Registration of Food Barley (*Hordeum vulgare* L.) Variety HB 1307 for Mid and High Altitude Areas of Ethiopia

Birhanu Bekele and Berhane Lakew

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Abstract: Six-rowed food type barley, HB 1307, was developed by Holetta Agricultural Research Center (HARC) from a cross between a landrace line and exotic germplasm (Awra gebs-1 x IBON93/91) and released in 2006 for mid and high altitude areas. The three consecutive years' (2002-2004) tests proved its superiority in grain yield performance, stability, and wide adaptation. It has good physical grain quality, resistance to leaf rust and scald, moderate resistance to net and spot blotch, lodging tolerance, and good biomass yield. The variety's agronomic and quality merits and better performance than the checks makes it dependable for similar agro-ecologies considered in the study.

1. Origin and Pedigree

HB 1307 is derived from a cross between a landrace line (Awra gebs-1) and an exotic germplasm from ICARDA (IBON 93/91). The local farmers' cultivar, Awra gebs, was collected from North Gonder, Ethiopia, in 1994. IBON 93/91 is a line introduced from ICARDA through an International Barley Observation Nursery in 1991 with a pedigree of GLORIA "S"/COME "S"//ESC.II.72.607. 14E.9E.6E/3/SHYRI CMB87-489-L-5Y-3B-1Y-OM. The cross (Awra gebs-1 x IBON 93/91) was made in the off-season of 1995 at HARC.

2. Breeding Methodology

Bulk method was employed, where the segregating materials were bulk harvested and advanced twice a year, using off-season irrigation and the main season rains till the fifth filial generation (F_5) and a plant was selected from space-grown F_6 plants to develop the line.

3. Agronomic and Morphological Characteristics

The agronomic and morphological characteristics of HB 1307 are given in Appendix I.

4. Grain Yield Performance and Stability

Twelve food barley genotypes, including one recently releaseed standard check, Dimtu, and one major local cultivar of the respective locations were tested during the main seasons of 2002 through to 2004 at 13 locations in the southeastern, central and northern parts of Ethiopia, and complete data was secured at 6 locations: Holetta, Bekoji, Kofele, Debre-Tabor, Ambo, and Hosaina. The grain yield performance and stability parameters of HB 1307 and the checks are as summarized in Table 1. The mean yield of the new variety was significantly higher than the checks. The grain yield advantages of the new variety over the standard check, Dimtu, and the local cultivars of the respective locations, were 28.3% and 34.4%, respectively, with better lodging tolerance and good biomass yield (Table 3). Moreover, for verification (2005/06 cropping season), the new variety was compared in 14 on-station and on-farm sites that are located between 2300 m and 3020 m altitudes in the southeastern, central and northern highlands of the country. Complete grain yield data and secured at 12 verification sites, and the new variety (HB 1307) was superior in 8 sites or 67% of the sites compared to the checks (Table 2). Severe waterlogged conditions at two verification sites in Galessa resulted in complete crop failure and poor performance, the only survivors and better performers being HB 1307 and the local cultivar, indicating the tolerance of the new variety to the this particulars stress.

Absence of significant genotype x location and the greater size of the G x E variance component (334%) relative to the genotypic variance component justified assessing the variety's merit with respect to stability (FAO, 2002).

Table 1. Mean actual on-station and on-farm grain yields (t/ha), Kataoka's yield reliability indices (I_E) at P=0.95 (t/ha), regression coefficients (b), deviations from regression (S_{dij}^2), and environmental variances (S_i^2) of the new and the check varieties tested through 2002 to 2004 in 18 environments.

No.	Variety	Grain yield (t/ha)			b [c]	S_{dij}^2	S_i^2 [d]
		On-station [a]	On-farm [a]	I_E [b]			
1	HB 1307	4.78 a	3.54 a	2.901 a	0.928	0.839	0.10 a
2	Dimtu	3.73 b	2.30 c	2.340 b	0.762 *	-0.817	0.05 a
3	Local check	3.56 c	2.84 b	1.524 c	0.937	-0.198	0.09 a

NOTE: All statistical comparisons are based on the analyses done on the complete genotypes (12 varieties) grain yield data.

[a] *= figures with different letters significantly differ at* $lsd_{0.05}$.

[b] *= figures with different letters significantly differ at* $P \leq 0.10$ *based on Dunnett's one-tailed test.*

[c] *= figures with * significantly differ from unity at* $P \leq 0.05$.

[d] *= figures with the same letter are not different from the most stable variety, 'Dimtu', at* $P \leq 0.05$ *and* $P \leq 0.01$ *according to Ekbohm's test.*

* Corresponding author. E-mail: birhanuale@yahoo.com

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Partitioning the G x E interaction effect, based on a joint linear regression method (Eberhart and Russel, 1996), indicated that the regression coefficient (*b*) of the new variety was not different from unity and its deviation from regression (S_{dij}^2) was insignificant. In additions, its environmental variance (S_i^2) was not significantly different from the most stable variety, Dimtu. Kataoka's yield reliability index (I_E) when computed, based on S_i^2 at P = 0.95, showed the significant superiority of the new variety over the standard and the local checks (Table 1). Out of 18 environments considered for analysis from the three consecutive years' multi-location data, the new variety won in 13 (87%) environments.

