Assessment of genetic variability, expected genetic advance, correlation and path analysis in barley (*Hordeum vulgare* L.)

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Abstract

An experiment was conducted to evaluate the genotypes of barley to assess the magnitude of genetic variability and to understand the heritable component of variation for seed yield and its component traits. Estimation of genetic parameters would be useful in developing appropriate breeding and selection strategies. A field trial was laid under a Randomized Block Design(RBD) with three replications; observations was recorded on ten quantitative characters viz. days to 50% flowering, days to maturity, plant height, number of tillers per plant, ear length, number of seed per spike, 100 seed weight, biological yield, seed yield and harvest index. The phenotypic coefficient of variation (PCV) was greater than that of genotypic coefficient of variation (GCV) for most of the character studied thereby, indicating the influence environmental effect on the character. The higher genotypic and phenotypic coefficient of variations were recorded for seed yield per plant biological yield, number of tillers per plant, harvest index, number of seeds per spike, 100-seed weight, ear length and plant height. Heritability is a measure of possible genetic advancement under selection. Higher estimates of heritability was observed for all the characters under study High heritability along with high genetic advance was recorded for all the characters studied. Biological yield per plant, harvest index, number of tillers per plant, number of grains per spike, 100-seed weight are the most important yield contributing characters as they recorded higher positive direct and indirect effects along with positive significant correlation toward seed yield per plant. Therefore, selection of genotype based on these traits could bring about desired improvement in yield of barley.

Introduction

Barley (*Hordeum vulgare* L.) belongs to the family Poaceae with chromosome number 2n=2x=14. It is included as the fourth agricultural commodity in India after wheat, rice and maize. Barley is considered as most cosmopolitan of the crop, grown over the wide environmental range as well as it has been considered, as poor man's crop because of its low input requirement and better adaptability to diverse environments, like drought, salinity, alkanity and marginal lands. Owning to its hardiness, in many countries around the world, it is often considered the only possible rainfed cereal crop under low input and stress full environment. In order to launch a sound breeding programme, it is essential to have an idea of the nature and magnitude of variability, heritability, genetic advance, correlation and path analysis in respect of breeding material in hand. The concept of heritability explain wheather differences observed among individual areas as a result of differences in genetic makeup or due to environmental forces. Genetic advance give an idea of possible improvement of new population through selections, when compared to the original population. Correlation coefficient ensures the degree of association, genetic and non genetic relationship between two or more characters which forms the bases of selection. Path analysis simply splits the correlation coefficients into the measures of direct and indirect effects of a set of independent variable on the dependent variables.

Materials and methods

The present experiment conducted at the Research Farm of department of Genetics and Plant Breeding, Post Graduate College, Ghazipur (U.P.), India, during *rabi* 2016-17. Experimental material for the present study consists of 19 genotypes of barley were grown in a Randomized Block Design with three replications. Each genotypes was sown in five row with space 30 x10 cm in a 4 m length. On the basis of five randomly selected plants were recorded on days to 50% flowering, days to maturity, plant height, number of tillers per plant, ear length, number of seed per spike, 100 seed weight, biological yield, seed yield and harvest index. The mean value were used for estimation of genotypic and phenotypic coefficient variations, heritability in broad sense and genetic advance according to Johnson *et al*. (1955). Correlation and path analysis were made according to Dewey and Lu (1959).

Results and discussions

The analysis of variance showed that the mean square due to treatments were highly significant for all the characters studied Table-1. The general mean, range, coefficients of variation, heritability, genetic advance and genetic advance as percentage of mean are presented in Table-2. The analysis revealed that for all the characters the phenotypic coefficient of variation(PCV) were slightly higher than the genotypic coefficient of variation(GCV), so it is evident that the expression of the characters mainly governed by the genotype itself along with meagre effect of environment. The findings also get corroborated with Katiyar *et al*. (2020), Ghimere and Mahat (2019), Mishra *et al*. (2007) and Singh *et al*.(2008) in barley. High genotypic coefficient of variation and phenotypic coefficients of variation were exhibited by seed yield per plant, biological yield per plant, number of tillers per plant, harvest index, number of seeds per spike, 100 seed weight, ear length and plant height. The low genotypic and phenotypic coefficients of variation were given by days to 50% flowering and days to maturity. Estimates of heritability help in estimating expected progress through selection. The genetic advance as percentage of mean provides indication of expected selection response by taking into account the existing genetic variability and heritability of the character. Higher estimates of heritability along with higher genetic advance as percentage of mean were recorded for all the characters under study. The higher heritability with high genetic advance as percentage of mean represent the additive gene action and helpful in selection the desirable characters. These findings correlated with Ghimire and Mahat (2019), Adhikari *et al*. (2018), Katiyar *et al.* (2020) and Mishra *et al*. (2007). Table-3 represents the genotypic and phenotypic correlation between all pairs of characters. It was observed that genotypic correlation were higher than the phenotypic correlation in all most of the cases indicating that the environmental influence were not marked enough to alter the degree of association in all the characters. Seed yield per plant possessed highly significant positive correlation with days to 50% flowering, number of tillers per plant, spike length, number of grain per spike, 100 seed weight biological yield and harvest index. Similarly the positive and significant correlation for number of tillers per plant, number of grain per spike, 100

