International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2018; 6 (3):701-706
ISSN:2320-7817(p) | 2320-964X(o)

Original Article Open Access

Evaluating Adaptability of nationally Released food barley varieties 2013/14

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Manuscript details:

Received : 21.12.2017
Accepted : 27.07.2018
Published : 23.08.2018

Editor: Dr. Arvind Chavhan

Cite this article as:
Atzeb Hailu and Teka Solomon (2018) Evaluating Adaptability of nationally Released food barley varieties 2013/14, *Int. J. of Life Sciences*, Volume 6(3): 701-706.

Available online on
http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

Evaluating Adaptability of nationally Released food barley varieties with the objective of improved the production and productivity of food barley there by contribute to the improvement of household food security and farm income of the small holder farmers through the selection of well adapted varieties .varieties were tested ABAY, BASSO, BIFTU, DAFO, DINHO, DRIBIE, MEZEZO, MISRATCH, MULU, SAE'SAE, SETEGN and TILA .The trial were conducted five districts of eastern and south eastern zone of Tigray viz Gulomekeda (eastern), Atsbi-wonberat (eastern), Dugua Tebien (south eastern), Enderta (south eastern) Hintalowajera (south eastern).The design was conducted randomized complete block design with three replication. All parameters exhibited significant difference among the varieties. The correlation coefficient of grain yield with biomass yield, harvest index and plant height highly correlated ,moderately with spike length and seeds per spike and weakly correlated with days to heading, days to maturity and 1000 seed weight.

Key words: Environment, genotype, interaction and grain yield

INTRODUCTION

Currently, in Ethiopia 948, 107.ha^{-1} of land was covered by both food and malt barley and 15,852,869.21 quintals were produced at national level.in Tigray, for 2011/12 Meher season barley production was 1,640,038.91 quintals produced from 99,453.31 hectares of land. Ethiopia is a country renowned for the diversity of its native barley types and is recognized internationally to harbor valuable barley genetic resources (Fetien *et al*., 2008). The crop is the fifth most important crop in Ethiopia after teff, maize, wheat and sorghum. It is also the fourth most essential crop in Tigray next to sorghum, teff and wheat (CSA, 2012). The regional average yield for barley is still much below the national average (CSA, 2012).The most important factors that reduce yield of barley in Ethiopia are low-yield capacity of farmers' varieties (landraces) and an inadequate number of improved varieties adapted to the different production systems and varied agro-ecological zones (Alemayehu, 2003), poor agronomic practices, poor soil fertility, low soil pH, drought, water logging and frost.

Tigray is a region characterized by an erratic rainfall and where heavy rain alternates with dry periods resulting in alternating floods and dry periods. The region receives the least rainfall compared to other parts of Ethiopia. the average annual rainfall for the period from 1961 to 1987 was 571 mm, which was 38% less than the national average (921mm) for the same period (webb and Braun, 1994).the annual rainfall shows a high degree of variation ranging from 20% in the western to 49% in the eastern parts of Tigray (COSAERT, 1994).Moreover, agro-ecological characteristic of the specific study site look at Table1.

Barley is a main food crop in the highlands and marginal areas of Tigray where other cereals cannot grow, as well as animal feed and forage around the world. Barley plays an important role in ensuring food security, as it requires relatively low input. Its yield stability is far better than other cereals, making it a dependable source of food in bad seasons (Berhane et al., 1996).

Therefore, food barley varieties of early set and high yielding which were released nationally could answer the problem of low yielding barley landraces that worsen food insecurity besides low rainfall. The performance of these varieties were tested at Mekelle agricultural Research center testing site and found were well adaptive and better in performed .the objective of improved the production and productivity of food barley there by contribute to the improvement of household food security and farm income of the small holder farmers.

METHODOLOGY

Twelve food barley varieties ABAY, BASSO, BIFTU, DAFO, DINHO, DRIBIE, MEZEZO, MISRATCH, MULU, SAE'SAE, SETEGN and TILA were tested at variety tested FTC and on station in five districts for each districts one FTC viz at Dugua Tembien(Anmberkeke FTC),Atsbi wenberta(Dera FTC), Gulomekeda (Ambeset fekada Shewitlemlem and FTC), Hintlo-wajerat(H/slam and Ara FTC) and Quiha center on station located contrasting soils and climatic zones during the period 2014 t0 2015 (2006 to2007 E.C.).At each location,12 varieties included local landrace for compassion were planted 3m^2 test plots (1.2mX2.5m) using randomized complete block design with three replications. The seed rate for all varieties was 80kg/ha .Fertilizer application was used blanket recommendation of 100kg/ha DAP (basal application) at planting and 50kg/ha Urea split application. Planting was done by hand drilling and weed was a implemented hand weeding twice at vegetative and booting stages.an analysis of variance was done for the combined analyses of variance across the test environment location and years.

