



Research Article

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# Performance Evaluation and Adaptability of Food Barely (*Hordeum vulgare L.*) in the Highlands of Eastern Hararghe



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## Abstract

Ten released Food barley varieties with one local check were tested at two sites in randomized complete block design with three replications during 2014/15 cropping season. The experiment was carried out to test the adaptability of improved food barley varieties and select the best high yielding variety/ies for the target area. The varieties used as treatments were (Guta, Harbu, Abdane, Dimtu, Shage, HB-1307, Biftu, Dafo, Dinsho and Ardu) along with one local check were evaluated at Kurfa chale and Kersa highlands of Eastern Hararghe. The Analysis of variance revealed that highly significant difference ( $P < 0.01$ ) for days to maturity, plant height, spike length and grain yield at both locations where as, significant difference ( $P < 0.05$ ) were observed at Kersa. The mean grain yield of HB-1107, Guta and Harbu were better by 35.2%, 24%, 3.1% and 38.4%, 19.3%, 10.4% grain yield over local check at both Kurfa chale and Kersa, respectively. Similarly, the mean grain yield of Ardu 24.4% grain yield advantage over the local check at Kersa. In addition 0% lodging was observed for HB-1307 at both locations which can be considered as good trait. Moreover, HB-1307 has showed better grain yield than other varieties in addition to lodging resistant which might be suitable agro-ecology for this variety. Overall, improved variety (HB-1307) was found superior over all other varieties tested including the local variety for its grain yield on both locations. Thus, this HB-1307 variety is recommended to demonstrate with production packages in Kurfa Chale and Kersa and similar agro ecologies.

**Keywords:** Adaptability food barley; Grain yield and variety; Soil erosion; Morphological types, Genetic races; Agro-ecology

## Introduction

Barley belongs to the genus *Hordeum L.* in the tribe Triticale of the family Poaceae. Barley is thought to have originated in the Fertile Crescent area of the Near East from the wild progenitor *Hordeum spontaneum*. Food barley is commonly cultivated in stressed areas where soil erosion, occasional drought or frost limits the ability to grow other crops [1]. The crop is now grown worldwide with greater concentration in temperate areas and high altitudes of tropics and subtropics. The greatest diversity of barley in terms of morphological types, genetic races, disease resistant lines and endemic morph types exists in Ethiopia.

Barley is one of the most important staple food crops in the highlands of Ethiopia. It has great importance in social and food habit of the people. The major barley producing regions are Oromia, Amhara, Tigray, Southern Nations and Nationalities which account for about 99.5 % of the total annual barley production. Even though, Ethiopia has a wide range of favorable agro-ecology for cultivating

Food Barley its production is gradually limited to a few localities of western and southern highlands of Oromia. But still there are some localities which have the potential for producing the crop in the country. Among suitable areas for producing Food barley Eastern Hararghe highlands has the potential. This indicates that there are some localities which are not fully addressed to satisfy the need for maximizing yield, using high yielder, disease resistant and early maturing variety of the crop.

Food barley is fourth important crop in eastern Hararghe followed by maize, sorghum and wheat in terms of number of households (101,994) producing and fifth important crop in terms of area coverage (6,431.46 ha) followed by sorghum, maize, wheat and tef. However, productivity of food barley in eastern Hararghe is low 20.29 quintal/ha compared to regional average of Oromia 21.73 quintal/ha [2]. So far, no efforts have been made in promoting newly released food barley in eastern Hararghe even though there is great potential in the highlands of the zone. Identification of

adaptable variety minimizes the magnitude of scale or rank shift of their performance across or specific environment [3-5]. Hence, it is important to adapt these medium to early maturing maize varieties to the study area. Thus, the present study was conducted to compare the performance of released food barely varieties for their adaptability and to recommend a suitable one for farmers of eastern Hararghe of Ethiopia and similar agro-ecologies.

## Materials and Methods

### Experimental materials and design

The experiment was conducted during 2014/15 main cropping season in highlands of Eastern Hararghe namely, Kurfa chale and Kersa districts. Ten improved food barley varieties released from agricultural research centers in the country were collected and evaluated. The varieties are namely Guta, Harbu, Abdane, Dimtu, Shage, HB-1307, Biftu, Dafo, Dinsho and Ardu and one local check were evaluated. The trial was laid down in RCBD design with two sites as replication and each treatment receiving the same management. Each variety was planted in three replications and with plot size of 2m x 3m.

The food barley seeds were drilled in a 3-4cm depth with spacing of 0.2m between rows. These genotypes were randomly assigned to each plot separated by 1m blocks and 0.5m between plots. Hundred kg ha<sup>-1</sup> Urea and DAP (Di Ammonium Phosphate) were used as a source of Nitrogen and Phosphorous respectively. Half of the urea fertilizer and the whole DAP were applied at the time of planting while the remaining Urea was applied after four weeks of emergence.

**Table 1:** The mean squares for different sources of variation and the corresponding CV (%) for 5 characters studied at Kurfa chale, in 2014/15 cropping season.