Table 1. Analysis of variance for 10 chracters in barley

Source of variation	Days to 50% flowering	Days to aturity	Plant height (cm)	Number of tillers per Plant	Ear length(cm)	Number of seeds per spike	100 seed weight(g)	Biological yield (g)	Harvest Index (%)	Seed yield per plant(g)
Replication	2.313738	1.399299	1.040785	2.204023	0.104265	2.482015	0.122807	1.701754	30.00833	16.07596
Treatment	64.22**	23.29**	275.67**	195.95**	3.90**	431.14**	0.62**	3102.20**	325.09**	717.99**
Error	8.25	3.19	0.38	1.48	0.20	1.40	0.18	10.41	18.83	16.55

Table 2. Estimates of range, mean, phenotypic coefficients of variation(PCV), genotypic coefficient of variation(GCV), heritability (broad sense) and genetic advance for seed yield and its attributes in lentil

Character	General mean	Range	Coefficients of Variation			Heritability	Genetic advance	Genetic advance as % age of mean
			GCV	PCV	ECV			
Days to 50% flowering	76.7646	68.33-84.67	5.6268	6.7578	3.7427	0.693	7.4087	9.6512
Days to maturity	126.7521	121.33-130.23	1.991	2.5634	1.6145	0.603	4.038	3.1858
Plant height(cm)	121.3528	97.50-134.27	7.8938	7.91.01	0.5073	0.995	19.6929	16.2278
Number of tillers per plant	21.1114	10.89-40.09	38.14	38.5719	5.7559	0.977	16.4012	77.6886
Ear length (cm)	8.2702	5.64-10.73	13.4326	14.4875	5.427	0.859	2.1218	25.6562
Number of seeds per spike	48.8047	19.67-60.67	24.5237	24.6429	2.4209	0.99	24.5363	50.2744
100 seed weight(g)	2.9649	2.00-3.67	13.0245	19.3012	14.2443	0.455	0.5368	18.1052
Biological yield(g)	83.0702	39.33-134.33	38.6456	38.8402	3.8832	0.99	65.8008	79.211
Harvest Index (%)	37.2072	15.97-50.40	27.1558	29.5541	11.6622	0.844	19.125	51.4013
Seed yield per plant(g)	31.1702	7.47-63.50	49.0567	50.7632	13.0516	0.933	30.4407	97.6596

Table 3. Genotypic and phenotypic correlation coefficients among all the characters

Traits		Days to maturity	Plant height(cm)	Number of tillers per Plant	Ear length (cm)	Number of seeds per spike	100 seed weight(g)	Biological yield (g)	Harvest Index (%)	Seed yield per plant(g)
Days to 50% flowering	G	0.071	-0.066	0.503**	0.370**	0.009	-0.252	0.536**	-0.014	0.462**
	P	0.059	-0.055	0.009	0.089*	0.022	-0.134	0.444**	-0.007	0.375**
Days to maturity	G		0.055	-0.167	0.054	0.074	-0.101	-0.157	0.045	-0.123
	P		0.047	-0.134	-0.006	0.043	-0.077	-0.105	0.036	-0.06
Plant height(cm)	G			-0.007	0.211	0.416**	0.250	0.223	0.063	0.133
	P			-0.007	0.198	0.12	0.167	0.221	0.054	0.124
Number of tillers per plant	G				0.528**	0.071	-0.303*	0.702**	0.279*	0.784**
	P				0.084	0.070	-0.178	0.688**	0.272*	0.760**
spike length	G					0.050	-0.262*	0.556**	-0.185	0.360**
	P					0.057	-0.046	0.506**	-0.112	0.341**
Number of grains per spike	G						0.646**	0.368**	0.715**	0.588**
	P						0.035	0.361**	0.654**	0.563**
100 seed weight	G							0.236	0.365**	0.297*
	P							0.166	0.420**	0.312*
Biological yield	G								0.084	0.826**
	P								0.077	0.803**
Harvest endex	G									0.595**
	P									0.616**