The data were collected: phonological data days to heading and days to maturity, growth parameter plant height and spike length, yield parameter biomass yield grain yield, 1000 seed weight, harvest index and farmers opinion . A combined ANOVA analysis was conducted using SAS software (Version 9.0) and Genstat software 16edition.

Table1: Description of the 5 locations used for evaluation of 12 food barley varieties included landrace

Testing location	AEZ	Geographical position		Altitude (m.a.s.l)	Annual Rainfall (mm)	Annual Temperature(°c)	
		latitude	longitude			Mini.	Max.
Atsbi-wemberta	SM2	13°52'N	39°44'E	2630	550	10°C	24°C
Quiha	SM1	13°30'N	39°29'E	2160	612	15.4°C	20.4°C
Gulo-mekeda	SM2-S	14°28'N	39°14'E	2180	552	7.72°C	24.14°C
Dugua Tembien	SM2-S	13°40''03.55'N	39°14''21.92'N	2412	884.6	8.7 °C	25.1 °C
Hintalo-wajerat	SM2	13°25'N	39°52'E	2200	578	10.34°C	24.7°C

Source: Abbadi (2008a.b) and New Loclim soil water (version)

RESULTS AND DISCUSSIONS

The analysis of variance released significant difference among the varieties days to heading, days to maturity, Plant Height (cm), Spike length (cm) seeds per spikes, 1000 seed weight (gm), Biomass yield (qt/ha**),** Grain yield (qt/ha) and Harvest index (Table2).

The result for phenological characteristic of the food barley varieties is presented in Table 2,The analysis of variance for days to 50% heading revealed highly significant effects (P<0.001). The overall mean for days to heading showed that Tila (62 days). Variety Abay on the other took longest days for heading (76 days) (Table 2). The days to 90% maturity also illustrated significant

differences among the varieties an average of 103 days and 114 days (Table2). Days to maturity ranged from 103 days for Sae'sae, Tila and Mulu to 114 days for Abay. According the study of *Bayeh Mulatu and Berhane Lakew(2011)* early cultivars is grown that require 3.5–4 months to mature. This variation in maturity is brought due to genetic variation. Therefore present study results laid the range of literature mentioned.

Crop growth and yield component

Biomass yield (gm) per plant

The analysis of variance for biomass yield revealed significant difference among the varieties (Table2), biomass yield ranged from 44.167 quintal per hectare (Mezezo) to 53.056quintal per hectare (Abay).

Plant height (cm)

The analysis variance exhibited highly significant difference among varieties (P<0.01). The mean length ranged between 63.114cm (Mezezo) to 78.101cm (Dribie). Plant height is strongly correlated with grain yield and significant (P <0.001) (Appendix c). OGTR (2008) stated that barley is annual grass that stands 60-120cm tall. Other study stated that plant height range between landrace populations was 52.0–113.0 cm at Holetta and 54.6–114.8 cm at Sheno (Berhane and Alemayehu, 2011). This research result laid down between the pervious studied outcomes.

Spike length (cm)

The analysis of variance for spike length revealed significant difference among varieties. The average spike length was 6.01cm, with a range 5.45cm (Biftu) to 6.56cm (Dribie). Spike length is positively and significantly correlated with grain yield (P <0.001) (Appendix C). According to Shafi *et al.* (2011) studied results indicated that lengthy spikes (18.25 cm) was produced by the application of 60 kg N per hectare, The present results of spike length was smaller than the literature indicated in both locations.

Harvest Index (HI)

The analysis of variance for harvest index revealed highly significant differences among varieties (Table2). Since, the percentage of harvest index ranged from 26 %(Abay) to 33 %(Sae'sae). Similar study was reported by Savin et al. (2012) indicated that harvest index for barley is similar or only slightly lower than for wheat, and ranges from 45 to 50% for modern cultivars under favourable conditions. The present study is therefore in not agreement to the above study.

