SHORT COMMUNICATION

Genetic Variability for Quality and Metric Traits and its Contribution to Yield in Barley (*Hordeum vulgare* L.)

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The barley (*Hordeum vulgare* L.) is cultivated under varied agro-climatic conditions and it is world's fourth most important cereal after wheat, maize and rice. There is need to identify and characterize the varieties/ genotypes suitable under varied agro-climatic conditions and fertility levels. Genetic variability present in a crop is more useful to a plant breeder for exploitation in selection or hybridization.

The experiment was conducted to evaluate diverse genetic populations and select the elite genotypes under different level of fertilizer and irrigation. The genetic parameters like, variability, heritability and genetic advance plays an important role in evaluating the material for desirable traits. Therefore, present investigation was undertaken to assess different parameters of variability, heritability and genetic advance.

The experimental material comprised of 35 diverse genotypes of barley obtained from the Director, National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi. The material was grown in a Randomized Block Design with three replications at experimental farm of Kisan Post Graduate College, Simbhaoli, Ghaziabad (U.P.), India during rabi season of 1997-98 and 1998-99 under two levels of each fertilizer and irrigation (Table 1). The standard packages of agronomic practices for raising a good crop were followed. The observations were recorded on three randomly selected competitive plants from each genotypes on eleven morphological traits viz., days to flowering, days to maturity, plant height (cm), tillers per plant, ear length (cm), spikelets per ear, seeds per spike, grain yield per plant (g), 1000 grain weight (g), biological yield per plant (g) and harvest index (%) and two quality traits malt percentage and starch percentage. The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were computed followed by Burton and De Vane (1953) while heritability and genetic advance were calculated as suggested by Allard (1960) for all the characters under study.

Table 1. Details of environments in the years 1997-98 and 1998-99

Fertilizer levels	Irrigations	Environments
1997-98		
40 kg N_2 20 kg P_2O_5 20 kg K_2O	One	I
40 kg N_2 20 kg P_2O_5 20 kg K_2O	Three	II
20 kg N_2 20 kg P_2O_5 20 kg K_2O	One	III
20 kg N_2 20 kg P_2O_5 20 kg K_2O	Three	IV
1998-99		
40 kg N_2 20 kg P_2O_5 20 kg K_2O	One	V
40 kg N_2 20 kg P_2O_5 20 kg K_2O	Three	VI
20 kg N_2 20 kg P_2O_5 20 kg K_2O	One	VII
20 kg N_2 20 kg P_2O_5 20 kg K_2O	Three	VIII

The Analysis of Variance (ANOVA) for 13 traits of 35 genotypes of barley for the two years is given in Table 2. ANOVA revealed that the mean sum of square (MSS) due to treatment is significant for all the thirteen traits under all the eight environments studies, except days to maturity in II and VI environments. It indicates that considerable genotypic variability exists amongst the genotypes. Similar results have also been reported by Yadav *et al.* (1991) and Ram Kishor *et al.* (2000).

Table 2. ANOVA for different characters in different environments-(i-viii)

