

Registration of a High Yielding Malt Barley Variety HB1454 for the Potential Highlands of Ethiopia

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ኤች ቢ1454 የተባለው ባለሁለት መስመር የብቅል ገብስ ዝርያ የተመዘገበበት ስም EH 1847/F4.2P.5.2) ሲሆን በሆለታ ግብርና ምርምር ማዕከል በገብስ ማሻሻያ ፕሮግራም በማዳቀል ዘዴ የተገኘ ነው። ዝርያው 1998-2000 ዓ.ም. በአገሪቱ ዋና ዋና ገብስ አብቃይ በሆኑ 10 የሙከራ ጣቢያዎች ላይ ከሌሎች ዝርያዎች ጋር ተፈትሾ በምርት መጠኑ፤ ዋና ዋና የቅጠል በሽታዎችንና ግሽበትን በመቋቋም እና ለብቅል ገብስ ተሰማሚ የሆኑ ባህሪያትን ከብቅል ፋብሪካዎች መስፈረት አንፃር በሚሟላቱ በ2003 ዓ.ም. ለምርት ተግባር አንዲውል ተለቋል። ዝርያው በአሁኑ ወቅት በዋና ዋና የብቅል ገብስ አብቃይ አካባቢዎች በሰፊው በሰርቶ ማሳያ እና በቅድመ-ማሰፋት የማስተዋወቅ ስራ እየተሰራበት ሲሆን፤ ጎን ለጎን የዘር ማባዛት ስራም እየተካሄደ ይገኛል። ይህ ዝርያ በአሁኑ ወቅት በአዳዲስ ቢራ ፋብሪካዎች መከፈት ምክንያት እየጨመረ የመጣውን የብቅል ገብስ ፍላጎት በመጠንና በጥራት ለማሟላት በአማራጭነት በደጋማው ገብስ አብቃይ አካባቢዎች መመረት የሚችልና አርሶ አደሩም በብዛት እና በጥራት በማምረት ለብቅል ፋብሪካ በማቅረብ ተጨማሪ የሆኑት ምንጭ የሚያስገኝ ዝርያ ነው።

Abstract

HB1454 (Reg. No. EH 1847/F4.2P.5.2) is a two - rowed, hulled, malting barley developed at Holetta Research Center (HRC). HB 1454 was tested in a multi location variety trial as EH 1847/F4.2P.5.2 from 2005- 2007 along with twelve genotypes advanced from the local crossing program. It was released in 2011 for its high seed and biomass yields, good agronomic performance and good grain quality traits for malting. HB 1454 is resistant to net blotch (caused by *Helminthosporium teres* Sacc.) and scald (caused by *Rhynchosporium secalis* (Oudem.) J.J. Davis). Therefore, the variety is recommended for the highlands of major barley growing areas of the country.

Introduction

Malt barley is an industrial crop with high priority for national research intervention. In the barley-based farming systems of the highlands of Ethiopia smallholder farmer have very few alternative crops. One source of income could be growing malting barley, which has dependable local buyers in the country (Bayeh and Berhane 2011). Even though Ethiopia has favorable environment and potential market opportunity, the share of malting barley production is quite low (about 15%) as compared to food barley. The malt demand in the country is growing significantly with the entry of new breweries such as Habesha, Raya and Heniken as well as the planned expansion of the other breweries. As a result, malt barley grain demand by the current breweries has increased significantly and the local supply by the malt factories is about 40 % and the balance has been fulfilled by importing malt. The gap between current malt barley production and consumption levels in Ethiopia shows the potential for further expansion of domestic supply of malting barley. This suggests that farmers in Ethiopia have

opportunities to supply malt barley to the growing domestic markets that can fully or partially substitute imports. This requires the development of malt barley varieties that feature the following: higher yielder, resistant to the major leaf diseases, stiff straw, contain higher malt sugar and low proteins, possess white and plump seeds and responsive for optimum use of external inputs and improved crop management.

Origin and Pedigree

HB 1454 (Reg. No. EH 1847/F4.2P.5.2), a two rowed malting barley developed by the Holetta Agricultural Research Center (HARC). HB1454 is a selection from the cross *BEKA/IBON64/91*. *Beka* is a two-rowed malt barley introduced from Spain and registered by the Holetta Agricultural Research Center in 1973, and was the dominant malt barley cultivated in Arsi-Bale highlands for the last 30 years with industry malt quality standard. *IBON 64/91* is an introduction from CIMMYT/ICARDA, as an international barley observation nursery in 1992. It was evaluated at Holetta and identified for its excellent straw strength and plump kernel size.