Grain yield (qt/ha)

Result of each location at Atsbi testing site the first year results not revealed significant difference among the varieties the yield was recorded the range of 22 quintal per hectare (Sae'sae) to 34.1 quintal per hectare (Abay). Second year results very low compared t0 first year by the reason of late starting of rain fall yield recorded ranged 3.8 quintal per hectare (Setegn) to 11.6 quintal per hectare (Basso).result of two years not indicating consistent result varieties but average yields of superior variety Basso, Dinsho, Mulu ,Dribie and Biftu (20.75, 20.55, 20.55, 20.25 and 20 quintal per hectare) respectively(Table5).

At Gulomekeda testing site the first year results not revealed significant difference among the varieties in the first season but second season exhibited significant difference among them the recorded yield that range for first year 3.6 quintal per hectare (Tila) to 14.6 quintal per hectare (Mulu) this season the rainfall distribution erratic and also early cease. Second year results shown higher than compared t0 first year by of rainfall distribution was normal yield recorded ranged 0.4 quintal per hectare (Tila) to 18.2 quintal per hectare (Dribie).Result of two years not indicating consistent result varieties but average yields of superior variety Dribie, SAE'SAE, Basso and Dafo (12.4, 10.9, 10.85 and 10.35 quintal per hectare) respectively. The main constraints of second year yield limitation were bird damage most of early maturing varieties damage all most above 80%.

At Dugua Tembien testing site first season yield well than second year analysis result for each year highly and moderately significant difference among varieties, ranged for first year 17 quintal per hectare (Abay) to 28.7 quintal per hectare (Biftu).in the second year yield intervals from 4.7 quintal per hectare (Abay) to 11.1 quintal per hectare (Biftu). Results of two years indicating consistent result varieties and average yields of superior variety Biftu, Setegn, Mulu, Dinho and Dribie (19.9, 18.25, 17.65, 17.75 and 17.25 quintal per hectare) respectively.

At Quiha testing site both year results revealed highly significant difference among the varieties the recorded yield that range for first year 2quintal per hectare (Abay) to 15.5 quintal per hectare (Dinho) this season the rainfall distribution erratic and also early cease. Second year results shown higher than compared to first year by of rainfall distribution was normal yield

recorded ranged 21.7 quintal per hectare (Misratch) to 40.4 quintal per hectare (Biftu and SAE'SAE).Result of two years not indicating consistent result varieties but average yields of superior variety Dinho**,** SAE'SAE, Dribie and Mulu (26.4, 25.9, 24.75 and 23.55 quintal per hectare) respectively.

At Hintalo-wajerat testing site both year results not revealed significant difference among the varieties the recorded yield that range for second year 21.7quintal per hectare (Misratch) to 40.4 quintal per hectare (Biftu and Sae'sae) this season the rainfall distribution erratic and also early cease. Result of one year's data was average yields of superior variety Biftu**,** SAE'SAE, Dribie and Dinho (40.4, 40.4, 38.8 and 37.3 quintal per hectare) respectively.

Combined analysis of variance

The results of combined analysis of variance (Table 4) not showed for, environments, significant differences years and GE interaction was not revealed significant differences among the varieties, therefore, result indicating that all varieties suitable for all tested environments, if the above interactions not significant not need further analysis of stability. As GE interaction was significant, therefore we can further proceed and calculate phenotypic stability (Jalilnejad, 2002; Farshadfar and Sutka, 2003; Farshadfar and Sutka, 2006; Farshadfar et al., 2013).

Table 2: Mean of parameters for food barley varieties Adaptation Trials for 2006-2007 in four location Atsbi, Dugua Tembien , Gulomekeda and Quiha

No	Variety name	Days to heading	Days to maturity	Plant Height (cm)	Spike length (cm)	Seeds per spike	1000 seed weight (gm)	Biomass yield (qt/ha)	Grain yield (qt/ha)	Harvest index
1	Abay	76	114	75.415	6.10	27	38.008	53.056	13.8	25.501
2	Dribie	69	109	78.101	6.56	28	37.250	51.840	18.6	32.224
3	Misratch	68	109	73.174	5.79	28	34.408	50.451	14.1	29.711
4	Setegn	67	108	74.101	5.72	28	35.050	51.285	16.5	28.599
5	Dafo	67	106	70.975	6.20	28	38.317	45.208	16.2	30.459
6	Basso	67	107	77.383	6.10	29	37.463	55.538	16.5	29.171
7	Mezezo	67	108	63.114	5.74	29	34.929	44.167	12.4	30.315
8	Biftu	66	108	75.790	5.45	29	35.704	54.271	19.8	30.807
9	Dinho	63	105	73.614	6.16	23	35.913	49.757	18.2	30.361
10	Mulu	63	103	76.137	5.99	25	35.338	49.757	17.7	29.444
11	Tila	62	103	76.474	6.32	24	35.425	49.514	15.7	29.248
12	Sae'sae	61	103	65.845	5.98	19	37.829	49.757	17.2	33.095
p-value		***	***	***	***	***	***	***	***	***
CV%		4.55	4.65	8.95	11.87	21.32	10.16	17.16	24	17.46