S.V	DF	DM	PH	SL	SPS	GY
Rep	2	0.2121	7.46	0.2666	3.39	6.38
Variety	10	84.5394**	82.01**	6.9962**	50.99NS	165.17**
Error	20	0.3121	19.77	0.3481	38.96	14.71
<b>Total</b>	<b>32</b>					
LSD (P <0.05)		0.9515	7.573	1.005	NS	6.533
CV (%)		0.8	4.6	8.3	13.4	13.7

S.V= Source of variation; DF= Degree of freedom DM= Days to 50% Maturity; PH= Plant Height; SL= Spike length, SPS= Seed per spike; GY= Grain yield kg/ha.

**Table 2:** The mean squares for different sources of variation and the corresponding CV (%) for 5 characters studied at Kersa, in 2014/15 cropping season.

S.V	DF	DM	PH	SL	SPS	GY
Rep	2	0.576	19.41	0.13604	104.12	6.38
Variety	10	121.824**	271.67**	1.63053**	162.36*	165.17**
Error	20	1.942	38.56	0.02732	63.32	14.71
<b>Total</b>	<b>32</b>					
LSD (P <0.05)		2.374	11.296	0.301	13.55	6.533
CV (%)		1.6	6.2	2.6	19.5	13.7

S.V= Source of variation; DF= Degree of freedom; DM= Days to 50% Maturity; PH= Plant Height; SL=Spike length; SPS= Seed per spike; GY= Grain yield kg/ha.

### Data collection

Data collected during the growing season were days to 50% maturity, plant height (cm), spike length (cm), seed per spike and grain yield (kg ha<sup>-1</sup>). Data collected on individual plant basis from five randomly selected plants were, plant height (cm), spike length (cm) and seed per spike. The randomly selected plants were carefully uprooted at physiological maturity to measure growth parameters. Data collected on plot basis were logging %, days to maturity and grain yield (kg ha<sup>-1</sup>).

### Statistical data analysis

Analysis of variance for the design was carried out using SAS 9.0 software for the parameters studied following the standard procedures outlined by [6]. The level of significance used in 'F' and 't' test was P =0.05. When the treatment effects were found to be significant, the means were separated using the Fisher's protected least significant test was P = 0.05.

### Results and Discussion

The Analysis of variance revealed that highly significant difference (P < 0.01) for days to maturity, plant height, spike length and grain yield at both locations whereas, significant difference (P < 0.05) were observed at Kersa and non-significant difference were observed for seed per spike at Kurfa chale during the study (Table 1 & 2). Even though there were no significant differences for number of seeds per spike obtained at (P < 0.05) at Kurfa chale, there was a slight numerical difference between them. Generally, the variation observed among varieties for the studied parameters are might be due to genetic variation.

The results revealed that the tallest plant height was obtained by Shage measuring 109.07cm followed by Dimtu, local, HB-1307 and Harbu variety with 100.89, 100.84, 99.34 and 98.64cm respectively and the shortest plant height obtained were 89.17, 93.56 and 93.63cm from Dinsho, Biftu and Ardu varieties at Kurfa chale respectively (Table 3). On the other hand, variety Ardu and HB-1307 was the longest and Abdane and Dafo was the

shortest in terms of height measuring 120, 108.5 and 86.3, 88.5cm respectively, as compared tested varieties at Kersa (Table 3). Earliest days to 50% maturity were recorded on Dinsho and Biftu varieties with 66 days, at Kurfa chale and 76.67 and 81.33 days for Dinsho and Dafo varieties at Kersa respectively, while latest days to 50% maturity were recorded on Ardu varieties at both locations taking 100 and 81.67 days at Kersa and Kurfa chale respectively.

**Table 3:** Mean comparison of grain yield and other parameters of highland food barley at both location Variety Kurfa Chale and Kersa.

Varieties	Location									
	Kurfa Chale					Kersa				
	DM	PH	SL	SPS	GY	DM	PH	SL	SPS	GY
Dinsho	66f	89.17c	8.7a	49	1825.6ef	76.67g	96.2cde	6.282d	33.67cd	1584f
Shage	81a	109.07a	6.8b	45.7	2082.1e	92c	97.6cde	4.933f	36.33bcd	2300de
Guta	71.67c	98.03b	8.9a	51	3646.2b	87.67e	104.5bc	6.583c	30d	3304bc
Dimtu	76b	100.89b	8.3a	46.3	2112.8e	96.33b	102.3bc	6.1de	37bcd	2561de
Dafo	71cd	94.87bc	8.3a	38	1518.0f	81.33f	88.5de	6.9ab	35.67cd	2068ef
Abdane	70e	95.22bc	6.0bc	47	2312.8de	90.33cd	86.3e	7.1a	44.67abc	2831cd
Harbu	70.67de	98.64b	6.7b	48.7	2835.9c	87e	105.3bc	5.883e	47abc	2918bcd
HB-1307	76b	99.34b	8.8a	53.7	4241.0a	91cd	108.5b	7.1a	54a	4328.5a
Ardu	81.67a	93.63bc	5.0c	43.3	2661.5cd	100a	120.8a	6.733bc	49.33ab	3536.6b
Biftu	66f	93.56bc	5.6c	45.7	2553.9cd	89.33de	100.0bc	6.15de	43.33abcd	2667cde
Local	70.33de	100.84b	5.2c	44.3	2748.7c	89de	97.8bcd	5.1f	38.33bcd	2667cde
CV%	0.8	4.6	8.3	13.4	1.6	8.4	6.2	2.6	19.5	13.7
LSD (0.05)	0.9515	7.573	1.005	NS	371.08	2.374	11.296	0.301	13.55	6.533

\*p<0.05 and NS =not significant; DM= Days to 50% maturity; PH= Plant height; SL= Spike length; SPS= Number of Seed per spike; GY= Grain Yield kg per hectore.

