to low income as a result of low productivity of local malt barley varieties and poor grain quality against minimum quality requirement set by breweries which in turn resulted in market problem to sell what subsistent farmers produced. Moreover, importers are also not privileged as the importing cost is high to satisfy beer factories in the country. Therefore, the problems at both sides (farmers and importers) need to be mitigated through enhancing the quantity and quality of malt barley production in the country. To come up with this output, research intervention for improvement of malt barley productivity at farm level is a paramount and thus this study was initiated with the objectives to:

- Evaluate malt barley varieties at farmers field in order to identify better yielding varieties.
- Create awareness on improved malt barley production techniques.

Materials and Methods

Description of the study areas

Soddo Zuria District is part of the Wolayita zone which is bordered on the southwest by Offa, on the west by Kindo Koysha, on the north west by Damot Sore, on the north by Boloso Sore, on the northeast by Damot Gale, on the east by Damot Weyde, and on the southeast by Humbo districts. Barley experiments were laid at Delbo Wogene Keble which is located at 6°53'N and 37°48'E at an altitude of 2203 meter above sea level. The mean annual rain fall is 1200-1300 mm and mean annual temperature is 180 °C-28 °C. The dominant soil type is sandy loam.

Doyogena District is part of the Kembata Tembaro zone which is bordered on the south by Kacha Bira, on the west and north by the Hadiya zone, and on the east by Angacha districts. Barley experiments were laid at Awora Arara kebele which is located at 7°19'N and 37°46'E at an altitude of 2712 meter above sea level. The area receives an annual mean rainfall of 1200 to 1800 mm [8]. The average annual temperature of the area is16 °C. The dominant soil type is red and black clay loams soil.

Crop production systems are almost identical at each district. Enset and potato are some of the major root crops grown in the districts. Bread wheat and barley are the only cereals grown in the areas with only little extent in tef production especially in Soddo Zuria. Malt barley, however, is the new introduction to both study sites where high demands are being emerged due to increasing demands of malts as well as breweries in the country.

Experimental materials

Four malt barley varieties, namely, IBON-174/03, Holker, EH1847, Bekoji were kindly provided us from Kulumsa Agricultural Research Center and used in the experiment. Six farmers of which five male and one female were selected from each of the districts, Soddo Zuria and Doyogena; thus, a total of 12 farmers of which 10 male and two females were hosted the experiment. Seeds were sown to a plot size of 5 m × 10 mat a rate of 125 kg/ha in to rows of 10 m long which spaced by 30 cm. In both of the study sites, planting was done during second week of July. Fertilizers NPS/urea were applied a rate of 120/50 kg/ha. The whole NPS was applied at planting. Urea was applied in a split base: one third during planting and two third after 35 days of emergence. Weeds were controlled manually once just before the 2nd round application of urea

Data collection and analysis

Six farmers in each district hosted the experiment. The six farmers in each district were considered as replications. Farmers' preferences on malt barley varieties were assessed based on their criteria. Grain yield data were collected in plot base from the six farmers field. Four malt barley varieties were evaluated using RCB design and grain yield data were analyzed using SAS software [9]. Means were separated using LSD.

Training and field day organizations

Awareness on trial management and malt barley production technologies were created through trainings organized prior to implementation of the experiments at both study sites. Male and female farmers and agricultural experts at each district level as well as development agents at each trial hosting Kebele were trained on management of trials and malt barley production technologies. Field days were also organized at each district. Farmers at each district, experts at district and zonal levels of study areas were also invited to participate in the event.

Results and Discussion

The present study was conducted to alleviate the problem associated with productivity of malt barley in SNNPR through participatory adaptation and demonstration of improved malt barley varieties in two districts such as Soddo Zuria and Doyogana. The two districts have potential areas for barley production. The experiment at each district was exposed to farmers to evaluate the malt barley varieties based on the criteria set by farmers such as spike length, uniformity (in terms of maturity), tillering capacity, seed size and grain yield.

Farmers have evaluated the varieties only by visual observation; and direct ranking which was done using farmers' selection criteria indicated in Tables 1 and 2 for Doyogena and Soddo Zuria, respectively. In previous studies, malting barley genotypes were also selected on the basis of differences in the agronomic traits of crop stand establishment, number of tillers per plant, spike length, number of kernels per spike, and 1000 kernel weight [10]. Soudabeh et al. also supported use of highly and genetically associated morphological traits in selection of barley genotypes for grain yields [11]. In the current study, at Doyogena both EH1847 and Holker were ranked first based up on the farmers criteria used whereas a variety Bokoji was ranked least for the criteria (Table 1). Although both ranked first based up on farmers criteria, varieties EH1847 and Holker were significantly differ in grain yield in Doyogena indicating that yield is not the only parameter to make selection decision among different varieties. Similarly, Jarius et al. also used different parameters in selection of malt barley varieties in their study [12]. Variety EH1847 gave a superior grain yield (3550 kg/ha) at Doyogena whereas Holker gave a mean grain yield of 2425 kg/ha in the district (Table 3).

	Malt barley varieties			
Farmers selection criteria	IBON 174/03	EH1847	Bekoji	Holker
Spike length	2	1	4	1
Uniformity	2	1	4	1
Tillering capacity	2	1	4	2
Seed size	3	2	4	1
Total score	9	5	16	5
Mean score	2	1	4	1
Overall rank	3	1	4	1

Table 1: Ranking of malt barley varieties using the selection criteria set by farmers in Doyogena district, 2017.

