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EVALUATION OF BARLEY (*HORDEUM VULGARE* L.) GENOTYPES FOR YIELD AND YIELD CONTRIBUTING TRAITS IN NORMAL SOWN CONDITION

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Abstract

An experiment was conducted to get information on genetic variability, heritability and genetic advance for twenty five genotypes of barley by using randomized block design in *rabi* during 2017-18 at the Agricultural Research Farm, School of Agriculture, Lovely Professional University. Quantitative analysis were carried out for all the characters which are directly or indirectly associated with the yield and there yield related characters. ANOVA showed were significant variability for all the studied traits. Moderate heritability was showed for grain yield per plant followed by harvest index, 1000 grain weight and grains per spike. Highest value of genotypic coefficient of variation and Phenotypic coefficient of variation was showed the grain yield per plant (14.06 and 21.97). Were observed high genetic variation between the all characters were moderately (30 to 60%) or low (<20) heritability which indicates that the environmental influence is high on characters. Moderate heritability associated with low GA (genetic advance) showed for these traits *i.e.* effective tillers per plant, plant height, biological yield, spike length, days to maturity, awn length, days to 50% flowering, biological yield, and awn length, which indicates were traits showed were highly environmental effects and genetic improvement through selected characters would be ineffective under study.

Key words: PCV, GCV, heritability, genetic advance, grain yield.

Introduction

Barley (Hordeum vulgare L.), 2n=14, belonging to family gramineae and grown as a 4th mostly grown and important crop in the world after wheat, maize and rice (Madakemohekar *et al.*, 2018). It is annual cereal crop of dry land agriculture due to its ability to tolerate drought, fluctuations in temperature, biotic and abiotic stresses (Roden 1997). Since pre-historic times, it was primarily consumed, as human food in the form of Cha-Patti and Sattu but barley alternately using now more for brewing and medicine industry, that's why it is important crop of present era. It have very good medicinal value like, treating hyper cholesteremia (Anderson *et al.*, 1990) and reduce the serum cholesterol level in the blood because presence of bran and bran oil (Arun Kumar *et al.*, 2016).

In India barley mainly grown as a fodder. It is mainly cultivated in Rajasthan, Uttar Pradesh, Bihar, Haryana, Uttaranchal, Punjab, Rajasthan, Madhya Pradesh, Chhattisgarh, Bihar and West Bengal. Rajasthan has a lion's share accounting for 40% of the total production. This barley production worldwide in crop from 2008-2009 to 2016-2017. In 2016- 2017 crop year, in one hand barley production amounted to approximately 148.03 mt from nearly sixty million hectares of land. Other hand, European unions are the first maintaining barley producer worldwide, with the production 59.9 mt (FAO). Cereals are less environmental effects as compared to the any other crops because of its resistance mechanism to tolerance to drought conditions. Although it requires less fertilizer and irrigation and its price stands in market equal to wheat. Till date availability of desirable genotypes with better yielding is not completely satisfactory. Hence effort is being made to develop the desirable genotype which also can be adopted in various range of environmental stress; it is the ultimate goal of plant breeders (Sabaghpour *et al.,* 2003). 'Fertile crescent' is the first originated. Vast

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amount of diversity have been observed in Nepal regions. (Azhaguval and Komatsuda 2007).

Inspite of its nutritional and medicinal value it is needed to be give more emphasis towards crop improvement programme. In any breeding programme aiming at improving yield, it is essential to know, the degree of association between yield and other metric traits. Mainly grain yield is the great component trait and it's affected by the environmental conditions. The each component character had their own genetic value. It would be affected by the environmental variation although separate the total genetic variation in to the heritable, non- heritable genetic advance, phenotypic coefficient of variation and genotypic coefficient of variation. (Binod *et al.,* 2013). In order to develop new hybrids for higher productivity of grain yield evaluation of genotypes is considered as basic step in any breeding programme.