Breeding Methodology

HB1454 was developed using a modified bulk pedigree selection procedure with all early-generation population and line development done under main season and off season using irrigation at Holetta. The original cross for HB1454 was made in 1998, and F₁ seed was planted in 1999 as a single in one meter row. The F₂ to F₄ bulks were grown in the field at Holetta from 2000 to 2002. The fifth filial generation plants were selected from space grown F₄ plants to develop pure line (Anderson, 1985). Selections were based on maturity, straw strength, disease resistance, uniform spike type and physical grain quality for malt. The selected lines from the F₄ bulk grown out as individual F₅ lines in 2003. The line from which HB1454 was developed was selected from this population. In 2004 this line was designated as EH 1847/F₄.2P.5.2 and tested in a preliminary variety trial and subsequently advanced to the multi-location variety trial from 2005 to 2007. Based on the yield, agronomic, diseases and malt quality data, HB1454 was entered into the variety verification trial for release in 2010.

Agronomic and Morphological Characteristics

Some morpho-agronomic attributes and malt quality analysis of HB 1454 is illustrated in Table 1, 2, 3 and in detail in Table 4.

Grain Yield Potential, Stability and Reaction to the Major Leaf Diseases

Thirteen malt barley genotypes along with two standard checks were evaluated at Holetta, Asasa, Bekoji, and South Gonder during 2005-2007 main cropping seasons. The candidate variety; EH 1847/F₄.2P.5.2 was significantly out yielded

the standard checks variety HB-120 and Beka in 2005 at Asasa, in 2006 and 2007 at Holetta and in 2007 at Asasa, Bekoji and South Gonder (data not shown). This variety was the top yielding in most of the testing locations with an overall average grain yield of 4422.9 kg ha⁻¹ (Table 1). Besides the yield potential performance, it showed good level of lodging resistance and disease tolerance to common barley diseases (Table 2). Moreover, it depicted an acceptable physical grain quality in thousand kernel weight and hectoliter weight (Table 1). Partitioning the GxE interaction effect based on a joint linear regression method (Eberhart and Russel, 1996) showed that the candidate variety is among the genotypes which gave high yield with values of regression slope (b) and deviation from regression (S_{ij}^2) not significantly different from 1 and 0 respectively (Table 2). Generally, variety HB 1454 (Reg. No. EH 1847/F4.2P.5.2) is showed yield advantage of 775.94 kg ha⁻¹ (21.28%) and 1229.15 kg ha⁻¹ (38.49%) over the standard checks; HB-120 and Beka varieties respectively. Consequently; HB 1454 was promoted to variety verification trial in 2010 and released for large scale production since 2011.

Malt Quality Evaluation

HB1454 and Beka were evaluated for important malt quality traits at Holetta. The malting profile for HB1454 is better than Beka for kernel weight, plump kernels, hectoliter weight and grain protein. HB1454 has shown relatively low percentage of malt extract to Beka (Table 1). The grain and malt quality trait analysis result of HB1454 are very similar to those of the mat factory standard.

Table 1 Mean value of agronomic, quality traits and grain yield of malt barley variety (2005-2007).

