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Studies on Genetic Variability and Interrelationship among the Different Traits in Barley (*Hordeum vulgare* L.) for Rainfed and Irrigated Environments

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Abstract

Twenty five diverse elite barely genotypes and three checks were grown in the two environment with three replications during Rabi 2013-2014 to study coefficient of variability, correlation, GCV, PCV, heritability and expected genetic advance for six characters. Significant variation were revealed for all the characters under study. High GCV and PCV were found for grain yield per plant, effective tillers per plant, 1000 grain weight and plant height in rainfed environment, while, for effective tillers per plant, grain yield per plant, and 1000 grain weight in irrigated environment. Estimates of heritability ranged from 21.81% for days to maturity to 89.55% for days to heading, while grain yield showed 48.61 % heritability in rainfed environment. And in irrigated environment it ranged from 15.17% for grain yield to 84.66% for 1000 grain weight. Positive and significant association was shown by grain yield per plant with only two traits viz. effective tillers per plant and plant height, while remaining traits showed negative association in both environments.

Key words: Rainfed, genetic advance, correlation, environment

Introduction

Barley (*Hordeum vulgare* L.) is one of the useful medicinal crops, which was widely grown from the time of agriculture origin. Among the cereals it is fourth cultivated crop after Wheat, Rice and Maize respectively. It is considered as one of the most suitable cereal crop, which can survive and grow over a wide range of soils and under many adverse climatic conditions compared with many other cereal crops (Saied and Ashraf, 2014). Barley originates from the Eastern Mediterranean region where plants experience many abiotic stresses in the field. It is an important winter cereal crop grown in the northern plains of India comprising the states of Uttar Pradesh, Bihar, Haryana, Rajasthan, Punjab, Madhya Pradesh, Himachal Pradesh and Uttarakhand that makes about 80% of total acreage of India.

Its production has become more intense and complex in recent years. From this reason it is necessary to carry out experiments to estimate the response of barley plants to a variety of adverse conditions, such as low and high solar energy availability, shortage or excess of water in soil, high temperature and salinity, which affects photosynthesis and yield formation (Kalaji, 2012). Drought is a major environmental stress reducing crop yield around the world (Bruce et al., 2002). The combined effects of drought and high temperature on the physiology, growth, water relations, and yield are significantly higher than the individual effects (Grigorova et al., 2011). Some genotypes can perform well, when grown under water stress condition and ultimately yield will be more. So to know the performance of genotypes, we need to grow them in both irrigated and water stress condition

Materials and Methods

Twenty five genotypes of HUBL series were used as test genotypes along with three checks. These genotypes were developed and maintained by All India Co-ordinated Barley Improvement Project. The present investigation was conducted during the rabi season at the Agriculture Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Sowing of same material was done in both rainfed as well irrigated conditions with Randomized Block Design and three replications. Each entry was sown with a six row of 5 meter length with row to row spacing of 25 cm and plant to plant spacing of 10 cm.

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Recommended package of all agronomic practices were followed to raise a good crop. Ten competitively plants were selected randomly for recording the data on yield and its contributing traits viz., days to heading, days to maturity, plant height, number of effective tillers per plant, 1000 grain weight and yield per plant. The mean data of each plot was used for statistical analysis.

The experimental data were subjected to statistical analysis as following standard statistical procedure described Panse and Sukhatme (1967) to assess component of variance and coefficient of variation. Genotypic and phenotypic coefficients of variation were estimated as per Burton (1952). The broad sense heritability and genetic advance as percent of mean were calculated as proposed by Johnson *et al.* (1955). Correlation coefficient between different characters were calculated as per Miller et al. (1958), path coefficient analysis was done as suggested by Dewey and Lu (1959).