Materials and methods

The study involved twenty five genotypes of barley collected from the Banaras Hindu University (table 1). The present investigation was conducted during the *rabi s*eason of 2017-2018 in the farm of lovely professional university, department of plant breeding and genetics, school of agriculture, Phagwara. Were design used Randomized Block design (RBD). Sown during the November, 25th 2017. In one replication each plot comprised of 5 rows and three meter length with spacing distance between row to row 30cm and plant to plant 10cm (30 × 10) respectively. All the cultural operations were carried to grow the crop effectively. Five representative plants from each plot were randomly marked to record the data for 11 Characters *viz.,* effective tillers per plant, plant height, grains per spike, days to maturity, awn length, days to 50% flowering, spike length (cm), 1000 grain weight, biological yield, grain yield per plant ,and harvest index. The experimental material comprised twenty five barley genotypes (table 1). The mean data of 5 plants for finding the significance by using the method of fisher (1935). GCV and PCV were calculated by using this method described by Burton (1952). Were used phenotypic coefficient of variation and genotypic coefficient of variation formed as low, moderate followed by Subramanian (1973).

Results and discussion

The mean sum of square in ANOVA revealed high variability among 25 genotypes for all the characters showing significant differences *i.e.* 1% level of probability. The significant differences remaining characters were endorsed to their genetically germplasm line are collected from the different regions. The mean performance of various genotypes has also showed good range of variability for various characters which were studied in present investigation. The range recorded for days to 50% flowering (89- 96.66), plant height (94.76-138.66), spike length (7.56 -11.1), awn length (10.2-13.56), days to maturity (117.66-130.66), grain yield per plant (31.16-57.4) and biological yield (100.53-160.93), effective tillers per plant (16-27.93), grains per spike (44.73-60.6), 1000 grain weight (38.26-63.03) and harvest index (24.42-36.86) (Table 3) were similar results showed by Baranwal *et al.,* (2014).

According to investigation was observed the magnitude of genotypic coefficient of variation (GCV) higher for the most of the characters pairs than their respective values of phenotypic coefficient of variation were results founded low range observed between phenotypic coefficient of variation and genotypic coefficient of variation (table 4). So characters showed less environmental effects and it is observable. Similar results were founded by Aidun *et al.,* (1989) and Ram *et al.,* (2010).

The genotypic coefficient of variation ranged from 1.15 % to 14.06%. Higher magnitude of GCV was

Table 1: List of genotypes and source.

S.No.	Genotypes	Source
1	RD 2503	Banaras Hindu University, Varanasi
2	DL 70	Banaras Hindu University, Varanasi
3	HIMANI	Banaras Hindu University, Varanasi
4	WFBCB 91	Banaras Hindu University, Varanasi
5	VMORLES	Banaras Hindu University, Varanasi
6	RD 2035	Banaras Hindu University, Varanasi
7	HORMAL	Banaras Hindu University, Varanasi
8	AZAD	Banaras Hindu University, Varanasi
9	DWRUB 73	Banaras Hindu University, Varanasi
10	KR 521	Banaras Hindu University, Varanasi
11	RATNA	Banaras Hindu University, Varanasi
12	K 741	Banaras Hindu University, Varanasi
13	KR 92	Banaras Hindu University, Varanasi
14	HUB113	Banaras Hindu University, Varanasi
15	ATHOVLPPL	Banaras Hindu University, Varanasi
16	RD 2508	Banaras Hindu University, Varanasi
17	DOLMA 6	Banaras Hindu University, Varanasi
18	BH 902	Banaras Hindu University, Varanasi
19	K 745	Banaras Hindu University, Varanasi
20	CLIPPER	Banaras Hindu University, Varanasi
21	K 603	Banaras Hindu University, Varanasi
22	BH 946	Banaras Hindu University, Varanasi
23	LAKHAN	Banaras Hindu University, Varanasi
24	KARAN 19	Banaras Hindu University, Varanasi
25	JAGRA 71	Banaras Hindu University, Varanasi

Table 2: Morphological traits of barley genotypes.

