Morphological Variation in Ethiopian Barley Germplasm (*Hordeum vulgare* L.)

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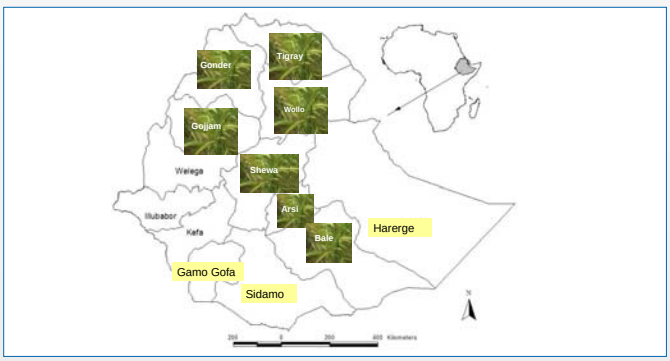
Introduction

Barley (*Hordeum vulgare* L.) is one of the oldest cultivated crops and has been grown in Ethiopia for at least 5000 years. According to Asfaw (1988) some morphotypes, which were reported by Orlov 1929s to occur in abundance in a given region or locality were either never encountered or found only in a rare mixture. It can be cultivated at altitudes between 1500 and 3500m, but is predominantly grown between altitudes of 2000m and 3000m (Lakew et al., 1996).

The objectives of this study were to assess the extent of morphological variation in barley accessions in respect to regions and altitude of collection, to classify the accessions into relatively homogenous groups and to identify the major traits contributing to the overall genetic diversity of the germplasm and thereby to identify sites with high allelic variation for in-situ conservation.

Fig 1. Map of Ethiopia showing 10 regions from which 199 barley accessions were collected



Materials and Methods

A total of 200 barley landraces collected from 10 administrative regions of Ethiopia and four released cultivars were evaluated for 10 agronomic traits using Augmented design with four blocks. The trial was conducted at Holeta and Bekoji Agricultural Research Centers of Ethiopia in the main cropping season of 2006. All Statistical analyses were conducted using SAS software. Data were analyzed by restricted maximum likelihood (REML) to fit a mixed model with checks and experimental sites as a fixed effect and unreplicated entries as random effects, which produced best linear unbiased predictors (BLUPs) for further analysis.

Fig 2. Phenotypic variation in days to heading and maturity

Result and Discussion

Current study detected high morphological variation for regions and different altitude classes based on quantitative characters. Significant variation observed in an altitude class II and III (Table 1), which includes the major barley growing areas in the country. This variation attributed to mixed farming system, which is typically found in areas of higher elevation usually above 2,000 meter a.s.l. Crop production under this farming system is diverse for food and as a source of cash income. It is highly varied being influenced by diversified agro-climates, and diverse social and cultural nature of the people.

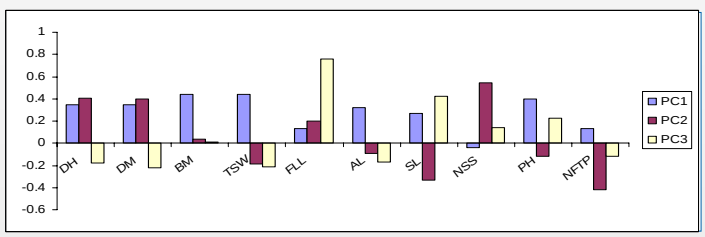
Since the administrative regions are political sub-divisions and not based on ecological aspects there was no variation among them. The presence of ample genetic diversity within each region indicated the importance of each region for future germplasm collection.