Results and discussion

Analysis of variance indicated highly significant difference among the genotypes for all the characters studied in both rainfed as well as irrigated conditions. The mean values for each variety for different traits are given (Table 1), which showing the differences between different genotypes for different traits under study in both environments. Highest estimate of genotypic and phenotypic coefficient of variance was noted for grain yield per plant, effective tillers per plant, 1000 grain weight and plant height in rainfed environment, while, for effective tillers per plant, grain yield per plant, and 1000 grain weight in irrigated environment (Table 2). Hence, these traits could be utilized for selection programme. Similar results were also reported by Chand *et al.* (2008), Singh (2012), Kole (2006), Singh *et al.* (2008) and Jalata *et al.* (2011).

In the present investigation broad heritability was estimated for various traits in rainfed and irrigated conditions. In the rainfed, estimates broad sense heritability showed that it was high for days to heading, 1000 grain weight and plant height, while grain yield per plant, effective tillers and days to maturity showed moderate heritability. Study of heritability in irrigated condition showed high for 1000 grain weight, days to heading and days to maturity and moderate for effective tillers per plant and plant height (Table 2). Moderate genetic advance coupled with moderately high to high heritability for spikelet number and grain yield indicates preponderance of additive gene action for these two characters days to heading and 1000 grain weight in rainfed condition, indicates preponderance of additive gene action for these two characters. And in irrigated condition 1000 grain yield showed high heritability with high genetic advance. These finding was in accordance with Kole (2006), Boryana and Darina (2014), Pal *et al.* (2010) and Muhammad *et al.* (2012). The results on correlations (Table 3) indicated that grain yield per plant had positive and significant correlations with only two traits viz. effective tillers per plant and plant height, while remaining traits showed negative association in both environments.

Table 1. Genetic parameter for yield and its component traits

S.No.	Genotype	Days to Heading		Days to Maturity		Effective tillers/plant		Plant Height		1000 grain weight		Grain yield/ plant	
		Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated
1	HUBL-10-1	84.25	75.75	109.50	99.75	233.00	316.50	71.65	111.25	10.00	10.04	0.52	0.85
2	HUBL-10-2	66.25	70.25	96.25	95.75	234.00	355.00	75.65	101.75	9.76	10.05	0.82	0.95
3	HUBL10-3	69.75	64.75	98.00	93.25	255.00	378.50	81.40	102.00	7.41	9.80	0.95	0.92
4	HUBL10-4	63.75	68.00	94.25	95.00	193.00	315.75	65.60	82.50	9.26	9.28	0.57	0.75
5	HUBL10-5	72.75	69.75	97.00	96.50	246.50	461.00	73.75	97.00	9.45	9.61	0.90	0.77
6	HUBL10-6	86.25	73.50	111.50	97.75	196.25	349.75	79.30	100.75	10.95	11.24	0.62	1.00
7	HUBL10-7	72.25	74.25	94.25	98.00	321.25	570.25	68.85	95.00	12.25	12.25	0.82	0.92
8	HUBL10-8	85.00	76.25	109.00	102.25	201.75	312.75	74.80	106.75	10.02	10.02	0.57	0.80
9	HUBL10-9	69.5	73.75	95.00	97.75	233.20	427.25	74.00	102.00	13.27	13.27	0.77	1.12
10	HUBL10-10	69.25	72.25	95.50	97.25	333.75	435.00	72.80	102.50	11.46	11.46	0.75	0.87
11	HUBL10-11	70.25	73.75	92.25	97.50	295.75	511.00	68.30	101.25	1078	10.78	0.67	0.98
12	HUBL10-12	69.25	63.50	95.25	94.25	190.75	289.00	70.85	95.50	10.67	10.67	0.37	0.70
13	HUBL10-13	77.00	75.75	99.25	99.75	218.25	507.50	69.80	94.75	9.45	9.45	0.62	0.75
14	HUBL10-14	74.75	72.25	99.50	95.00	176.25	374.75	60.45	89.00	8.50	8.50	0.42	0.87
15	HUBL10-15	74.00	72.50	99.25	95.75	206.75	424.00	60.45	90.00	8.60	8.60	0.47	0.77
16	HUBL10-16	71.25	69.75	96.25	95.00	231.50	260.75	78.40	97.00	10.79	10.79	0.57	0.85
17	HUBL10-17	65.25	65.75	95.25	95.75	217.50	303.75	79.15	108.50	11.12	11.12	0.65	0.72
18	HUBL10-18	90.0 0	73.75	111.00	99.75	163.50	362.25	76.40	117.75	11.79	11.79	0.37	0.82
19	HUBL10-19	71.0 0	67.00	97.25	94.50	173.75	347.50	79.75	110.00	11.81	11.81	0.50	0.92
20	HUBL10-20	64.75	66.50	94.00	94.75	208.25	315.75	57.20	81.50	10.68	10.95	0.80	1.02
21	HUBL10-21	63.75	66.50	92.50	95.75	213.25	386.00	75.15	104.50	8.87	8.91	0.55	0.60
22	HUBL10-22	74.75	70.75	98.00	95.00	208.50	292.50	74.25	102.50	11.47	11.69	0.62	0.77
23	HUBL10-23	69.75	65.00	95.75	93.75	164.75	317.50	74.05	96.00	11.36	11.57	0.47	0.80
24	HUBL10-24	66.75	62.75	93.25	92.75	190.25	362.50	73.55	102.50	10.70	10.85	0.50	0.87
25	HUBL10-25	73.75	73.75	97.75	97.75	239.50	343.50	71.50	110.25	10.28	10.57	0.65	0.85
26	K-603 (c)	81.25	69.50	112.00	94.75	232.50	379.75	92.60	94.00	9.76	9.81	0.87	1.07
27	RD-2508 (c)	77.25	75.00	76.47	98.50	247.50	450.25	77.25	99.25	8.77	9.01	0.90	1.00
28	LAKHAN (c)	74.25	73.75	103.25	99.00	263.50	316.250	93.85	114.25	10.73	10.96	1.00	1.12

