Barley Genetics Newsletter (2008) 38:14-17

Phenotypic Stability of Elite Barley Lines over Heterogeneous Environments

Nanak Chand[1], S.R. Vishwakarma[1, 2], O.P. Verma[1†] and Manoj Kumar[1, 3]
[1]Department of Genetics and Plant Breeding, N.D. University of Agriculture and Technology, Kumarganj, Faizabad- 224229 (U.P), INDIA
[2]Correspondence address: Barley Breeder, Deptt. of Genetics and Plant Breeding, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, UP, India; email- vishwakarma_sr@rediffmail.com,
[3]Present address: Research Scholar, PG 0614, Deptt. of Genetics and Plant Breeding, Institute of Agricultural Sciences, BHU, Varanasi 221005, email- manojsbhu07@gmail.com
[†] Additional author Email: ompverma_2002@yahoo.co.in

ABSTRACT

It is perceived that barley cultivation has flourished since 9000 years ago. Due to versatile and hardy nature, barley is grown world wide for staple food, industrial and medicinal uses. Barley is used in in form of malt, beer, syrups, maltova, horlicks and delicious chocolates. Thirty diverse elite lines of barley along with six checks were assessed in three environments with two replications for three characters *i.e*. 1000-grain weight (g), harvest index (%) and grain yield per plant (g). The genotypes x environment (G x E) interactions were significant for all the traits studied. Among twenty three average yielding genotypes, only sixteen genotypes showed suitability for wide adaptation. Better phenotypic stability were observed in four genotypes *viz.*, RD2634, RD2689, JB47 and RD2620 having high yield mean performance, bi=1 and S^2di=0. These were found promising for wide adaptation over sites across environments. Twelve genotypes namely, JB42, NDB1401, Jyoti, BH657, JB40, NDB1280, NDB1289, NDB1281, RD2552, RD2677, RD2683 and Narendra Jau 3 had average mean performance with bi=1 and S^2di=0 showing stability over wider range of environments. Only two genotypes *viz.*, DWR51 and K792 associated with bi<1 and S^2di=0 was found stability for poor environments. Thus, on the basis of mean performance and stability parameters DWR51, JB42, NDB1401, NDB1289, RD2677, JB40, RD2670, NDB1276, BH65, NDB1280, NDB1281, JB47, RD2552, RD2689, JB47 and RD2634 were identified stable for most of the traits studied. These genotypes may be utilized as a donor in barley improvement programme.

Key words: Barley (*Hordeum vulgare* L.), phenotypic stability, G x E interaction, donors, heterogeneous environments.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is grown under varying agro climatic situations. It is an important crop grown worldwide for food, feed and forage. Due to hardy nature, superior nutritional and medicinal importance, barely is being considered as highly needed crop of present era. It has superior nutritional qualities due to presence of beta-glucan (an anticholesteral substance), acetylcholine (a substance which nourishes our nervous system and recover memory loss), easy digestibility (due to low gluten content) and high lysine, thiamin and riboflavin. Barley food product provides cooling and soothering effect in the body sustained for a longer time. Its alternate uses in malt and beer industry and health tonics have proved that barley is an important crop of present era. As breeders are developing new lines day by day but their stability across sites over environments remains unknown. Thus, some elite lines of barley collected from various coordinated units were sorted out for their stability.

MATERIALS AND METHODS

The material used in this study included thirty diverse new advance elite genotypes of barley with six checks. These elite lines of barley were drawn from N.D. University of Agriculture & Technology, Kumarganj (Faizabad), C.S.A. University of Agriculture & Technology (Kanpur), Panjab Agriculture University (Ludhiana), Directorate of Wheat Research (Karnal), C.C.S. Haryana Agriculture University (Hissar), Rajasthan Agriculture University (Durgapura), J.N. Krishi Vishwavidyalaya (Rewa). These genotypes, planted in randomized block design with two replications during *rabi* 2006-07, were evaluated under three environmental conditions *viz.,* rainfed, low fertility situation (E1), and saline sodic and late sown condition (E2) at Genetics and Plant Breeding Farm, Kumarganj, Faizabad; and normal fertile soil, irrigated, timely sown condition (E3) at Crop Research Station, Masodha, Faizabad. Each genotype was grown in 3 rows of 3 m long plots with spacing of 25 cm between the rows. An approximate distance of 10 cm was maintained between plant to plant by hand thinning. Five competitive random plants from the middle row of the experimental plots were taken for recording the observations on 1000-grain weight (g), harvest index (%) and grain yield per plant (g). Stability analysis was worked out following Eberhart and Russel (1966).

