

Research Article

Evaluation of Grain yield Performance and Quality Parameter of Malt Barley (*Hordeum vulgare*) Variety in Eastern Amhara

Akalu Gebru*

Sirinka Agricultural Research Center, Woldiya University, Ethiopia

*Corresponding author

Akalu Gebru, Sirinka Agricultural Research Center, Woldiya University, Ethiopia, Tel: 251-091-277-1083; Email: akalgebru@gmail.com

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- Protein content

Abstract

Evaluation of Grain yield Performance and Quality Parameter of Malt Barley (*HordeumVulgare*) Variety in Eastern Amhara. Seven malt barley varieties were evaluated with the objective of selecting high yielder and adaptable varieties that fulfill the standards of malt barley quality parameters. The trial was conducted in the high land areas of Eastern Amhara at Legambo, Dessiezuria, Geregra and kone districts in 2014 main crop growing season using RCBD using three replications. Each variety was planted on a plot size of 5m²(2.5m with 2m).Space between rows, plots and replications were 0.2m, 0.5m and 1m respectively. Analysis of variance revealed the presence of highly significant difference ($p<0.01$) between varieties for days to heading, days to maturity and spike length. Significant difference ($p<0.05$) was also observed between varieties for plant height, thousand seed weight and grain yield. Variety IBON 174/03 score the highest grain yield (4239), good germination energy (99.02), average hectoliter weight(63.52),protein content(10.52), and good grading size (92.4) were recorded in consistence in all tested location whereas, the lowest grain yield (2228kg/ha) was recorded at Legambo in variety Bahati. From the combine analysis, variety IBON 174/03 have 19.3%and 31% -grain yield advantage over the grand mean (3122.2) and the lowest grain yield Bekoji 1 (2853)kg/ha. IBON 174/03, Sabini, Bekoji-1, Holker and EH1847 fulfill the minimum requirement breweries quality standard. Therefore, IBON174/03 varieties were recommended for further seed multiplication and make import substitution of malt barley and improve the income of farmer in highlands of Wollo barely growing area of eastern Amhara.

INTRODUCTION

Barely (*HordeumVulgare*.) is an ancient crop that grows widely in marginal area up to 3500 m.a.s. l during uncivilized time and now. It is one of main cereal crop that belong to grass family poceae. Ethiopia is the second center of diversity for barely that is due to the presence of great genetic diversity and endemic of barely landrace. The total area covered by the crop is about 1,019,477 hectares with the total production 21,583,522.6 million ton in Ethiopia with the average yield per hectare in 1.8 ton (CSA, 2013/14). In the world, barely ranked fourth in production followed by wheat, rice, maize.

The majority of barely production is for animal feed and alcoholic beverage in the world. The interest aspect of malt barley production in Ethiopia is that used for double purpose. It used for food like (Enjera, besso, kollo, Porridge, kitta) and malt for brewery industry. As the result malt barley productions have different competitive alternative channels for the crop making it sustainable source of income for smallholder farmer in highlands of Wollo. Apart from these, there is a huge gap between the amount of malt barley produced in domestic farmer and the demand of breweries industry in the country. Due to these Ethiopia has spent huge amount of money to import malt barley ERCA [1]. The

gap between domestic supply and demand on one hand favorable biophysical environment indicate huge opportunity to enhance exist local production and substitute import.

Malt barley is more prefers for malt production is due to unique morphological and genetically constitution of the grain that helps to change the stage of water absorption, germination and the final flavor product. Barley has morphological structures that contains lemma and palea has tightened and cemented with crop that helps to protect the embryo during grain handling as well as the coleoptiles during malting, resulting in more uniform germination. In addition, the lemma and palea, or hulls, serve as an aid for filtering the brewing mash [2].

Barely contains 67% carbohydrate and 12.5% protein. Malt barely is a source of sugar (principally maltose) which is fermented in to beer. The grain partially germinates, releasing enzymes in the aleuronic layer. The endosperm is composed of large and small starch granules that are packed in a protein matrix. Muluken Bantayehu reported that the cell walls of barley within the matrix which holding starch granules were primarily composed of beta-glucans (a type of cellulose), some pentosans (gummy polysaccharides) and some protein.