Table 2. Genetic parameter for yield and its component traits

S. No.	Character	Mean		Range		PCV		GCV		Heritability in broad sense %		Genetic advance as % of mean	
		Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated
1	Days to heading	73.14	70.53	63.75- 90.00	62.75- 76.25	9.90	6.21	9.37	5.48	89.55	77.97	18.27	9.97
2	Days to Maturity	98.15	96.51	76.47-112.00	92.75-102.25	11.69	2.90	5.46	2.17	21.81	55.82	5.25	3.34
3	Plant Height(cm)	73.70	100.35	57.20-93.85	81.50-117.75	13.64	12.87	10.22	6.65	56.18	26.70	15.78	7.08
8	Effective tiller/plant	224.62	373.79	163.25-333.75	260.75-570.25	26.27	26.28	15.57	17.58	35.13	44.75	19.01	24.22
10	1000 grain weight(g)	10.36	10.47	7.41-13.27	8.50-13.27	15.10	11.78	11.50	10.84	57.98	84.66	18.04	20.54
11	Grain yield/plant(g)	0.65	0.87	0.37-1.00	0.60-1.125	34.47	24.43	24.04	9.51	48.61	15.17	34.52	7.63

Table 3. Correlation coefficient analysis for yield and its components

	Environments	Days to heading	Days to maturity	Eeffective tiller/plant	Plant Height (cm)	1000 grain weight (g)	Grain yield/plant(g)
Days to heading	Rainfed	**1.00**	0.4448	-0.1621	0.1296	0.0320	-0.1678
	Irrigated	**1.00**	0.2369	-0.0957	0.1569	0.0425	-0.1114
Days to maturity	Rainfed		**1.00**	-0.0761	0.1472	0.0289	-0.0379
	Irrigated		**1.00**	0.0327	0.213	0.0751	-0.0154
Eeffective tiller/plant	Rainfed			**1.00**	0.1773	0.0318	0.5299
	Irrigated			**1.00**	0.2897	0.1424	0.4993
Plant Height (cm)	Rainfed				**1.00**	0.1226	0.3908
	Irrigated				**1.00**	0.3251	0.4215
1000 grain weight (g)	Rainfed					**1.00**	-0.1216
	Irrigated					**1.00**	-0.052
Grain yield/plant(g)	Rainfed						**1.00**
	Irrigated						**1.00**

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