Source	d.f.	Days to flowering	Days to maturity	Plant height (cm)	Tiller no. per plant	Ear length (cm)	No. of spikelets per ear	No. of seeds per spike	Grain yield per plant(g)	1000 grain wt. (g)	Biological yield per plant (g)	Harvest index (%)	Malt (%)	Starch (%)
Environment-I														
Replication	2	19.37	52.00	-0.12	0.26	1.12	28.65	0.34	0.10	1.95	0.64	3.86	516.34	270.54
Treatment	34	41.82**	38.19**	48.97**	5.71**	0.30**	82.50**	71.82**	3.21**	18.45**	21.59**	59.36**	15.35**	7.52**
Error	68	9.61	18.57	14.42	8.73	9.32	4.88	4.06	0.13	0.90	0.82	4.45	0.83	0.51
Environment-II														
Replication	2	1.06	10.00	1.43	0.34	4.73	17.04	0.00	0.54	1.63	7.81	3.51	507.00	304.10
Treatment	34	32.84**	21.37	51.96**	6.59**	0.33**	82.67**	62.58**	3.29**	17.14**	18.44**	62.73**	15.63**	6.29**
Error	68	11.83	20.37	15.42	0.13	0.10	5.32	4.39	0.18	0.96	0.99	1.51	0.81	0.48
Environment-III														
Replication	2	11.75	7.00	13.75	3.22	9.08	1.96	3.59	6.59	1.68	8.20	0.24	462.65	261.51
Treatment	34	26.67**	44.59**	39.20**	4.09**	0.70**	74.13**	60.49**	3.64**	15.83**	18.78**	59.00**	15.96**	3.56**
Error	68	10.48	17.88	14.02	7.87	8.48	4.60	3.53	0.11	0.87	0.73	0.22	0.67	0.42
Environment-IV														
Replication	2	4.15	20.75	7.43	8.78	4.56	4.07	1.53	0.11	0.37	0.32	0.15	50.03	302.9
Treatment	34	33.76**	37.24**	40.28**	4.81**	0.49**	111.11**	67.61**	3.99**	15.42**	18.63**	64.55**	16.15**	42.06**
Error	68	10.67	19.36	14.57	0.11	9.28	4.08	3.81	0.13	0.93	0.83	0.13	0.87	0.48
Environment-V														
Replication	2	11.68	43.50	1.75	0.25	2.24	32.71	0.59	1.61	0.42	2.42	2.64	310.68	166.68
Treatment	34	36.75**	35.20**	52.02**	5.88**	0.37**	84.89**	69.74**	3.45**	18.75**	19.88**	59.80**	22.43**	6.85**
Error	68	9.47	17.07	16.72	8.89	9.84	5.35	3.80	0.23	0.85	1.27	5.09	4.06	4.52
Environment-VI														
Replication	2	1.90	4.31	1.56	0.24	53.71	24.42	0.85	0.68	1.87	0.21	5.74	369.06	239.32
Treatment	34	30.54**	21.74	46.90**	6.64**	0.34**	84.28**	62.85**	3.34**	17.31**	17.58**	69.12**	13.71**	5.65**
Error	68	13.65	18.17	16.92	0.14	0.10	7.01	5.13	0.17	0.94	1.18	2.37	4.20	1.52
Environment-VII														
Replication	2	42.59	5.12	6.68	8.30	0.15	4.98	4.31	5.51	2.60	9.37	4.73	364.81	287.17
Treatment	34	27.78**	39.96**	33.05**	4.03**	0.70**	66.09**	60.35**	3.80**	16.92**	18.87**	57.25**	15.15**	4.10*
Error	68	9.56	14.74	15.05	9.78	8.52	5.83	3.75	0.13	0.88	1.20	1.68	2.08	0.74
Environment-VIII														
Replication	2	10.25	23.06	6.06	0.11	4.34	4.14	2.28	0.11	0.48	0.46	0.14	431.12	289.35
Treatment	34	33.78**	34.37**	45.73**	5.14**	0.49**	119.35**	64.31**	4.00**	14.78**	17.64**	74.37**	14.79**	41.44**
Error	68	11.61	18.17	17.74	0.12	9.60	4.08	4.47	0.13	0.97	1.06	1.55	1.51	0.52

**Significant at1% level

The phenotypic coefficient of variation (PCV) is found higher than the corresponding genotypic coefficient of variation (GCV) for all the traits (Table 3) studied. This is because that variability at phenotypic level includes genotypic and environmental variability as earlier reported by Chauhan *et al.* (1988) and Ram Kishor *et al.* (2000). On the basis of pooled analysis, phenotypic coefficient of variation for different traits ranged from 1.77 to 13.10 whereas, genotypic coefficient of variation ranged from 1.07 to 12.64. The high estimates of both PCV and corresponding GCV values for tillers per plant, spikelets per ear, seeds per spike, grain yield per plant, biological yield per plant, 1000 grain weight and harvest index indicate the presence of ample genetic variability in the experimental material for these traits. Similar results were also reported by Chauhan *et al.* (1988), Sharma and Maloo (1994), Sajeda Begum and Khatun. (1997) and Ram Kishor *et al.* (2000). The lowest PCV and GCV values were observed for malt and starch percentage indicating that these traits exhibits low variability which suggests that more variability should be generated for these traits through hybridization or mutation breeding.