Genotypes	Agronomic traits			Grain yield (kg ha ⁻¹)				
	DTH	DTM	PHT	Holetta	Bekoji	Assasa	South Gonder	Average
EH 1847/F4.2P.5.2	77.0	125.7	110.8	3787.9	4791.9	4554.0	4827.5	4422.9
EH 1900/F4.1P.58.2	76.1	125.4	111.1	3458.2	4378.7	4534.7	4023.8	4113.9
EH 1505/F6.31H.1	79.8	125.8	103.4	3037.1	3846.1	4162.4	4230.0	3736.7
EH 1893/F4.1P.51.1	82.4	128.8	107.1	3372.5	4807.3	4321.3	2572.5	3665.1
IBON 44/99	76.0	124.2	109.9	3099.6	4256.3	4412.7	3783.8	3909.0
EH 1877/F4.1P.35.1	78.2	124.9	98.2	3013.4	4654.3	4238.7	3822.5	3954.2
EH 1869/F4.3P.27.3	83.1	130.0	110.1	3157.5	4924.7	3743.2	3743.8	3922.0
EH 1551/F6.22H.1	73.8	119.9	104.9	2291.7	3976.6	3254.4	2271.3	3083.9
EH 1847/F4.4P.5.4	83.3	127.9	118.1	2814.6	4372.4	3715.0	3247.5	3595.3
EH 1864/F4.2P.22.2	81.2	127.7	96.0	2491.3	4436.6	4403.8	2935.0	3693.0
IBON 27/96	72.9	122.4	94.8	3024.2	4921.2	4990.6	2651.3	4145.9
F2 SXS 133/95	78.7	127.9	105.8	3033.1	4510.4	4646.5	3723.8	4029.4
BNEth. 01/9	73.2	122.8	103.1	2730.4	4289.3	4221.5	3947.5	3767.1
HB 120	83.2	130.8	118.7	3003.4	4355.5	3771.0	3080.0	3647.0
Beka	84.8	130.4	118.4	2717.5	3559.0	3486.4	2648.8	3193.8
Mean	78.9	126.3	107.3	3001.7	4405.3	4163.7	3433.9	3814.6
CV (%)	4.4	2.4	5.0	16.9	10.6	13.4	16.6	13.9
LSD	1.5	1.4	2.4	732.1	665.5	798.3	813.0	740.0

DTH – days to heading, *DTM*-days to maturity, *PHT* – plant height,

Table 2. Regressions of grain yield t/ha malt barley genotypes

Genotype	\bar{x}	B	S _{ij} ²	SC (0-9)	NB (0-9)	SB (0-9)
EH 1847/F4.2	4.42	0.75	0.14	3.20	1.10	1.60
EH 1900/F4.1	4.11	0.76	0.18	2.90	1.10	0.70
EH 1505/F6.3	3.74	0.60	0.13	3.20	0.80	0.40
EH 1893/F4.1	4.01	1.11	0.22	2.70	1.50	1.10
IBON 44/99	3.91	0.82	0.31	2.80	1.50	1.00
EH 1877/F4.1	3.95	1.06	0.17	3.10	1.30	0.00
EH 1869/F4.3	3.92	0.97	0.28	3.80	0.90	0.00
EH 1551/F6.2	2.87	0.97	0.85	6.80	0.90	0.00
EH 1847/F4.4	3.67	0.99	0.27	3.50	1.10	0.00
EH 1864/F4.2	3.65	1.40	0.20	4.20	0.80	0.00
IBON 27/96	4.10	1.54	0.30	3.10	1.50	0.70
F2 SXS 133/9	4.09	1.23	0.13	3.90	1.60	0.40
BNEth. 01/9	3.79	1.07	0.11	4.00	1.30	0.00
HB 120	3.63	0.95	0.10	3.10	2.10	0.40
Beka	3.36	0.89	0.17	5.60	1.30	0.70

Disease score 0-9 scale for; SC= scald, NB= Net Blotch, SP=spot blotch.

Table 3. Malt quality of HB1454 compared to beka at Holetta

Trait	HB1454	Beka
Kernel weight (g)	46.8	36.8
Plump Kernels (>2.2 mm)	93.0	89.9
Hectoliter weight (kg/hl)	64.0	63.6
Grain Protein (%)	10.6	11.6
Malt extract (%)	76.0	78.9

Table 4. Morpho-agronomic and quality trait description of HB 1454

Adaptation Area:	The Highland of Central Ethiopia, Arsi and Gonder	
Rainfall (mm):	>500	
Altitude (m.)	2200-2800	
Planting Date:	Mid June to late June	
Fertilizer rate (kg/ha):	As per recommendation for the specific growing areas with due consideration to N fertilizer not to increase level of grain protein	
Row Number:	Two	
Spike Density:	Intermediate	
Ear Attitude:	Semi erect	
Stem color:	White	
Stem/sheath:	Glaucoousity: strong /chalky	
Seed Rate (kg/ha):	100	
Days to Heading:	71-90	
Days to Maturity:	121-161	
Plant height (cm):	81-110	
1000 Seed Weight (g):	40-46	
Test Weight (kg/hl):	60-64	
Crop Pest Reaction:	Resistant	
Sieving Test% (>2.5 mm):	87-93	
Fine extract (%)	76.0	
Protein (%):	10.6-11.1	
Yield (qt/ha):	Research field: 44.23	Farmers field: 34.97
Year of Release:	2011	
Breeder/Maintainer:	EIAR/HARC	

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