Table 3: Correlation matrix of grain yield, biomass yield, days to heading, days to maturity, harvest index, plant height, spike length seeds per spike and 1000 seed weight

	GY (qt/ha)	BY (qt/ha)	DH	DM	HI	PH(cm)	SPL(cm	SPS	TKW
GY(qt/ha)	1								
BY(qt/ha)	0.90	1							
DH	0.13	0.19	1						
DM	0.20	0.20	0.65	1					
HI	0.83	0.55	-0.04	0.10	1				
PH(cm)	0.62	0.60	0.22	0.37	0.47	1			
SPL(cm	0.56	0.47	0.11	0.08	0.53	0.44	1		
SPS	0.54	0.50	0.48	0.45	0.43	0.49	0.35	1	
TKW	0.11	0.04	-0.44	-0.20	0.26	0.12	0.18	-0.12	1

Table 4: Analysis of Variance for GY (qt/ha)

Source	DF	SS	MS	% Explained
Year	1	9208	9208*	1.384895
Location	3	189797	63266***	28.54571
Variety	11	22056	2005^{ns}	3.31725
Rep(Location)	8	6922	865^{ns}	1.041078
GXE	33	55025	1667^{ns}	8.27583
Error	231	381880	1653	57.43524
Total	287	664888		

Table 5: Grain yield data for adaptation trial of barley varieties across years & locations

No	Variety	Location and year 2006(qt/ha)					Location and year 2007(qt/ha)						Grand mean
		Atsbi	D/T	Gulo	Quiha	Mean	Atsbi	D/T	Gulo	Quiha	mean	H/w	
1	Abay	34.1	17	10.5	2	15.9	3.4	4.7	9.8	28.6	11.6	2.86	13.8
2	Basso	29.9	25.7	11.2	5.5	18.1	11.6	8.9	10.5	28.6	14.9	2.86	16.5
3	Biftu	29.5	28.7	8.6	4.1	22.3	10.5	11.1	9.3	40.4	17.8	4.04	19.8
4	Dafo	32.7	24.4	9.3	7.1	18.4	6.6	7.6	11.4	30.3	14	3.03	16.2
5	Dinho	32.9	26	11.2	15.5	21.4	8.2	9.5	5.2	37.3	15	3.73	18.2
6	Dribie	32.9	27	6.6	10.7	19.3	7.6	7.3	18.2	38.8	18	3.88	18.6
7	Mezezo	26.3	11.4	9.9	11.1	14.7	4.4	6.5	7.4	22.5	10.2	2.25	12.4
8	Misratch	39.3	19	8.7	5.9	18.25	8.3	8.6	1.49	21.7	10	2.17	14.1
9	Mulu	34.3	26	14.6	12.5	21.9	6.8	9.3	3.4	34.6	13.5	3.46	17.7
10	SAE'SAE	22	22	8.2	11.4	15.9	9.2	11	13.6	40.4	18.6	4.04	17.2
11	Setegn	33.5	28	10.5	9.7	20.4	3.8	8.5	0.99	37.2	12.6	3.72	16.5
12	Tila	31.5	26	3.6	10.4	17.9	8.8	8.4	0.4	36.8	13.6	3.68	15.7
p-value		ns	***	ns	***	***	ns	*	***	***	***	ns	***
CV%		19.1	16.5	46.9	36.4	23.9	50.6	24	26	18.1	26.7	27.8	24

Notice: the grand means excluded location Hintalo wajerat by the reason of the first year data not included total failure of the trial.

CONCLUSION AND RECOMMENDATION

Even though the yield of combined analysis non revealed significant difference among the varieties the mean yield of variety Biftu, Dribie were shown higher yield compared among other varieties including farmers variety sae'sae but most of location variety Dinho higher grain yield also days to maturity the range of acceptable ranges 3-4 months .therefore, variety Biftu, Dribe and Dinsho selected for future demonstration trails.

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