

Popularization and Performance Evaluation of Improved Malt Barley Varieties in Three Zones of Oromia Region

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Abstract: This study was designed to evaluate the performance of proven malt barley technologies in the Oromia regional state and popularize the selected malt barley varieties to enhance grain supply to the agro-industry. During the three years of popularization efforts the malt barley varieties including Bekoji-1, Holker, and IBON 174/03 have been introduced to Wolmera, Kersa Malima, Jeldu, and Degem districts. The results of descriptive statistical analysis revealed that a total of 46.32 quintals of malt barley improved seeds were disseminated with a total area coverage of 28.45 hectares. The total beneficiaries of the technology were 132 (124 male and 8 female) farmers in the four selected districts of three zones. A total of 519 participants from farmers, regulatory bodies, agricultural experts, development agents, and cooperative bureaus participated in the knowledge-sharing platform. About 398 individuals, including farmers, agricultural experts, and development agents attended the training on malt barley production and management practices. During the field days, and knowledge-sharing platform a total of 449 male and 70 female participants from farmers, agricultural experts, researchers, and district administration representatives participated. The purpose of field days was to share experiences and to collect feedback from the participants on the performance of malt barley technologies popularized. With regards to production, a total of 496.5 quintals of seed yield were obtained from 28.45 hectares of land, with an average grain yield of 17.45 q/ha. The performance evaluation revealed that variety IBON 174/03 got wider acceptance by farmers for its grain yield, high productivity, good malting quality traits, and earliness among the three varieties popularized. Thus, it is recommended that the highland areas above 2300 meters have the potential for malt barley production. In general, improving institutional support, strengthening the market linkage and commitment of all actors and farmers are crucial for enhancing malt barley productivity and farmers' livelihoods.

Keywords: Popularization, Performance Evaluation, Malt Barley, Varieties, Oromia Region

1. Introduction

In Ethiopia, cereal crops are the major food and cash crops grown both in terms of the areas of cultivation and volume of production attained. Cereal crops are grown in all regions and cultivated by 15.8 mill farm households' which takes 81.97% (9.9 mill hectares) of the growing areas and accounted for 88.69% (290,808,263 quintals) of production. Barley is the most crucial grain crop grown in Ethiopia by a total of 3,630,719 farming households with annual production of about 20,718,071 cultivated on an area of about 799,127.84 hectares of land [1]. In Ethiopia, both food and malting barley types are grown in the highland areas for food security and marketing purposes for the brewery industry and malt

factories [2].

Barley production is an old tradition in Ethiopia that more number of smallholder farmers' barley varieties were used and followed traditional farming practices. The food barley took approximately 85% of cultivated land owed for barley in Ethiopia and nearly a total of 150,000 acres (15%) of land was covered by malt barley cultivation which is used as a major input for malt and beer processing [3]. Malt barley is used as a cash crop in potential barley production areas, especially when linked with malt factory and brewery industries. The malt barley cultivation subsector has recently emerged as a rapidly emerging subsector due to many in-country brewing companies have shown interest in meeting their malting needs by sourcing domestically [4]. The

findings by [5] show domestic supply covers about 25% of the demand for raw grain of malt barley that is required by brewery factories.

However, there is a scarcity of MB grain and poor quality to fill the requirements of the local breweries forcing the malt factory to import large quantities of malt barley from abroad. The scarcity of domestic production and increased demand shows an opportunity to boom smallholder farmers' production to substitute the import of malt barley grain. The low production and supply of smallholder-produced malt barley is because of the low yield potential of Ethiopian barley in general and the low yield specifically [6]. The major cause for low production and productivity is inefficiency in the production process of farmers [7, 8]. The imports of malt grain have grown extremely that over 75,000 tons in 2017 covering 70% of annual malt demand and costing around 41.5 mill USD [9]. A large number of farmers in the potential barley production areas can allocate part of their land to malt barley cultivation. But the question is how to involve farmers in the supply of quality malt barley grain in the potential highland areas. Many of them are traditionally good producers of food barley, but not quite accustomed to the quality standards of malting barley.

Agricultural production technologies with full crop production packages that include multiple components such as high-yielding varieties (HYVs), fertilizers, and similar land management practices provide a better yield to farmers. Although the parts of the package can complement each other, some of them can be implemented independently [10]. An innovative strategy for overcoming some of these difficulties involves the provision of small packs of seeds of new and highly demanded malt barley varieties. The strategy attempts to bridge the difference between the demand and production of quality grain through provisions of potential and promising varieties identified from the previous demonstration trials and multiplied in the smallholder farmers' seed multiplication methods. This study intends to popularize and evaluate the performance of improved malt barley technologies in the potential malt barley growing areas thereby improving productivity and production under small-scale farmers' conditions.