Table 2. Grain yield (t/ha) results of HB 1307 and the check varieties from 12 verification sites conducted during 2005/06 cropping season.

Locations	Altitude (m.a.s.l)	Varieties		
		HB 1307	Dimtu	Local cultivar
Ambo (On-station)	2300	1.57	1.37	0.80
Wolmera	2400	2.02	1.46	1.25
Holetta (On-station)	2400	2.82	1.81	0.76
Bekoji Chefa	2600	2.61	1.18	0.90
Altufa	2725	0.73	0.87	0.67
Bekoji (On-station)	2780	4.84	2.97	2.19
Anokere I	2970	2.31	2.03	1.69
Anokere II	2970	1.47	1.72	1.12
Galessa I [a]	3000	2.10	1.02	1.67
Galessa II [a]	3000	1.11	*	1.35
Gaint (On-station)	3020	2.14	1.66	1.26
Gaint	3020	1.48	0.78	0.84
Mean		2.10	1.53	1.21

NOTE: Figures in bold indicate the best performing variety at each site
** = Complete crop failure due to severe water logging*
[a] = sites with severe water logging

5. Reaction to the Major Leaf Diseases and Quality Traits

The mean reactions of the varieties to the major foliar diseases of barley are as shown in Table 3. The resistance level of the new variety was better than the standard and the local checks for scald and leaf rust and comparable for net and spot blotch. The physical grain quality of HB 1307 is superior to the checks since its grains are white colored and heavier in hectoliter and thousand grain weight unlike the gray and light seeded standard and local checks (Table 3).

Table 3. Agronomic performance and disease scores of HB 1307 and the check varieties tested in food barley national variety trial through 2002 to 2004 averaged across 6 locations.

No.	Variety	DH	PH	BY	Lodging %	Sc	Nb	Sb	Lr [a]	HW	TGW
1	HB 1307	83	106	16.4	9	1	3	3	2 R	65.3	43.9
2	Dimtu	88	118	13.2	28	2	2	2	30 MR	64.7	41.2
3	Local check	84	114	14.0	40	2	3	2	47 S	62.8	38.1
	Mean	85	113	14.5	26	2	3	2	26	64.3	41.1

NOTE: DH=Days to heading, PH=Plant height (cm), BY = Biomas yield (t/ha), Sc=Scald (0-9), Nb = Net blotch (0-9), Sb = Spot blotch (0-9), Lr = Leaf rust (%), HW=Hectoliter weight (kg/hl), and TKW = Thousand kernel weight (g).
[a] = R=resistant, MR=moderately resistant, and S=susceptible

6. Conclusions

HB 1307 was superior in grain yield performance in most environments with satisfactory grain yield stability. It is more resistant to scald and leaf rust than the checks and comparable for net and spot blotches. It has better agronomic characteristics, particularly lodging tolerance with good biomass yields and moderate tolerance to water logging. The superiority of its physical grain quality compared to the standard and the local check was also among its important merits. Therefore, the cultivation of the new variety in mid-and high-altitudes of the major barley growing areas is strongly advised.

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8. References

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Appendix I. Description of variety HB 1307

1. Variety: HB 1307 (Cross number EH 1700/F_7.B1.63.70)
2. Agronomic and morphological characteristics
   - 2.1. Adaptation area: Highlands of Shewa, highlands of Arsi, Hosaina, South Gonder and Similar areas.
     - Altitude (m.a.s.l.): 2000 – 3000
     - Rainfall (mm): 700 – 1000
   - 2.2. Seed rate (kg/ha): 85 for drilling and 125 for broadcasting
   - 2.3. Planting date: Optimum dates for the different localities ranging from late May to end of June.
   - 2.4. Fertilizer rate (kg/ha):
     - ♦ N 46
     - ♦ P_2O_5 41
   - 2.5. Days to heading: 83
   - 2.6. Days to maturity: 137
   - 2.7. Plant height (cm): 106
   - 2.8. Growth habit: Intermediate
   - 2.9. 1000 seed weight (g): 43.9
   - 2.10. Test weight (kg/hl): 65.3
   - 2.11. Seed color: White
   - 2.12. Row type: 6
   - 2.13. Spike orientation: Drooping (at maturity)
   - 2.14. Glume appendage: Awnleted on all rows
   - 2.15. Glume awnlet length: Less than glume
   - 2.16. Glume awnlet texture: Rough
   - 2.17. Lemma awn texture: Rough
   - 2.18. Lemma awn size: Long
   - 2.19. Lodging tendency: Resistant
   - 2.20. Water logging tolerance: Moderate
   - 2.21. Crop pest reaction: Resistant to leaf rust and scald, and moderately resistant to net and spot blotches.
   - 2.22. Grain yield (t/ha):
     - ♦ Research field: 4.78
     - ♦ Farmers' field: 3.54
3. Year of release: 2006
4. Breeder/Maintainer: HARC/EIAR