RESULTS AND DISCUSSION

The phenotypic stability of each variety was expressed by two parameters: the slope of regression line and sum of squares of deviation from regression. A stable variety was defined as "one with unite regression (bi=1) and low deviation from linearity (S^2di=0)". Analysis of variance showed that the mean sum of squares due to genotypes (G) and environment (E) difference tested against the G x E interaction were significant for all the traits studied, indicating the presence of wide variability among the genotypes and environment. The significant estimates of G x E interaction indicated that the characters were unstable and may considerably fluctuate with change in environments. The G x E (linear) interaction was significant against pooled deviation suggesting the possibility of the variation for all characters (Table 1). These findings are in close agreement with those of Semin *et al*. (1986), Afiash *et al*. (1999) and Mohamadi *et al*. (2005). The result for grain yield per plant revealed that out of 36 genotypes, RD2634, RD2689, JB47 and RD2670 had higher mean yield, bi=1 and S^2di=0 were promising for wide adaptation over sites across environments (Table 2). Twelve genotypes *viz*., JB42, NDB1401, Jyoti, BH657, JB40, NDB1280, NDB1289, NDB1281, RD2552, RD2677, RD2683 and Narendra Jau 3 had average mean performance associated with bi=1 and S^2di=0 showing stability over wider range of environments. For harvest index six genotypes *viz*., DWR51, JB42, NDB1401, DWR54, NDB1289 and RD2677 with average mean, bi=1 and S^2di=0 showing stability over wider range of environments. Only one genotype JB40 with higher mean, bi<1 and S^2di=0 were stable and suitable for poor environmental conditions. Three genotypes *viz*., RD2696, RD2670, and NDB1276 had higher mean, bi>1 and S^2di=0, indicating their stability for favourable environment. Five genotypes, *viz*., BH657, NDB1280, NDB1281, RD2552 and JB47 had average mean associated with bi >1 and S^2di =0, indicating their stability for favourable environments. For 1000- grain weight, only one genotype RD2634 had average mean associated with bi=1 and S^2di=0, identified for wider adaptation and stability over all sites across environments. These results are in conformity with the findings of Yadav and

Rao (1985), Hadjichristodolon (1992), Shahmohamadi *et al.* (2005) and Verma (2007). Two genotypes *viz.*, NDB1401 and RD2668, possessing higher mean, bi=1 and S^2di=0 showed wider stability over all sites across environments. Three genotypes *viz.*, RD2689, BH663 and NDB1276 had higher mean performance, bi<1 and S^2di=0, thus, it may be suitable for poor environmental conditions. These promising genotypes may be utilized as a donor in barley improvement programme for target ecosystems (E1, E2 and E3).

REFERENCES

Afiash S.A.N., Sallam H.A and Khattab S.A.M. 1999. Evaluation of divergent barley (*Hordeum vulgare* L.) genotypes under certain environments. *Annals of Agricultural Science*, Moshtohor, **37**(2): 973-988.

Eberhart S.A. and Russel W.L. 1966. Stability parameters for comparing varieties. *Crop Sci.*, **6**: 36-40.

Hadjichristodolon A.1992. Stability of 1000-grain weight and its relation with other traits of barley in dry areas. *Euphytica*, **51**(1): 11-17.

Mohamadi M.S., Dehghani H., Uosefi A., Moeini A. and Omidi H. 2005. Study of yield stability in barley (*Hordeum vulgare* L.) cultivars through non-parametric measures. *Agricultural Science and Technology*, **19**(2): 1-9.

Shahmohamadi M., Dehghani H. and Youself A. 2005. Stability analysis of barley (*Hordeum vulgare* L.) genotypes in regional trial in cold zone. *J. Science and Technology of Agricultural and Natural Resources*. **9**(1): 143 – 155.

Simin E.A., Servart V.I. and Udovenko G.V. 1986. Change in yield structure element of barley under saline condition and role of individual selection in increasing salt tolerance. *Agrokhimiya*, **8**: 56-57.

Verma A.K. 2007. Combining ability, gene action and heterosis for yield and quality components in barley. Ph.D. Thesis, N.D.U.A. & T., Kumarganj, Faizabad, Pp 184.

Yadav H.S. and Rao S.K. 1985. Stability analysis of grain yield in barley. *Agric. Science Digest*, India. **5:** 29-32.

TABLE 1. Pooled analysis of variance for grain yield and its components in barley over three environments (Eberhart and Russell's 1966 model)

Source of variance	d.f.	Mean of Square		
		1000-grains weight (g)	Harvest index (%)	Grain yield per plant (g)
Genotypes (G)	35	27.98**	48.63	35.1**
Environment (E)	2	228.14**	254.52**	1909.62**
G ×E	70	15.38**	46.90**	22.80**
E+ (G×E)	72	21.29**	52.67**	75.21**
E (linear)	1	456.24**	509.13**	3819.26**
G×E (linear)	35	30.27**	54.69**	29.33**
Pooled deviation	36	0.47**	38.05**	15.82**
Pooled error	105	0.02	3.74	1.98

