

Registration of HB 1120 Food Barley (*Hordeum vulgare* L.) Variety for Upper High Altitude Areas of Ethiopia

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ABSTRACT

Eighteen food barley genotypes advanced from the local crossing program were evaluated to identify stable genotypes with high grain yield and good grain qualities. The experiment was conducted in a randomized complete block design with three replications at six environments during 2005-2007 cropping seasons. Analysis of variance depicted that HB 1120 demonstrated the highest mean yield potential with good agronomic performance across testing environments. Moreover, the variety was highly preferred and rated top score by farmers in the participatory variety evaluation. Accordingly, HB 1120 was released in 2012 and then demonstration and seed multiplication is underway. Therefore, cultivation of the new variety in the higher altitude areas of major barley growing environments of the country is highly recommended.

Keywords: Barely variety, grain yield, grain quality, genotypes

ORIGIN AND PEDIGREE

Barley is an old heritage with a large number of landraces and traditional practices in Ethiopia. For millennia it has been supplying the basic necessities of life for many farmers in the highlands and it has a long history of cultivation in the country (Zemedu, 2000). Currently, barley is the most important cereal crop with total area coverage of 993,918.89 hectares and total annual production of about 1.9 million tons in main season (CSA, 2015). According to Birhanu *et al.* (2005) barley is used in diversity of recipes and deep rooted in the culture of people's diets in Ethiopia. Despite the significance of barley as one of food security crops in the country, there are limited food barley varieties in the country. Moreover, majority of the released varieties were derived from landrace selection. On the other hand, yield potential study showed that promising genetic gain was realized in varieties developed from hybridization and comprehensive crossing activities are indispensable (Wondimu *et al.*, 2011). Accordingly, HB 1120 is a cross number EH 1493/F6.32H.3 which was

developed by the Holetta Agricultural Research Center from a cross between (W.Sasa/comp.29//W.Sasa/EH538).

White Sasa is a dominant landrace collected from, Tigray region; while the other parent (composite 29) was developed at Holetta during early 1970s. Cross number EH538 was derived from across between Kenya Research and EH8B.F4E.I.7.L while EH8B.F4E.I.7.L in turn was derived from a cross between Holetta mixed and Kenya Research.

2. Breeding Methodology

Bulk pedigree method was employed in which the segregating populations were bulk harvested and advanced during the main season and off-season using irrigation. The fifth filial generation plants were selected from space grown F₆ plants to develop pure line (Anderson, 1985).

3. Agronomic and Morphological Characteristics

Major morpho-agronomic attributes of HB 1120 food barley variety is illustrated in table 1, 2 and 3. Moreover, other characteristics of the variety were described in Appendix I.

Table 1: Mean value of morpho-agronomic traits of food barley variety trial across test environments (2005-2007)

| SN | Genotypes | DTH | DTM | PHT | TKW | HLW | GYLD |
|----|------------------|-------|--------|--------|-------|-------|---------|
| 1 | EH 1562/F6.49H.2 | 78.34 | 125.44 | 98.94 | 43.28 | 61.51 | 2823.40 |
| 2 | F2 SxS 117/99 | 84.81 | 134.88 | 101.24 | 40.07 | 62.32 | 3640.50 |
| 3 | EH 1516/F6.48H.3 | 90.56 | 138.16 | 109.32 | 42.99 | 60.07 | 3530.20 |
| 4 | EH 1493/F6.32H.3 | 86.34 | 134.59 | 98.85 | 38.98 | 64.06 | 4047.20 |
| 5 | EH 1553/F6.21H.1 | 80.19 | 129.91 | 109.39 | 42.00 | 62.55 | 3598.00 |
| 6 | Acc # 3674-1 | 88.25 | 134.19 | 97.44 | 39.33 | 58.63 | 3204.90 |
| 7 | 11 EMBSN 11/02 | 78.84 | 129.63 | 90.52 | 39.83 | 61.86 | 3458.90 |
| 8 | EH 1500/F6.17H.3 | 87.00 | 133.66 | 98.25 | 41.82 | 60.56 | 3390.40 |
| 9 | EH 1481/F6.1H.4 | 82.78 | 130.47 | 107.35 | 40.45 | 62.12 | 3297.80 |
| 10 | EH 1500/F6.17H.1 | 81.13 | 130.78 | 90.08 | 39.25 | 65.50 | 2749.20 |
| 11 | Tikur Demoye-3 | 85.81 | 132.78 | 96.44 | 37.78 | 62.42 | 3467.00 |
| 12 | BN6RIRR 01/42 | 82.81 | 132.72 | 87.61 | 39.92 | 59.49 | 3331.80 |
| 13 | Miscal-1 | 85.06 | 136.19 | 91.21 | 38.65 | 65.46 | 3046.80 |
| 14 | BN6RIRR 01/38 | 85.59 | 128.25 | 84.24 | 35.61 | 61.02 | 2989.20 |
| 15 | Acc # 019-2 | 87.47 | 136.19 | 100.53 | 43.72 | 61.19 | 3457.80 |
| 16 | Acc # 076-3 | 80.88 | 125.16 | 106.98 | 38.36 | 59.14 | 3268.60 |
| 17 | Acc # 225785-1 | 80.28 | 126.97 | 93.73 | 35.38 | 58.73 | 3090.80 |
| 18 | Acc # 073-2 | 88.59 | 135.09 | 111.43 | 40.47 | 62.09 | 3247.40 |
| 19 | Shege | 86.44 | 134.50 | 101.27 | 38.89 | 59.96 | 3339.90 |
| 20 | Local check | 85.88 | 132.44 | 105.73 | 41.36 | 61.59 | 3118.30 |
| | Mean | 84.35 | 132.09 | 99.03 | 39.91 | 61.5 | 3304.91 |
| | CV (%) | 4.42 | 2.68 | 6.93 | 9.85 | 4.37 | 21.43 |
| | LSD (5%) | 1.83 | 1.74 | 3.37 | 1.93 | 1.39 | 347.97 |