Table 4. Direct and indirect effect of different character toward seed yield

Traits		Days to 50% flowering	Days to maturity	Plant height(cm)	Number of tillers per Plant	Ear length(cm)	Number of seeds per spike	100 seed weight (g)	Biological yield (g)	Harvest Index (%)	Seed yield per plant(g)
Days to 50% flowering	G	0.275	0.010	0.007	0.831	-0.026	0.006	-0.221	-0.428	0.008	0.462**
	P	0.023	0.001	0.002	0.076	-0.004	0.000	-0.006	0.286	-0.003	0.375**
Days to maturity	G	0.019	0.137	-0.006	-0.277	-0.004	0.049	-0.141	0.125	-0.027	0.123
	P	0.001	0.019	-0.002	-0.025	0.000	-0.001	-0.003	-0.068	0.018	-0.06
Plant height(cm)	G	-0.18	0.008	-0.111	0.012	-0.015	0.277	0.219	-0.178	-0.038	0.133
	P	-0.001	0.001	-0.040	-0.001	-0.003	-0.008	0.007	0.142	0.028	0.124
Number of tillers per plant	G	0.139	-0.023	0.001	1.652	-0.037	0.047	-0.266	-0.561	0.168	0.784**
	P	0.009	-0.003	0.000	0.186	-0.006	-0.001	-0.008	0.443	0.139	0.760**
spike length	G	0.102	0.008	-0.023	0.872	-0.070	0.33	-0.229	-0.444	0.112	0.360**
	P	0.007	0.000	-0.008	0.090	-0.013	-0.001	-0.002	0.326	-0.057	0.341**
Number of grains per spike	G	0.002	0.010	-0.046	0.117	-0.004	0.667	0.566	-0.294	-0.431	0.588**
	P	0.001	0.001	-0.017	0.013	-0.001	-0.020	0.019	0.233	0.335	0.563**
100 seed weight	G	-0.069	-0.022	-0.28	-0.501	0.018	0.431	0.876	-0.188	0.221	0.297**
	P	-0.003	-0.001	0.007	-0.330	0.001	-0.009	0.043	0.107	0.251	0.312**
Biological yield	G	0.148	-0.022	-0.025	1.161	-0.039	0.246	0.207	-0.799	-0.051	0.826**
	P	0.010	-0.002	-0.009	0.128	-0.007	-0.007	0.007	0.644	0.039	0.803**
Harvest endex	G	-0.004	0.006	-0.007	0.461	0.013	0.477	0.32	-0.067	-0.604	0.595**
	P	0.000	0.001	-0.002	0.051	0.002	-0.013	0.018	0.049	0.512	0.616**

Seed weight were recorded with harvest index; days to 50% flowering, number of fillers per plant, spike length, number of grains per spike with biological yield. The similar results have been reported by several workers Madake Mohehar *et al.* (2015), Kole (2009), Singh *et al.* (2008). Path coefficient analysis revealed that the characters biological yield per plant, harvest index and number of tillers per plant had high positive direct effect towards seed yield (Table 4).These traits also recorded strong significant positive association with seed yield per plant which is an accordance with the results of Madake Mohehar *et al.* (2015), Kole (2009), Singh *et al.*(2008). The character 100seed weight, days to 50% flowering and days to maturity had low positive direct effects as seed yield. Similarly the plant height, spike length and number of grains per spike had low negative direct effect on seed yield per plant. High positive indirect effect towards seed yield per plant were recorded for number of tillers per plant, spike length, number of grain per spike, days to 50% flowering, plant height and 100 seed weight and biological yield. The number of tillers per plant spike length, 100-seed weight, biological yield, number of grains per spike and harvest index are the most important yield contributing characters as the recorded high direct and indirect effect towards seed yield in barley.

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