Heritability estimates along with genetic advance are more useful in predicting the possible gain under selection. High estimates of heritability, in broad sense, were recorded for tillers per plant, harvest index, grain yield per plant, 1000 grain weight, spikelets per ear, seeds per spike, biological yield per plant, malt percentage and starch percentage. It indicates the high heritable nature of these traits and are less affected by the environments. Therefore, selection should be based on these traits. Sajeda Begum and Khatun. (1997), Kaeppler and Rasmusson (1991), Yadav *et al.* (1991), Hennawy (1997), Yadav. (1993) and Vimal and Vishwakarma (1998) have also reported high heritability for grain yield/ plant, alpha amylase activity, tillers/plant and grains/spike, 1000-grain wt. and grain yield/plant, respectively. Plant height, days to flowering and ear length exhibited moderate heritability indicating that these traits are more influenced by the environments. Therefore, direct selection for these traits may not be so useful from the genotypes under study.

Heritability and GCV are not sufficient to determine the amount of variation which is heritable from parents to their off springs. Burton and De vane (1953) found that the high heritability estimate alone is of little use in predicting the breeding value of any trait. High heritability coupled with high genetic advance gives an idea of the possible improvement through selection. High heritability coupled with high genetic advance over mean, observed for tillers per plant, biological yield per plant, harvest index, 1000 grain weight, grain yield per plant, seeds per spike and spikelets per ear are given in (Table 3). Therefore, improvement in these traits may be achieved through selection. Malt and starch percentage exhibits low genetic advance with moderate heritability estimates indicating the presence of non-additive gene effects. Therefore, the direct selection for these traits in segregating populations will not contribute for the genetic improvement in yield of barley. High heritability and high genetic advance was also observed by Aidum *et al.* (1990), Vimal and Vishwakarma (1998) and Ram Kishor *et al.* (2000) for tillers/plant, length of spike, number of spikelets/ spike, grain yield/plant, number of seeds/spike, 1000-grain wt. and grain yield/plant, respectively.

Table 3. Estimates of mean, range, phenotypic and genotypic coefficient of variability, heritability and genetic advance on pooled basis

Characters	Mean ± SEm	Range	PCV	GCV	Heritability	Genetic advance as % of mean
Days to flowering	94.53±1.31	88.18-100.03	4.64	3.14	45.80	4.37
Days to maturity	124.33±1.72	117.28-129.12	4.04	2.19	29.30	2.44
Plant height (cm)	109.58±1.57	103.24-117.02	4.71	3.12	44.00	4.26
Tiller no./plant	9.37±0.13	7.31-11.83	13.10	12.64	93.10	28.06
Ear length (cm)	8.82±0.12	8.24-9.57	4.43	2.83	40.90	3.74
Spikelets/ear	62.89±0.90	51.74-71.60	7.21	6.29	76.20	11.30
Seeds/spike	57.15±0.80	49.63-67.21	8.01	7.22	81.20	13.40
Grain yield/plant (g)	11.03±0.15	9.13-12.80	8.54	7.80	83.40	14.68
1000 grain wt. (g)	27.64±0.38	25.06-31.26	9.00	8.33	85.70	15.88
Biological yield/plant (g)	26.80±0.39	20.86-38.12	9.30	8.58	85.10	16.30
Harvest index (%)	42.04±0.55	34.47-48.10	8.90	8.30	87.00	15.93
Malt percentage	80.92±0.46	77.73-83.88	1.77	1.07	73.72	5.14
Starch percentage	58.69±0.35	57.17-64.87	1.98	1.32	68.56	5.75

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