Sr. no	Character	Days to 50% Flowering	Plant height	Spike Length cm	Awn Length	Days to Maturity	Grain Yield /plant	Biologi-cal yield /plant	Effective tillers /plant	Grgains Per Spike	1000 Grain Weight	Harvest Index
1	RD 2503	93.6667	121.8000	9.3867	11.8333	125.0000	35.7000	127.0000	18.2667	44.7333	43.7333	28.2933
2	DL 70	91.6667	118.6667	9.6667	12.0000	119.3333	38.7333	131.5333	24.6333	47.5333	41.9000	29.4667
3	RD 2503	93.6667	126.4000	9.6333	11.7000	123.0000	54.4333	160.9333	22.3333	51.9667	49.9667	34.0533
4	WFBCB 91	93.3333	115.2000	8.9000	12.3333	123.3333	36.3000	142.4333	20.2667	50.3333	48.5000	25.7033
5	VMORLES	92.0000	106.8000	8.8000	10.9667	119.6667	54.7000	158.0667	23.8667	52.0000	52.0333	34.9500
6	RD 2035	93.6667	113.6000	7.5667	10.2000	123.3333	44.6333	121.9667	18.6667	48.4667	48.9333	36.7100
7	HORMAL	89.0000	102.7333	9.2333	10.8333	129.3333	36.6000	124.2667	25.4000	53.7333	63.0333	29.4100
8	AZAD	91.0000	94.7667	9.1333	10.5333	127.3333	45.5667	146.9333	22.1333	60.6000	38.2667	31.2167
9	DWRUB73	91.3333	138.6667	8.9000	11.3667	129.3333	45.9667	125.3333	19.8000	60.1333	56.0000	36.8267
10	KR 521	90.3333	123.5333	9.3333	13.5667	129.3333	55.0667	150.0667	23.6667	59.1333	38.4000	36.2133
11	RATNA	91.3333	107.5333	9.4667	12.1667	121.3333	50.9333	155.4667	21.2000	57.8667	53.2667	32.6433
12	K 741	92.3333	109.7500	9.0333	10.7467	119.6667	43.4000	135.0000	22.7667	52.7333	45.2667	32.2933
13	KR 92	92.0000	106.5333	8.0667	12.5000	130.6667	43.4000	132.4667	27.9333	52.8667	48.4333	32.8767
14	HUB 113	91.0000	109.0000	8.2733	11.1867	125.0000	38.7333	158.8667	19.3333	46.9333	46.9333	24.4233
15	ATHOVLPPL	90.6667	117.2000	9.0667	12.8333	123.3333	35.0000	138.6667	17.2000	45.3333	46.1000	25.2433
16	RD 2508	89.6667	107.5333	8.7333	12.3000	126.6667	36.3667	138.6333	19.0667	55.3333	46.8333	27.0267
17	DOLMA 6	90.6667	101.8000	9.7000	10.6667	126.6667	36.0000	100.5333	16.0000	54.7333	41.6667	35.5000
18	BH902	92.3333	112.0000	7.9333	10.5000	117.6667	57.4000	158.6000	23.2000	56.7333	46.6000	36.3133
19	K 745	92.3333	122.4000	8.7333	10.9667	123.3333	43.8667	136.1667	20.9333	51.2667	47.0333	32.2133
20	CLIPPER	92.6667	117.6000	9.4000	13.3000	119.3333	31.1667	105.2667	16.0667	50.0667	47.2000	29.7733
21	K 603	91.6667	123.6000	9.4000	12.6333	117.6667	48.0000	130.2333	21.9000	53.6667	45.7667	36.8600
22	BH 946	92.6667	112.6667	9.1667	11.0533	117.6667	34.8667	118.7333	21.4667	51.6000	46.4333	29.5567
23	LAKHAN	93.6667	125.4667	9.5667	13.0867	123.0000	38.4667	133.3333	20.8000	60.1333	43.5333	28.6967
24	KARAN 19	93.6667	113.8667	11.1000	10.4333	125.0000	46.6333	142.9833	24.2333	53.2000	44.4667	32.5933
25	JAGRA 71	96.6667	106.4000	8.7000	10.8000	119.6667	43.2667	130.3333	21.4667	49.2667	51.6667	33.1767
Mean		92.1200	114.2207	9.0757	11.6203	123.4267	43.0080	136.1527	21.3040	52.8147	47.2787	31.6813
C.V.		2.2717	8.0364	8.0449	10.1370	3.9875	16.8848	14.9515	16.7340	7.8067	11.2662	10.0356
F ratio		1.7752	3.2594	2.7460	2.1397	1.9662	3.0820	1.8334	1.9832	3.6361	2.9917	4.3020
F Prob.		0.0452	0.0003	0.0015	0.0125	0.0231	0.0005	0.0369	0.0218	0.0001	0.0006	0.0000
S.E.		1.2082	5.2996	0.4215	0.6801	2.8415	4.1926	11.7530	2.0583	2.3805	3.0753	1.8356
C.D. 5%		3.4356	15.0693	1.1986	1.9338	8.0797	11.9216	33.4195	5.8526	6.7688	8.7444	5.2196
C.D. 1%		4.5830	20.1024	1.5990	2.5797	10.7783	15.9033	44.5814	7.8074	9.0296	11.6650	6.9629
Range Lowest		89.0000	94.7667	7.5667	10.2000	117.6667	31.1667	100.5333	16.0000	44.7333	38.2667	24.4233
Range Highest		96.6667	138.6667	11.1000	13.5667	130.6667	57.4000	160.9333	27.9333	60.6000	63.0333	36.8600

Table 3: Analysis of variance for morphological traits of barley genotypes.