Farmers selection criteria	Malt barley varieties			
	IBON 174/03	EH1847	Bekoji	Holker
Spike length	1	3	4	2
Uniformity	1	4	3	2
Tilering capacity	1	3	4	2
Seed size	1	3	4	1
Total score	4	13	15	7
Mean score	1	3	4	2
Rank	1	3	4	2

Table 2: Ranking of malt barley varieties using the selection criteria set by farmers in Soddo Zuria district, 2017.

Although EH1847 exhibited higher yield compared to Holker in Doyogena, famers in the area were highly impressed with the seed size of Holker. They described that Holker is better for preparing locally roasted food called Kolo compared to other varieties. Currently, Holker has high demand and better price in local market, 1500 ETB/100 kg whereas the price of other varieties is less than this amount. A variety EH1847 was depressed at Soddo Zuria where it gave 1317 kg/ha implying less adaptability to the area (Table 4). Jairus et al. also evaluated promising malt barley varieties in Kenya and found differential response of varieties between two different locations [12]. A variety which was superior in one location was found depressed in other location. In the current study, variety EH1847 was not preferred by farmers at Soddo Zuria for criteria set by farmers (Table 2). Therefore, it is essential to make specific recommendation based up on performance of barley varieties in case of each district.

Average grain yield obtained from all varieties was generally low in Soddo Zuria with maximum productivity of 1500 kg/ha, which was recorded on a variety IBON 174/03 (Table 4). This may imply that the environment in this study site has disfavored all the malt barley varieties included under the present study. Therefore, it can be suggested that the other available malt barley varieties need to be brought and evaluated for better grain yield. However, the farmers in the district ranked IBON 174/03 first based up on the farmers' criteria used (Table 2).

No.	MB varieties	Grain yield by farmer (kg/ha)						Av. GY (kg/ha)	Rank
		F1	F2	F3	F4	F5	F6		
1	IBON-174, 03	3100	2300	2500	2000	2465	2485	2475	3
2	EH1847	4800	4100	2500	2800	3530	3570	3550	1
3	Bekoji	2000	1400	1400	2000	1710	1690	1700	4
4	Holker	2900	2100	2100	2600	2405	2445	2425	2
CV		-						20.4	-
LSD (5%)		-						366.10	-

Table 3: Grain yield (kg/ha) in evaluation and demonstration of malt barley varieties conducted in Doyogena, 2017.

A variety Bekoji had only 1050 kg/ha in Soddo Zuria and it was also relatively least in grain yield compared to other barley varieties in Doyogena where only 1700 kg/ha was recorded. Muleken also reported the same trend where malt barley genotypes behaved differently for grain yield and economically important malting quality traits across various test locations and an author further recommended development of both specific and wide adaptable varieties [3].

Training and field day organizations

Fifty and thirty participants from Doyogena and Soddo Zuria, respectively, which were composed of both sex groups were trained. Field day organization, conducted just before harvesting the trials, was also used as one of the tools to demonstrate malt barley varieties as well as production techniques of the crop. This event has also provided opportunities to evaluate all varieties at each farmer field. Both male and female farmers and experts from each district were participated during both trainings and field days.

No.	MB varieties	Grain yield by farmer (kg/ha)						Av. GY (kg/ha)
		F1	F2	F3	F4	F5	F6	
1	IBON 174/03	1400	800	1200	1600	2400	1600	1500
2	EH1847	1200	500	1100	2100	1800	1200	1317
3	Bekoji	1800	400	800	1600	1100	600	1050
4	Holker	1800	600	1200	1700	1000	2200	1417
CV		-						21.39
LSD (5%)		-						240.12

Table 4: Mean grain yield of four malt barley varieties evaluated in Kokate, 2017.

Lessons learned and challenges faced (gaps identified)

We have learned that farmers can be good partners in evaluation and identification of varieties to recommend to specific locality. They were capable of generating important criteria for evaluation of varieties used in the study. Farmers realized that the varieties appeared well in one environment were not as better as same in other environments implying the need to consider specific recommendations to enhance productivity in a particular area. Although all farmers preferred malt barley variety IBON 174/03 ranked it first due to its relative better yield at Soddo Zuria, they suggested that the field performance of all varieties was generally low. Thus, besides scaling up of this variety, it was suggested to looking for other new malt barley varieties which would be more suitable in terms of grain yield as well as other important features including acceptable seed size and tillering capacity.

Farmers also shared their knowledge on challenges of marketability posing on grain of malt barley. They were aware of and raising questions on extent of benefits that the local malt barley grower earns. Farmers participated in the field day were asserting that the fellow growers are disfavored due to low income resulted from low market demand. Therefore, the market issue needs to be addressed through value chain studies.

Conclusions and Recommendations

To maximize the benefit of breweries and enhance income of malt barley growing farmers, it is essential to improve malt barley productivity at farm level through use of improved crop production technologies. This has motivated to conduct an experiment and evaluate four malt barley varieties at Doyogena and Soddo Zuria. The experiment revealed differential response of varieties to different locations. A variety EH1847 had superior productivity, 3550 kg/ha, at Doyogena. However, this variety was highly depressed at Soddo Zuria. Relatively better average grain yield productivity (1500 kg/ha) was realized on IBON 174/03 at Soddo Zuria. Therefore, it is essential to consider specific recommendations following the routes of better adaptability of malt barley varieties. Thus, we recommend further dissemination and adoption of EH1847 to Doyogena and the like agro-ecologies. Although a variety IBON 174/03 showed relatively superior grain yield, 1500 kg/ha, at Soddo Zuria, we prefer assessing of other new barley varieties which might yield better than this variety in this area for future scaling up activities in the district. However, besides of

this we suggest IBON-174/03 to disseminate around Soddo Zuria to sustain barley production until the better variety would come up.

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