According to Mohammed and Getachew, the major constraints for malt barley grain production were the current malt barley varieties are generally not well adapted higher altitude, hence limited to different agro-climatic zones, limited package of comprehensive cultural practices and poor quality grain such as high screen loss, low thousand kernel weight, high protein content. Therefore, the main objective of these experiments was to evaluate their adaptability, grain yield, malting quality and disease resistance.

MATERIAL AND METHOD

This experiment was conducted under rain fed conditions in 2014 main growing seasons in high land area of eastern Amhara around Legambo, Dessiezuria, Geregra and kone districts. Seven malt barely varieties (IBON 174/03, Bekoji, Bahati, Sabini, Holker, EH1847 and Frigebs) obtained from different agricultural research center were planted at four locations in randomized complete block design with three replications. The seeds were drilled in row with the Plot size of 2.5m by 2m for each variety consisting of 10 rows with 20 cm row spacing.

The seeding rates were 100kg/ha for rain fed conditions. The plots were fertilized with 46kg/ha of P₂O₅ and 41kg/ha of N, Half of the N rate was applied at planting together with full rate of P₂O₅ and the remaining half rate of N was applied at 35days after planting. All data were collected from eight central rows. Moisture content of grains were adjusted to 12.5% and converted to kilogram per hectare. Plant heights were measured from the ground to the spike excluding the own.

Days to heading and days to maturity were recorded when 50% of the plants give raise to heads and 90% of the plants fully attain physiological maturity respectively. Thousand seeds weight were counted and weighed using electronically grain analyzer equipments. Germination energy in percent were determined from 100 seeds soaks and allowed to germinate in Petri dish after 120hours counting the number of seeds properly germinated then purely germinated seed divided to total seed soaks in petridish. Seed size test was carried out using 2.2, 2.5, 2.8 mm sieve sizes and proportion of the seed trapped by each sieves were weighted and converted to percentage. Analyses of variance were calculated using GenStat software. Mean separation was carried out using least significant difference (LSD) test at 5% level of significant.

RESULT AND DISCUSSION

Grain yield and phonological performance

Analysis of variance revealed the presence of highly significant ($p < 0.01$) difference between varieties for days to heading, days to maturity, spike length, and significant ($P < 0.05$) difference between varieties for plant height, 1000 seed weight and grain yield. Variety IBON174/03, Frigebs, Sabini, and Bekoji-1 takes short numbers of days to head and mature. This idea was supported by kifleet al., [3]. Whereas, variety EH1847 and Holkertakes relatively longer days to head and mature (Table 1). The difference in heading date among the test varieties ranges from 76 days to 89 days.

The early maturing varieties complete their life cycle

relatively in short period of time, which has an advantage over the late maturing varieties when rainfall cease early. Variety IBON 174/03 gave the highest grain yield over all tested locations consistently. The combined analysis of variance also showed that the average grain yield of variety IBON 174/03 was higher (3743kg/ha) followed by variety Sabini (3130kg/ha) and Frigebs (3094 kg/ha). Variety IBON 174/03 gave 20% and 35% grain yield advantage over the overall grand mean and the lowest yielder variety Bokoji-1 respectively (Table 1).

This study confirmed that Feregebs was the longest (102.0cm) and variety IBON 174/03 was shortest (88.4cm) varieties in plant height of all tested varieties. In all locations no disease incidence (net blotch, scaled, leaf rust) were observed through the growing season.

Malt quality trait

Seven malt barley varieties were evaluated in quality standards for breweries industry in Easter Amhara. Variety IBON 174/03, Frigebs and Holker recorded the highest thousands seed weight 47.37, 46.27, and 46.27 gram respectively, at the same time those varieties scores the highest hectoliter weight and grain yield but Bekoji and Sabini relatively the lowest thousand seed weight 45.52 and 45.06 gram. Protein accumulates during grain filling period. However, the quality of malt barley depends on the variety in which constituting the genetic makeup, growing environmental condition, appropriate storage condition resulting in loss of vitality [4]. According to ERCA [1] the national standard value of 1000 kernel weight, hectoliter weight, and kernel protein content are 35-46, 60-65, and 9-11.5 respectively. Therefore, the varieties which have the highest grain yield and low grain protein fulfill the requirements of malt factories. From the tested variety IBON 174/03 fulfill all quality parameter standards like germination energy (99%), protein content (10.5), hectoliter weight (63.5) and both (2.8+2.5) mm grain size. The final grain size is determined by the environmental effect which affects the biochemical component within the grain having 84% in grading size). From all tested varieties IBON 174/03, Holker, Ferigbes, and Bokoji 1 full fill the required grain size standards (2.8, 2.5, and 2.8+2.5mm) (Table 2).

