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Worth of genetic parameters to sort out new elite barley lines over heterogeneous environments

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Abstract
Thirty six diverse elite barely lines and six checks were grown in the three environments with two replications during Rabi 2006-2007 to study coefficient of variability, heritability and expected genetic advance for ten characters i.e., Days to 50% flowering, days to maturity, total tillers per plant, number of effective tillers per plant, plant height (cm), number of grains per spike, 1000-grain weight (g), biological yield per plant (g), harvest index (%) and grain yield per plant (g).The phenotypic coefficient of variability (PCV) was higher than genotypic coefficient of variability (GCV). Environmental coefficient of variability (ECV) was less than both the parameters except days to maturity in E2. Grain yield per plant has the highest coefficient of variability followed by number of grains per spike. High estimates of heritability in broad sense were recorded for 1000-grain weight and number of grains per spike followed by biological yield per plant and grain yield per plant. The characters which showed higher estimates of genetic advance coupled with higher estimates of heritability reflecting additive gene action, were grain yield per plant and number of grains per spike followed by biological yield per plant. Thus, selection of these characters should emphasized in barley improvement programme.

Keywords: Barley (*Hordeum vulgare* L.), GCV, PCV, genetic advance, heritability, heterogeneous environments

Introduction
Barley constitutes the fourth agricultural commodity in India after wheat, rice and maize. It is the best known crop grown worldwide under varying agro climatic situations for food, feed and forage. It has superior nutritional qualities due to presence of beta-glucan (an anticholesteral substance), acetylcholine carbohydrate substance which nourishes our nervous system and recover memory loss, easy digestibility due to low gluten content and high lysine, thiamin and riboflavin render cooling and soothering effect in the body. Its alternate uses in malt and beer industry and health tonics have proved that barley is an important crop of present era. In order to launch a sound breeding programme, it is essential to have an idea of the nature and magnitude of variability, heritability and genetic advance in respect of breeding material at hand. The concept of heritability explains whether differences observed among individuals arose as a result of differences in genetic makeup or due to environmental forces. Genetic advance gives an idea of possible improvement of new population through selections, when compared to the original population. The genetic gain depends upon the amount of genetic variability and magnitude of the masking effect of the environment. Keeping these points in the view, present investigation was undertaken for study of variability, heritability and genetic advance in indigenous elite lines of barley.

Materials and Methods
The material used in this study included thirty six diverse new advance elite genotypes of barley. 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* 2016-16, 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) Normal fertile irrigated condition at student's Instructional farm Kumarganj, 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

In the present investigation the phenotypic coefficient of variability (PCV) was higher than genotypic coefficient of variability (GCV) for all the characters studied (Table 1). Environmental coefficient of variability (ECV) was less than both the parameters except days to maturity in E1 and E2. A perusal of coefficient of variability indicates that PCV was quite higher for grain yield per plant and number of grains per spike. Day to maturity showed considerable low variability, which indicates little opportunity for improvement through selection. This observation is in agreement with the result of Andonov *et al*. (1979) [2] and Sandeep *et al*. (2002) [10]. Genotypic coefficient of variability (GCV) for grain yield per plant and number of grains per spike was also high except in E3 environment where grain yield was recorded low. ECV were high for total tillers per plant in E1, plant height in E2 and number of grains per spike in E3. Considerable environmental influences were observed for grain yield per plant in E3, total tillers per plant and number of effective tillers per plant in E1, suggested that environmental manipulation may be effective for bringing about favourable change in expression of these characters. In general, high estimates of heritability were found for all the traits except plant height, total tillers per plant and number of effective tillers per plant in E1 and days to maturity in (E2). In present study, the highest heritability was recorded for 1000-grain weight followed by number of grains per spike in all the environments except number of grains per spike in E3. Lowest value of heritability was recorded for days to maturity in all the environments except in E3. Similar views were also reported by Delogu (1988) [5] and Sinha *et al*. (1999) [9]. Barraiga (1976) [3] reported in spring wheat that combination of high variability and high heritability is considered useful for success of selection. High amount of genetic variability among the population indicated an increased opportunity for the selection of desirable genotypes, as the variation is heritable one. Genetic advance expressed in percentage of mean showed a wide range of variations across the environments. High heritability estimates were associated with high genetic advance for number of grains per spike, biological yield per plant and grain yield per plant except in E3 for grain yield per plant, reflected the involvement of additive gene action for the inheritance of these traits. Similar results have been reported by Aidun *et al*. (1990) [1] and; Vimal and Vishwakarma (1998) [11]. Such estimates of genetic advance indicated that moderate gains could be achieved with strengthening the selection. These results are in close agreement with the findings of Lee (1987) [7] also. However, the high estimates of heritability with low genetic advance were detected for days to ear emergence and 1000-grain weight except in E2 environment for 1000-grain weight. The traits possessing low genetic advance with high heritability indicates the presence of non-additive gene action, thus simple selection procedure in early segregating generations will not be effective for screening of the desirable traits.