Table 1. Error variance estimates of altitude classes and Regions of collection

Traits	Altitude classes				Regions									
	I	II	III	IV	Arsi	Bale	Gamo	Gojjam	Gonder	Hareege	Shewa	Sidamo	Tigray	Wollo
DH	5.63**	3.78**	6.16**	8.87**	6.73**	2.67**	2.38**	4.19**	8.28**	4.11*	10.86**	6.04**	5.04**	6.50**
DM	4.76**	4.62**	9.15**	26.11	16.33*	3.26**	7.22	3.17**	19.55**	1.75*	21.47*	4.45**	5.19	7.70**
BM (g)	38906	32201**	44957**	21499*	49588*	28054	21958**	36830	23814**	44776	53896	34418*	50983	41957
TSW (g)	5.76**	19.24**	10.28**	8.84**	6.82**	14.23	10.51**	20.42	33.75	17.98	14.82**	15.89**	8.13**	4.77**
FLL(cm)	1.09	0.96**	1.1**	0.86	0.93**	0.84	1.07	1.39	1.38**	0.99	0.78	1.07	1.08	1.08
AL (cm)	0.23*	0.25**	0.19**	0.16*	0.22**	0.28	0.20*	0.15	0.15	0.17	0.12**	0.45**	0.08*	0.27*
SL (cm)	0.42**	0.23**	0.27**	0.16**	0.19**	0.25**	0.15**	0.22	0.44	0.36	0.22**	0.37**	0.21	0.21*
NSS	16.34**	15.08**	10.39**	18.18**	19.92	14.87**	25.85**	4.55*	20.20**	17.00**	14.22**	22.81**	2.01**	23.87*
PH (cm)	10.27**	14.11**	24.04**	19.53	16.58	9.53	23.86	28.88	19.92	14.33	32.63	9.80**	12.5	21.09
NFTP	0.34	0.31*	0.28**	0.23	0.25	0.36	0.21	0.43	0.42	0.33	0.35*	0.24*	0.39	0.31

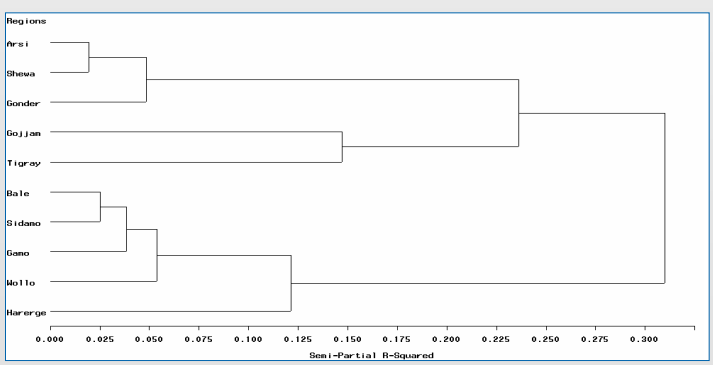
The concentration of some morphological traits at high or low altitudes and in different sites could result from farmer selection of morphotypes based on their selection criteria to the prevailing climatic and edaphic conditions.

Fig 3. Total variance explained by the first three PCs for 199 accessions



The first three principal components contributed 71.4%(see Fig 3.) of the total variance for 199 accessions, which confirmed diversity since the entire variation can not be explained in terms of few PCs. This, in turn indicates the involvement of a number of traits in contributing towards the overall observed diversity. The well adapted traits like days to heading, days to maturity, biomass, plant height and thousand seed weight, played a role in differentiating accessions collected from different regions in to principal components.

Fig 4. Clustring of 10 Regions based on 10 quantitative traits



Grouping accessions into morphologically similar cluster of different groups resulted into seven clusters, which are useful for selecting parents for crossing. Clustering of accessions based on the agronomic traits under study revealed no distinct regional grouping patterns. While clustering of regions resulted in five relatively homogeneous groups (Fig.4). In general results obtained from analysis of regions of origin and different altitude classes showed wide variation in regions of high altitude, humid and cooler temperature.

Generally presence of substantial variation in the barley germplasm indicated possibility of selection response in these traits. The structure of morphological variation in Ethiopian barley landraces strongly influenced by environmental factors so that the degree of variation of characters differ with regions and altitudes from where the accessions collected.

Literature

Asfaw Z. (1988). Variation in the morphology of the spike within Ethiopian barley (*Hordeum vulgare* L.) (poaceae). Acta Agric. Scand. 38: 277-288.

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