When protein content exceed from the recommended levels were undesirable for malt factory that increase the steeping time and cause uneven water uptake during steeping, create uneven germination during malting, and increase malt loss due to abnormal growth. Excessive enzymatic activity, low extract yield, excessive nitrogenous compound in the wort during brewing, and Chille haze formation in beer [5]. However, excellent grain protein contents of these varieties also possess the highest germination energy records (97.79 to 99.02%) (Table 2). These means all varieties fulfill the required standard of germination energy ($> 95\%$ in 120 hours). Table 2 Mean quality traits of seven malting barley variety tested at Legambo, Dessiezuria, Geregra and kone, (2014) GE (Germination energy (%), PC (Protein content(%), HLW (Hectoliter weight (kg/ha-1), TSW (Thousand seed weight) [6-9].

CONCLUSION AND RECOMMENDATION

Seven malt barley varieties were evaluated for their

Table 1: Mean of grain yield and other desirable agronomic trait of malt barley varieties tested at Legambo, Dessiezuria, Geregra and Kone (2014).

VARIETIES	DH	DM	PH	TSW(g)	HLW(kg/hl)	GY(kg/ha)
Ibon 174/03	76.42	133.83	88.4	47.37	63.51	3742.60
Sabini	77.56	135.94	86.3	45.06	56.72	3130.40
Firgebs	81.00	139.17	102.0	46.27	56.37	3094.50
Holker	89.17	147.33	95.1	46.27	59.67	3088.70
EH1847	83.67	142.75	86.6	44.85	58.37	3084.70
Bekoji 1	87.17	142.08	92.6	45.52	60.06	2892.00
Bahati	82.44	145.90	95.0	45.75	55.06	2858.00
Mean	82.47	141.79	92.3	92.30	58.54	3137.70
SE+	4.49	3.39	3.39	1.30	2.13	224.00
LSD (%)	3.99	6.70	11.67	2.56	4.60	447.00
Cv (%)	5.90	5.90	15.5	6.70	4.50	17.60

Abbreviations: DH: Days to heading (days); DM-Days to Mature(days); PH- Plant Height(cm); TSW:Thousand Seed Weight (gram); HLW- Hectoliter Weight (kg/hl)

Table 2: Mean quality traits of seven malting barley variety tested at Legambo, Dessiezuria, Geregra and kone, (2014).

Varieties	Germination Energy (%)	Protein content (%)	Hectoliter Weight (kg/ha ⁻¹)	Sieving test (%)				
				2.8mm	2.5mm	2.8+2.5mm	2.2mm	<2.2mm
IBON 174/03	99.02	10.56	63.52	34.5	44.2	84.2	17.4	7.6
Sabini	98.81	10.86	56.72	32.4	36.40	12.9	23.3	16.8
Frigebs	98.99	11.44	56.37	37.1	39.28	80.2	18.3	12.9
Holker	98.61	10.44	59.69	32.0	52.84	82.5	25.6	25.3
EH 1847	97.79	10.39	58.37	34.3	48.70	18.7	22.0	25.9
Bekoji 1	98.78	10.60	60.06	25.3	42.56	81.6	15.9	10.6
Bahati	98.83	10.32	55.04	32.5	67.20	11.2	21.8	13.2
Mean	98.74	9.35	58.54	32.6	66.50	26.9	20.6	16.1
SE+	0.50	0.50	2.13	5.5	8.70	7.7	5.14	12.59
LSD(%)	1.20	1.30	4.60	14.2	18.90	14.51	11.9	27.43
Cv(%)	0.70	7.30	4.50	24.2	16.00	32.0	32.5	96.0

Abbreviations: GE: Germination energy (%); PC: Protein content (%); HLW: Hectoliter weight (kg/ha⁻¹); TSW: Thousand seed weight

grain performance and quality standards in the highlands of eastern Amhara. Out of the seven varieties tested at Legambo, Dessiezuria, Geregra and kone districts variety IBON 174/03 gave the highest grain yield with acceptable grain quality characters across locations. So variety IBON 174/03 was recommended for Legambo, Dessiezuria, Geregra, kone districts and areas with similar agro-ecologies for sustainable and quality malt barley production to facilitating malt barley import substitution of the country.

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