*, ** Significant at 5 % and 1% probability levels, respectively

TABLE 2. Estimates of stability parameters for 1000-grain weight (g), harvest index (%) and grain yield per plant (g)

S.No.	Genotypes	1000-grain weight (g)			Harvest index (%)			Grain yield per plant (g)		
		X_i	bi	S^2di	X_i	bi	S^2di	X_i	bi	S^2di
1	DWR 61	45.06	3.31**	0.43**	39.57	-0.57	-1.36	19.91	1.23	5.57*
2	RD 2634	44.00	0.55*	-0.01	49.85**	3.44	13.85**	23.11	1.12	1.49
3	BH 855	44.64	1.95**	11.67**	42.61	1.80	83.39**	17.00	0.87	54.54**
4	RD 2689	48.43**	0.35**	0.01	47.31**	2.81	0.42	22.94	0.62	-0.78
5	NDB 1173	41.01	2.49**	0.15**	40.85	1.28	30.07**	17.22	0.97	16.64**
6	BH 646	44.97	-1.66**	0.18**	37.20	1.62	27.58**	19.39	1.11	44.18**
7	JB 42	41.36	-0.09**	0.37**	40.28	1.44	5.68	21.16	0.95	2.46
8	NDB 1245	41.35	-0.28**	0.06*	31.81	5.63**	6.46	17.00	1.13	3.65
9	Lakhan	44.79	1.55**	0.04*	39.59	-0.09	80.98**	21.50	1.34	117.35**
10	K 792	42.79	-0.78**	0.11**	38.88	0.20	2.03	23.00	0.09*	-0.87
11	NDB 1401	46.99**	0.50*	-0.01	39.29	0.63	-1.42	20.67	0.58	-0.98
12	K 625	39.67	2.85**	0.28**	38.32	0.58	10.76*	16.78	0.57	0.29
13	DWR 51	47.65**	1.52**	0.05*	42.74	0.05	2.83	20.11	0.39	0.13
14	Jyoti	48.16**	0.98	0.06*	34.51	-0.83	24.20**	21.89	1.12	-0.84
15	BH 657	41.36	0.74	0.04*	41.85	2.44	0.78	19.44	1.15	2.28
16	RD 2696	48.00**	3.46**	0.43**	43.27	1.98	-0.63	18.17	0.67	-0.74
17	DWR 52	48.20**	1.72**	0.16**	41.24	-0.43	25.71**	19.28	0.99	21.74**
18	JB 40	42.40	1.27	0.03	47.16**	-0.25	-1.83	19.77	0.50	-0.82
19	NDB 1280	41.81	-1.82**	0.23**	39.73	3.10	-1.63	20.00	0.97	-0.84
20	DWR 54	47.77**	2.17**	0.12**	40.84	1.35	-1.79	17.94	0.84	0.17
21	Narendra Jau -1	47.67**	-0.29**	-0.01	39.88	-0.25	18.37**	18.33	0.36	28.08**
22	NDB 1289	40.17	-1.52**	0.33**	39.41	1.41	-0.87	18.50	0.76	-0.99
23	RD 2668	46.07**	1.08	-0.01	41.09	1.93	988.96**	27.78**	2.17**	192.69**
24	NDB 1281	39.54	-0.73**	0.10**	40.01	1.75	0.13	20.39	0.81	-0.95
25	RD 2683	43.65	0.82	0.09**	36.06	-0.05	-1.78	20.39	1.21	0.42
26	RD 2552	41.17	1.09	0.01	41.55	1.59	-1.60	20.27	1.45	2.62
27	RD 2677	49.94**	2.53**	0.15**	40.26	0.98	0.13	15.33	0.52	-0.98
28	JB 47	47.49**	2.54**	0.29**	40.14	1.51	-1.87	25.05**	1.47	0.55
29	BH 673	43.88	1.74**	0.05*	36.90	-2.01	0.91	15.33	0.26	6.89
30	RD 2620	44.12	4.01**	0.53**	33.73	0.63	-1.87	16.05	1.07	1.43
31	PL 762	47.65**	2.82**	0.36**	37.71	-1.09	-1.02	22.72	1.22	18.64**
32	RD 2670	47.59**	2.70**	0.36**	42.39	2.25	-1.85	27.22**	2.26**	5.14*
33	BH 663	50.26**	0.25	-0.01	47.69**	1.20	-1.62	25.94**	1.70	6.13*
34	Narendra Jau-3	43.51	-0.67**	0.04*	48.10**	2.54	-1.74	25.44**	1.08	-0.02
35	NDB1252	43.70	-1.38**	0.07**	39.87	-6.31	3.47	18.89	0.24	-0.65
36	NDB1276	47.17**	0.27	-0.01	46.47**	3.73	-1.47	28.17**	2.22**	10.35**
	Mean	44.83	1.00		40.78	0.99		20.61	1.00	
	SEm±	0.48	0.19		4.36	1.64		2.81	0.38	