DTH= days to heading, DTM= Days to maturity, PHT= Plant height, GYPG= Grain yield kg/ha, TKW= 1000; Seed Weight, HLW= Hectoliter Weight. Cross number EH 1493/F6.32H.3 is labeled HB 1120 variety

Table 2: Mean grain yield performance of food barley variety trial at different testing environments (2005-2007)

| Genotype | Bekoji | | Holeta | | Bekoj | | Holeta | | Bekoji | | Holeta | |
|---------------|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|-------------|----|
| | 2005 | R | 2005 | R | 2006 | R | 2006 | R | 2007 | R | 2007 | R |
| EH 1562/F6.4 | 3927 | 18 | 3012 | 8 | 4517 | 20 | 1124 | 20 | 3234 | 20 | 2063 | 18 |
| F2 SxS 117/9 | 4511 | 12 | 3161 | 4 | 5914 | 2 | 3266 | 6 | 4995 | 2 | 2606 | 12 |
| EH 1516/F6.4 | 4400 | 13 | 2322 | 11 | 5535 | 9 | 3963 | 2 | 5080 | 1 | 2884 | 6 |
| EH 1493/F6.3 | 5652 | 1 | 3035 | 7 | 6478 | 1 | 4443 | 1 | 4714 | 6 | 3909 | 1 |
| EH 1553/F6.2 | 3935 | 17 | 3305 | 3 | 5197 | 12 | 3550 | 3 | 3790 | 17 | 3501 | 2 |
| Acc # 3674-1 | 5006 | 3 | 2076 | 14 | 5605 | 6 | 2954 | 10 | 4356 | 11 | 2841 | 7 |
| 11EMBSN11/02 | 4265 | 16 | 3102 | 6 | 5540 | 8 | 3156 | 7 | 4273 | 14 | 2801 | 9 |
| EH 1500/F6.1 | 4355 | 14 | 2495 | 10 | 5728 | 4 | 3464 | 4 | 3551 | 18 | 2378 | 15 |
| EH 1481/F6.1 | 3485 | 20 | 3377 | 2 | 5095 | 14 | 2465 | 15 | 3995 | 15 | 3443 | 3 |
| EH 1500/F6.1 | 5007 | 2 | 2933 | 9 | 4543 | 19 | 1239 | 19 | 3956 | 16 | 1201 | 20 |
| Tikur Demoy | 4303 | 15 | 2205 | 13 | 4976 | 17 | 3413 | 5 | 4733 | 4 | 3186 | 4 |
| BN6RIRR 01/4 | 4908 | 4 | 1491 | 19 | 5840 | 3 | 3149 | 8 | 4476 | 9 | 2639 | 11 |
| Miscal-21 | 4742 | 9 | 3143 | 5 | 5553 | 7 | 1853 | 18 | 4635 | 8 | 2211 | 16 |
| BN6RIRR 01/3 | 4752 | 8 | 3665 | 1 | 5191 | 13 | 2505 | 14 | 3353 | 19 | 1964 | 19 |
| Acc # 019-2 | 3836 | 19 | 1944 | 15 | 5330 | 11 | 3013 | 9 | 4664 | 7 | 3144 | 5 |
| Acc # 076-3 | 4757 | 7 | 1668 | 17 | 5032 | 16 | 2534 | 13 | 4930 | 3 | 2801 | 8 |
| Acc # 225785 | 4794 | 6 | 1422 | 20 | 5073 | 15 | 2046 | 17 | 4716 | 5 | 2546 | 13 |
| Acc # 073-2 | 4812 | 5 | 2315 | 12 | 5516 | 10 | 2591 | 11 | 4353 | 12 | 2136 | 17 |
| Shege | 4708 | 10 | 1514 | 18 | 5655 | 5 | 2556 | 12 | 4386 | 10 | 2694 | 10 |
| Local check | 4604 | 11 | 1768 | 16 | 4900 | 18 | 2391 | 16 | 4346 | 13 | 2461 | 14 |
| CV (%) | 15 | | 24 | | 10 | | 24 | | 12 | | 18 | |
| LSD | 985 | | 840 | | 742 | | 938 | | 756 | | 665 | |
| Mean | 4538 | | 2498 | | 5361 | | 2784 | | 4327 | | 2670 | |