Objectives of the study

- 1) To create awareness and popularize the improved MB varieties
- 2) To evaluate the performance of improved MB varieties in the study areas

2. Research Methodology

2.1. Description of the Study Areas

Oromia region was the target study area selected for the popularization of malt barley production technologies. Three zonal administrative areas were considered for the study in the Oromia regional state and a district per zone was selected. The first district was Welmera district which is geographically, located between 8°50'0"-9°15'0"N latitude

and 38°25'0"-38°45'0"E longitude and 65,605 hectares area coverage. The majority of the areas are highlands 61 percent and mid-highlands cover 39 percent with an altitude ranging from 2060 to 3380 meters above sea level [11]. The soil in the area is reddish-brown clay type similar to some other highland areas of Ethiopia. The district is characterized by mixed crop-livestock farming systems both crop and livestock play a central role in the lives of the farmers. The major crops grown in the district are barley, tef, wheat, potato pulses crops, oil seed, and other vegetables.

The second target area is the Kersa Malima district which is located in the Southwestern Shewa zone of Oromia. The district is geographically located between latitudes of 8°36'0" N to 8°71'0" N and with longitude of 38°34'0" E to 38°71'0" E. The district was 60 Km to the southwest of Addis Ababa with a total area of 58,613 hectares. The elevation varies from 1839 to 3568m a.s.l. The study area is characterized by tropical and warm too cold humid temperate. These areas are characterized by an average temperature that ranges from 10-19°C and the rainfall of the areas ranges from 974-1319 mm. The highland part of the districts is characterized by a moderate average temperature of 10-15°C and 1170-1319 mm rainfall. The farming system in the district is mixed crop-livestock type, whereby crops contribute a larger share to farmers' income. As for potentialities, the district has a high potential for crop production. The five major crops grown in the areas are wheat, tef, barley, faba bean, and chickpea.

The third district was Jeldu which is located in the West Shewa zone of Oromia. The district is far away 72 km the east of the zonal capital Ambo town and 115 km from the capital Addis Ababa. The topography of the areas is characterized by mountains, plateaus, and hills with an average elevation and rainfall of 2800 m above sea level and 900 mm, respectively. The three dominant soil types are vertisol (42.10%), nitosol (36.83%), and sandy sol (21.07%). Wheat, barley, tef, sorghum, maize, faba beans, field peas, chickpeas, potato, onion, and inset are the major crops grown by farmers in the district. The fourth location for the study was Degem district is located in the North Shewa zone of Oromia. The district is found in the northwestern direction at a distance of 123 km from Addis Ababa capital city of Ethiopia and 10 km from Fitcha zonal city. The district is geographically with a longitude of 38°25'0"E-38°45'00 E and 09°03'0"0; N-10°30'0" N latitude.

2.2. Data Types and Methods of Data Collection

In this study to supplement the experimental data both primary and secondary data sources were employed. A semi-structured questionnaire was used to collect the primary data from target farm households. Secondary data on malt barley production was taken from different published and unpublished documents.

2.3. Sampling Procedure and Sample Size

This performance evaluation and popularization of

improved varieties are carried out in four districts of three different zonal administrations in the Oromia region. Four districts were selected focusing on the potential in malt barley cultivation and agro-ecological suitability for barley. Farmers were selected in consultation with the respective bureau of agriculture by considering their malt barley growing interest and areas of land they have. Finally, a total of 132 smallholder (124 were male-headed and 8 were female-headed) households considered performance evaluation and popularization of malt barley technologies.

2.4. Methods of Data Analysis

Descriptive statistical analysis methods were used to present the data collected from the improved malt barley producers in the study areas. The total beneficiaries of improved malt varieties, training participants, and technology disseminated, participants of malt barley production knowledge sharing field day, and the number of outputs gained were presented using tables.

3. Results and Discussions

3.1. Awareness Creation and Practical Training Provided

The training provided was on techniques of malt barley production both at a farmers training center and in the field is carried out to improve the knowledge and skill of smallholder farmers to enhance the productivity of malt barley. In line with this, different efforts have been exerted to build the capacity of farmers, development agents (DAs), the office of agricultural experts, and other relevant actors. A total of 398 participants (255 male and 143 female) attended

the training (Table 1). The main training areas covered were input preparation and farm management, agronomic practices to be followed to cultivate quality malt barley, and quality malt barley grain production.

Table 1. Training participants of improved malt barley production.