Table 1: Estimates of range, grand mean, PCV, GCV, ECV, heritability in broad sense (h2 b) and genetic advance in per cent of mean (GA %) for 10 characters in barley under heterogeneous environments:

S.N.	Character	Environment	Range	Grand mean	PCV (%)	GCV (%)	ECV (%)	h2 (b) (%)	GA % of mean
1.	Days to 50% flowering	E1	78.00-88.00	82.722	3.70	2.92	2.27	62.29	6.08
		E2	76.00-88.00	83.611	4.65	2.91	3.62	39.34	4.83
		E3	74.00-88.00	81.833	4.70	4.12	2.26	76.76	9.52
2	Daysto maturity	E1	115.00-128.00	121.916	3.23	2.25	2.32	48.61	4.15
		E2	116.00-127.00	121.694	2.95	1.86	2.28	39.96	3.11
		E3	116.00-127.00	121.472	2.98	2.08	2.13	48.66	3.82
3	Total tillers/ plant	E1	4.00-9.00	5.614	18.39	16.91	7.22	84.60	41.07
		E2	3.80-7.80	5.344	17.03	15.43	7.19	82.17	36.93
		E3	4.396-10.500	6.675	22.04	20.78	7.35	88.87	51.71
4	Plant height (cm)	E1	33.00-66.00	46.989	19.54	17.91	7.82	83.99	43.34
		E2	33.20-82.80	58.677	19.80	18.36	7.41	85.98	44.93
		E3	54.20-98.00	77.272	14.73	12.66	7.51	73.96	28.75
5	No.of Grain/ Ear	E1	18.00-54.00	36.916	23.33	22.06	7.60	89.39	55.06
		E2	22.00-65.00	44.250	26.09	25.09	7.17	92.45	63.68
		E3	22.00-66.00	42.083	24.57	23.53	7.08	91.70	59.48
6	Spike length (cm)	E1	3.80-6.80	5.327	18.25	16.94	6.81	86.09	41.49
		E2	3.59-8.20	6.010	18.15	16.87	6.68	86.46	41.42
		E3	4.80-9.80	6.594	17.65	16.27	6.84	85.00	39.61
7	1000 grain weight (g)	E1	22.50-41.50	32.816	13.41	11.29	7.23	70.09	25.10
		E2	23.50-42.50	33.222	15.26	13.43	7.26	77.40	31.19
		E3	6.90-54.00	24.949	41.60	40.96	7.28	96.93	106.47
8	Biological yield/ plant (g)	E1	14.00-82.00	39.552	41.16	40.40	7.87	96.34	104.69
		E2	2.00-83.00	40.883	42.51	41.71	8.21	96.27	108.03
		E3	16.00-84.00	41.850	39.89	39.13	7.73	96.24	101.34
9	Harvest Index	E1	5.90-56.00	23.794	45.33	44.87	6.46	97.97	117.24
		E2	6.90-54.00	24.055	44.03	43.66	5.68	98.34	114.30
		E3	6.900-54.00	24.948	41.44	41.04	5.77	98.06	107.29
10	Grain yield/ plant (g)	E1	5.10-18.09	9.268	27.96	27.12	6.81	94.07	69.43
		E2	3.20-18.09	9.971	31.36	30.52	7.20	94.73	78.42
		E3	3.20-18.50	9.798	29.98	28.11	7.05	94.08	71.67

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