R- Rank order of the genotypes in respective testing location. Cross number EH 1493/F6.32H.3 is labeled HB 1120 variety

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

Eighteen food barley genotypes along with two standard checks were evaluated at Holetta and Bekoji during 2005-2007 cropping seasons. Combined analysis of variance depicted that the candidate genotype HB 1120 (cross number EH 1493/F6.32H.3) gave 4047.20 kg ha⁻¹ with remarkable yield advantage of 707 kg (21%) and 929 kg (30%) over *Shege* and local cultivar respectively (Table 1). The candidate variety was among the top ranking genotype in grain yield potential across most of the testing environments (Bekoji 2005, Bekoji 2006, Holetta 2006 and Holetta 2007 (Table 2). Besides the yield potential performance, the candidate HB1120 variety demonstrated moderate tolerance to common leaf diseases (Table 3). Partitioning the GxE interaction effect based on a joint linear regression method (Eberhart and Russel, 1996) showed that the candidate HB 1120 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 3). Furthermore HB 1120 variety was included in the participatory plant breeding experiment at Robe Gebeya peasant association in Wolmera district. The selected sites represented the main cropping system/rotation for barley in the area i.e., potato field and fallow land. Group evaluation was conducted from seedling stage to maturity time and after threshing where farmers rated for different barley genotypes according to their own selection criteria. Farmers specifically emphasized on some important traits like early seedling vigor, tillering capacity, and stiff straw, intermediate maturity period and high bio-mass. Moreover, they associate spike size and row orientation with yield potential of the variety. Similarly kernel color, kernel plumpness, '*Injera*' and '*Tela*' making qualities were among important traits of focus for participant farmers. Accordingly, HB1120 was one of the top varieties that received the best score by farmers during participatory evaluation (Table 4).

Table 3: Regressions of Grain Yield in t/ha for each Variety on Means of GYTH at Each Site

| SN | Variety | \bar{x} | b | Se | S_{ij}^2 | NB | SC | SB |
|----|---------------------|-------------|-------------|-------------|-------------|------------|------------|------------|
| 1 | EH 1562/F6.4 | 2.82 | 0.74 | 0.23 | 0.61 | 3.6 | 5.5 | 1.0 |
| 2 | F2 SxS 117/9 | 3.64 | 1.08 | 0.11 | 0.13 | 3.5 | 5.2 | 4.8 |
| 3 | EH 1516/F6.4 | 3.53 | 1.01 | 0.18 | 0.37 | 3.1 | 4.3 | 3.3 |
| 4 | EH 1493/F6.3 | 4.05 | 1.18 | 0.19 | 0.41 | 3.6 | 4.5 | 3.7 |
| 5 | EH 1553/F6.2 | 3.6 | 0.57* | 0.1 | 0.12 | 3.9 | 3.2 | 4.2 |
| 6 | Acc # 3674-1 | 3.2 | 1.24 | 0.13 | 0.19 | 3.9 | 6.0 | 2.9 |
| 7 | 11 EMBSN 11/ | 3.46 | 0.91 | 0.08 | 0.07 | 4.4 | 5.0 | 3.8 |
| 8 | EH 1500/F6.1 | 3.39 | 0.87 | 0.15 | 0.24 | 4.0 | 5.5 | 2.9 |
| 9 | EH 1481/F6.1 | 3.3 | 0.69 | 0.16 | 0.28 | 3.5 | 5.5 | 2.4 |
| 10 | EH 1500/F6.1 | 2.75 | 1.08 | 0.25 | 0.69 | 4.9 | 5.5 | 4.2 |
| 11 | Tikur Demoy | 3.47 | 0.83 | 0.11 | 0.13 | 4.1 | 5.6 | 3.1 |
| 12 | BN6RIRR 01/4 | 3.33 | 1.21 | 0.13 | 0.18 | 4.0 | 5.5 | 2.9 |
| 13 | Miscal-21 | 3.05 | 1.32 | 0.17 | 0.34 | 4.2 | 4.4 | 4.6 |
| 14 | BN6RIRR 01/3 | 2.99 | 1.06 | 0.24 | 0.62 | 4.4 | 5.2 | 2.6 |
| 15 | Acc # 019-2 | 3.46 | 0.82 | 0.17 | 0.32 | 4.1 | 5.8 | 2.3 |
| 16 | Acc # 076-3 | 3.27 | 1.07 | 0.14 | 0.21 | 4.6 | 6.3 | 3.3 |
| 17 | Acc # 225785 | 3.09 | 1.13 | 0.15 | 0.27 | 5.0 | 5.6 | 1.0 |
| 18 | Acc # 073-2 | 3.25 | 1.1 | 0.07 | 0.06 | 3.8 | 6.4 | 3.2 |
| 19 | Shege | 3.34 | 1.11 | 0.19 | 0.39 | 4.3 | 5.7 | 3.0 |
| 20 | Local check | 3.12 | 0.98 | 0.1 | 0.12 | 4.4 | 6.1 | 2.6 |