Production year	Participants	
	Male	Female
2015/16	137	23
2016/17	13	101
2018/18	105	19
Total	255	143

Source: own computation result

3.2. Popularization of Improved Malt Barley Varieties

The four districts by type of malt barley varieties distributed, area covered, and number of farmers involved are presented in Table 2. With effort exerted on the popularization of proven malt barley technologies the varieties including Bekoji-1, Holker, and IBON 174/03 have been introduced. The popularization of Malt barley varieties was carried out for three consecutive years (2015-2017). During the first intervention period in 2015, the MB variety called Holker was popularized in Welmera, Jeldu, and Degem districts with a total of 34 participants (32 male and 2 female) farmers (Table 2). In the second production year, the varieties called IBON 174/03 Holker, and Bekoji-1 were popularized in Jeldu and Kersa Malima districts with the involvement of 33 male farmers. In the third year, two malt barley varieties Holker and IBON 174/03 were disseminated in Welmera districts with a total participant of 65 (59 male and 6 female) headed households.

Table 2. Malt barley technology beneficiaries and areas covered.

Zone	Production year	Areas cultivated	Participants	
			Male	Female
West, Southwest, and North Shewa	2015	6.93	32	2
West, and Southwest Shewa	2016	5.21	33	0
West Shewa	2017	16.31	59	6
Total		28.45	124	8

Source: Study result

Concerning the improved seed distribution, a total of 46.32 quintals seeds were distributed to 132 households (124 male and 8 female), and a total of 28.45 hectares of areas were covered in the four selected districts. Subsequently, 25 kg of malt barley seeds sufficient for a quarter of a hectare was offered to each farmer who attended the training on a revolving basis, which returned after production and distributed to surrounding farmers with the help of the respective district bureau of agriculture.

3.3. Performance Evaluation of Malt Barley Varieties

In the study areas selected for the popularization of improved malt barley varieties, a total of 496.5 quintals of seed were obtained from 28.45 hectares of land, with an average grain yield of 17.45 q/ha. In the 2015 production

year, 14 quintals of variety Holker were cultivated on 6.93 hectares, and a total of 101.1 quintals of total grain yield was obtained. The three major malt barley varieties disseminated in 2016 were Bekoji-1, Holker, and IBON174/03. A total of 12.22 quintals of seeds were distributed in the three districts and a total of 139.8 quintals of grain yield was obtained. In the 2017 production year two varieties, namely varieties Holker and IBON 174/03 were used to popularize the technologies, and a total of 20.1 quintals of seed were cultivated on 16.31 hectares in the Wolmera districts. Consequently, a total of 308.9 quintals of grain was produced out of which 40% of the produced seed was used for consumption, 50% for marketing and the remaining 10% was used as seed source for the coming season.

Joint monitoring and evaluation of the three malt barley

varieties were made at the different plant growth stages to evaluate crop performance, identify problems, devise corrective measures, and provide technical backstopping to district experts and development agents of the study areas. Hence in the performance evaluation and selection, the highest mean grain yield of 17.94 qt/ha was recorded by IBON 174/03 variety. The findings of [12] showed that the variety (IBON 174/03) was selected by farmers because of its good adaptability and productivity. Regarding farmers' reaction, in most districts' farmers confirmed variety IBON 174/03 was the best-performing variety in terms of earliness, yield potential, good in Enjera making, and wider adaptation. This result is supported by the findings of [2] who reported the introduction of a widely used early maturing and high-yielding malting barley IBON 174/03 variety that was highly valued by farmers for its inspiring performance. On the other hand, variety Holker showed inconsistent performance across the districts.

3.4. Field Demonstration and Knowledge-Sharing Platform

Field days were organized at representative and model popularization sites by the Holetta Agricultural Research Center to get feedback on the new malt barley varieties and create awareness of introduced technologies thereby improving the technical knowledge and skill of farmers, DAs, and district experts on improved malt barley technologies. Hence, a total of 519 (449 male and 70 female) participants from farmers, regulatory bodies, agricultural experts, development agents, and cooperative bureaus attended the different field demonstrations and information-sharing days organized at the study areas (Table 3).

Table 3. Participants in field demonstration and knowledge-sharing platform.