On the other hand, longest spike length was recorded on Guta, HB-1307, Dinsho, Dimtu and Dafo measuring 8.9,8.8, 8.7, 8.3 and 8.3cm respectively while shorter spike length recorded were 5, 5.2 and 5.6cm from Ardu, Local and Biftu respectively at Kurfa chale. In contrary, 7.1, 7.1 and 6.9cm of spike length were obtained from HB-1307, Abdane and Dafo as highest value and 4.9, 5.1 and 5.8cm as shortest spike length respectively at Kersa (Table 3). At the mean time although, seed per spike were not-significant highest and lowest number of seed per spike were counted from HB-1307 (53.7) and Dafo (38) at Kurfa chale. However, again the highest seed per spike were obtained from HB-1307 (54) during the study.

In the same way highest grain yield were obtained from HB-1307 at both locations giving 4241 and 4328.5kg ha<sup>-1</sup> at Kurfa chale and Kersa respectively, as also reported by [7]. The second-best variety were Guta and Ardu at Kurfa chale and Kersa yielding 3646.2 and 3536.6kg ha<sup>-1</sup> respectively while the lowest yield was recorded from Dafo (1518kg ha<sup>-1</sup>) and Dinsho (1825.6kg ha<sup>-1</sup>) at Kurfa chale and variety Dinsho (1584kg ha<sup>-1</sup>) and Dafo (2068kg ha<sup>-1</sup>) at Kersa during the study (Table 3).

Generally, the mean grain yield of HB-1307, Guta and Harbu gave 35.2%, 24%, 3.1% and 38.4%, 19.3%, 10.4% grain yield advantage over the local check at both Kurfa chale and Kersa, respectively. Similarly, the mean grain yield of Ardu gave 24.4% higher grain yield advantage over the local check at Kersa. Along

food barley varieties tested HB-1307, Guta and Harbu were performed well in terms of yield and other agronomic parameters.

This result is in line with Sinana Agricultural Research Center (SARC) which reported potential yield for Shage variety were 2.1-5.1ton ha<sup>-1</sup> grain during the release of the variety [8], and 3.37ton ha<sup>-1</sup> were reported by [7]. Similarly, 2.3-4, 3.6-6.3 and 4.8ton ha<sup>-1</sup> grain yield potential was reported for Dimtu, Ardu and HB- 1307 respectively [9,10]. However, this result varies from the study conducted by [11], in Bale highlands which reported 2.3ton ha<sup>-1</sup> which is a little bit lower compared to this finding which might be suitable environment for the variety in the study area.

This might be variation between the two environments. Food barley varieties used in the present study had diverse genetic composition and as a consequence produced results in the parameters studied. Overall, the variation in plant height, days to maturity, spike length, seed per spike and grain yield observed were due to differences among the variety. However, the variation observed in the parameters studied compared to other location is environmental. Tahir et al. [12], reported that plant height is genetically as well as environmental controlled factor; however, the selection of proper crop cultivar manages the influence of environment.

Additionally, logging percentage were considered as a criteria along with other agronomic yield and yield related traits to

select best suitable variety/ies for the areas and were scored in percentage (Table 4). As clearly illustrated in the table 0% logging were observed for HB-1307 at both location which can be considered as good trait and make this variety more preferable.

Moreover, HB-1307 has showed better grain yield than other varieties in addition to logging resistant which might be suitable

agro-ecology for this variety. Additionally, 0% was seen for Dimtu and Shage at Kersa, although 50% logging were scored for both varieties at Kurfa chale (Table 4). Overall, 100% logging were scored from Dinsho, Dafo and Biftu at Kurfa chale and variety Harbu at Kersa. The variation observed between varieties over location might be due to soil type difference, environment and varietal response over environment.

**Table 4:** Mean score of logging percentage of highland food barley tested at both location during 2014/15 season.

Site	Variety										
	Guta	Abdane	Shage	Ardu	Dimtu	Local	Dinsho	HB-1307	Harbu	Dafo	Biftu
K/chale	90	85	50	50	50	75	100	0	85	100	100
Kersa	50	50	0	50	0	50	50	0	100	50	85

### Summary and Conclusion

The experiment was conducted in 2014/15 main cropping season at two locations of Kurfa chale and Kersa districts to select food barley varieties that have a good performance in terms of yield and other different parameters to the area. Overall, improved variety (HB-1307) was found superior over all other varieties tested including the local variety for its grain yield on both locations. Thus, this variety is recommended for production at Kurfa chale, Kersa and similar agro ecologies of eastern Hararghe.


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