Slope (b) - slopes of regressions of variety means on site index.* indicates slopes significantly different from the slope for the overall regression which is 1.00. Ms-dev - deviations from regression component of interaction. NB- net blotch, SC- Scald, SB Spot blotch sore 0-9 scale; Cross number EH 1493/F6.32H.3 is labeled HB 1120 variety.

Table 4: Participatory variety selection identified ten varieties with the highest farmers' score in each of the two locations where farmers did the selection

| Potato Field (Farm 1) | Score (1-3 scale) | Fallow field(Farm 2) | Score (1-3 scale) |
|--------------------------|-------------------|----------------------|-------------------|
| HB1307 | 2.89 | HB1307 | 2.55 |
| EH 1493/F6.32H.3 | 2.67 | EH 1493/F6.32H.3 | 2.24 |
| P.STO/3/LBIRAN/UNA80/.. | 2.66 | Agele IV | 2.23 |
| IBON174/03 | 2.65 | Guta | 2.23 |
| Guta | 2.62 | Alidoro | 2.23 |
| Mezezo | 2.62 | Lukaa | 2.23 |
| Misratch | 2.59 | Wuchu-Guraghie | 2.23 |
| FORRAJERA KLEIN/CANTUA.. | 2.59 | Baleme | 2.22 |
| CABUYA/CHAMICO | 2.59 | CABUYA/CHAMICO | 2.21 |
| Cross41/98 | 2.59 | Temej | 2.21 |

Farmers score: 1= poor and 3= very good

CONCLUSION

HB1120 is the best variety identified by farmers in the participatory evaluation trial and also superior in grain yield performance in the multi-location trials across the testing environments with good quality attribute and yield stability. It has

better agronomic performance with moderate tolerance to leaf diseases as compared to the standard checks. Hence, cultivation of the new variety is recommended in major barley growing areas of the country having similar climatic conditions with the testing sites.

and local knowledge. Proceedings of the international workshop on food barley improvement, 14- 17. January

ACKNOWLEDGMENT

The authors are grateful to Ethiopian Institute of Agricultural Research and barley research team of the respective testing centers for provision of facilities, implementation of the experiment and data collection. Moreover, authors extend special gratitude to Mr Seid Ahimed for his diligent barley crossing ingenuity and trial data management.

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Appendix: I Description of HB 1120 Food Barley Variety

Variety Name: HB 1120 (Cross number EH 1493/F6.32H.3)

Agronomic and Morphological Characteristics

Adaptation Area: Highland of Shewa, Arsi and similar areas

Altitude (m.a.s.l.): 2300-3000

Rainfall (mm): >700

Sowing date: Mid June to Early July

Seed Rate (kg/ha): 125

Fertilizer Rate: 41/46 kg ha⁻¹ N/P₂O₅

Days to Heading: 86

Days to Maturity: 135

Plant Height (cm): 99

Row Number: Six

Growth Habit: Erect

Stem Pigmentation: Green

Auricle pigmentation: Green

Spike Density: Intermediate

Lemma awn barbs: Intermediate