Production year	Participants	
	Male	Female
2015/16	23	209
2016/17	23	171
2017/18	24	69
Total	70	449

Source: own computation result

3.5. Factors Affecting the Effective Popularization of Malt Barley

From focus group discussion and the monitoring and evaluation, it's raised that the major challenges encountered during the popularization of malt barley technologies are: Some of the fields were sloppy with poor soil fertility status and water-logged fields. Some farmers were also very reluctant to apply the recommended packages for malt barley production and management. The scarcity and timely unavailability of improved malt barley seeds. Thus, production and provision of quality improved malt barley seed should get due consideration. Weak participation of stakeholders that most development agents were engaged with other non-agricultural activities and their involvement in the technology promotion is very limited. In addition, the

turnover of district experts and DAs is very high. To this effect, [13] finds that the expansion of an improved extension method that requires the participation of various stakeholders is vital to encourage the application of new agriculture technologies and to develop an approach based on the problems and needs of the farmer. Continuous follow-up and training by all concerned actors mainly by the district bureau of agriculture and DAs should be strengthened.

Pest management: pest management includes weeds, diseases, and insects observed in the production year, and weak follow-up and grass weeds, shoot fly and leaf diseases such as scald and net blotch contribute to the reduction of outputs in some sites. **Agronomic practices:** the partial application of recommended production packages possibly contributes to low malt barley productivity. In some sites, malt barley fields are not properly prepared, fertilized, rotated with pulses or oil crops, weeded, and roughed out from mixed crops and varieties. This is in line with [14] which showed poor crop management is a major yield-limiting factor for improved cultivars in Ethiopian agroecologies. Most of the farmers didn't apply row planting even if they believed that row planting is advantageous over broadcasting by fear of row planting takes more time and labor than broadcasting and leads to delay the other crops planting time. Thus, effective small-scale row planters should be identified and introduced. **Institutional factors:** poor linkage between producers, cooperatives, unions, and agro-industries in the production and marketing of malt barley requires due attention.

From the focus group discussion key informants', it's raised that the major constraints in malt barley production were a timely supply of improved seed, chemical fertilizers, herbicides, and pesticides. The price inflation of inputs and lack of market linkage are the main ones. The possible solutions raised for these problems where the government has to deliver agricultural inputs on time with subsidized prices and participation of all stakeholders in production and marketing is crucial.

3.6. Lessons Learned from the Popularization of Malt Barley Varieties

The critical lessons learned from the popularization of improved varieties are important to expand the technology to new areas for sustainable malt barley grain production and enable farmers or a community to quality malt barley production. Farmers have to be trained on the quality of grain production and have to be provided with good start-up quality certified seed initially. Training on quality malt barley production is very vital. Farmers, DAs, and district experts should be trained and acquainted with the concept of malt barley production technology for sustainable quality malt grain cultivation. A strong partnership of stakeholders: agricultural research centers, bureau of agriculture, district administration, and seed enterprises have to be strengthened for effective joint planning, and executions of quality Malt barley grain production and marketing. Strengthening of the linkages among all actors in malt barley production improves

the efficiency of value chains which increases farmers' incomes and ensures equitable benefits in the whole value chain [15]. Commitment from the farmers is central to implementing the technical recommendations of the improved malt barley production technologies and moving towards a more commercial quality grain production scheme.

4. Conclusions and Recommendations

The performance evaluation and popularization activity was conducted for three production years from 2015 to 2017 in three potential malt barley-producing zones. Efforts to enhance malt barley production have been initiated to meet the growing malt demand in the country. To this effect, the malt barley varieties including Bekoji-1, Holker, and IBON174/03 were popularized and evaluated to increase the productivity and production of malt barley in the highland areas. The results of descriptive statistical analysis revealed that a total improved seed disseminated was 46.32 quintals of certified malt barley with a total of 28.45 hectares coverage and a total of 132 households (124 male and 8 female) benefited in the four selected districts of three zones. A total of 519 (449 male and 70 female) participants from farmers, regulatory bodies, agricultural experts, development agents, and cooperative bureaus participated in the knowledge-sharing platform. In the three-year promotion and evaluation activity variety IBON 174/03 has gained wider acceptance by participants for its high productivity, good malting quality traits, and earliness out of the three varieties.

Thus, malt barley varieties IBON 174/03 are recommended for the potential areas of the highland areas above 2300 meters. This will substantially increase the income as well as improve the livelihood of the farming community. The performance evaluation and popularization initiative has improved access to improved malt barley varieties, and improved farmers' skills, knowledge, and attitudes on quality malt barley grain production. On the other hand, proper site and farmer selection, weak commitment of actors in implementing the program in all stages of the activity, and weak market linkages challenges confronted during the implementation of the popularization activity. Thus, based on the findings of this study strengthening the linkage among concerned stakeholders, formation of an agreement between malt barley producer farmers and brewery companies and widely extending the proven malt barley technologies in a well-organized approach requires due consideration in the future to satisfy the increasing malt barley demand of agro-industries in Ethiopia.

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Conflicts of Interest

The authors declare no conflicts of interest.

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