Sr. no	Source of Variation	d. f.	MEAN SUMS OF SQUARES										
			Days to 50% Flowering	Plant height	Spike Length cm	Awn Length	Days to Maturity	Grain Yield /plant	Biologi-cal yield /plant	Effective tillers /plant	Grgains Per Spike	1000 Grain Weight	Harvest Index
1	Replications	2	1.560	161.65	0.196	0.917	4.333	7.834	729.83	25.65	2.0389	74.137	19.174
2	Genotypes	24	7.774*	274.62***	1.463**	2.969*	47.625*	162.52***	759.76*	25.20*	61.81***	84.87***	43.48***
3	Error	48	4.379	84.25	0.533	1.387	24.22	52.73	414.40	12.709	16.99	28.371	10.108
4	S. Ed ±	-	1.183	5.192	0.413	0.666	2.784	4.107	11.515	2.016	2.332	3.013	1.98
5	CD	-	3.1752	13.927	1.107	1.787	7.467	11.018	30.886	5.4091	6.255	6.058	8.081

*Significant at 5% **Significant at 1%

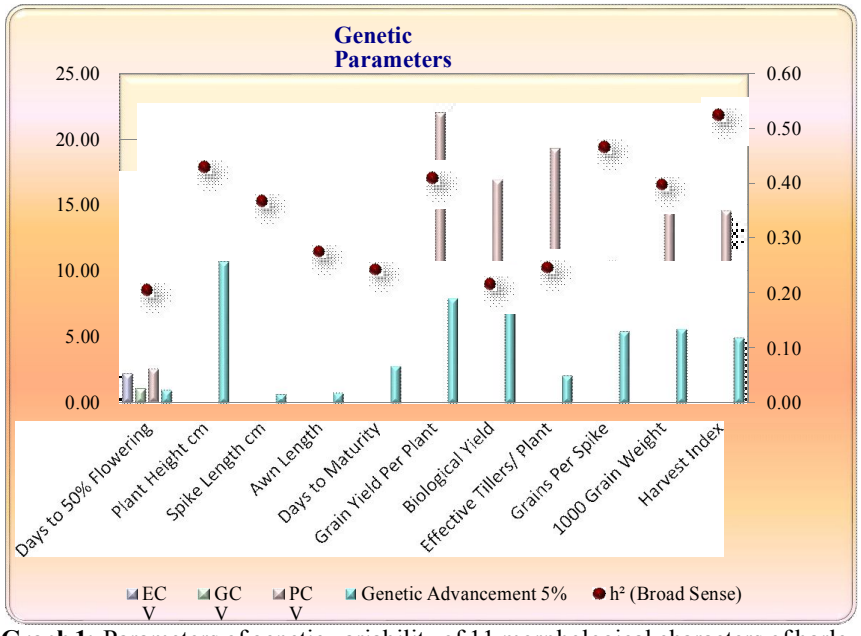
observed by grain yield per plant (14.06%), similar finding reported by Jafar *et al.,* (2016), Milomirka (2005), Ram *et al.,* (2000) and Zahid *et al.* (2008). Low amount of GCV estimated for harvest index (10.52), 1000 grain

Table 4: Parameters of genetic variability for morphological traits of barley genotypes.

Sr. No.	Character	Range		Mean	GCV (%)	PCV (%)	h² (bs) (%)	GAPM
		Min	Max					
1	DTF	89	96.66	92.12	1.154	2.548	20.53	1.078
2	PH	94.76	138.66	114.22	6.974	10.64	42.9	9.416
3	SL	7.566	11.1	9.075	6.137	10.11	36.79	7.668
4	AL	10.2	13.566	11.62	6.248	11.9	27.53	6.753
5	DTM	117.66	130.66	123.42	2.262	4.584	24.36	2.3
6	GYPP	31.166	57.4	43	14.066	21.976	40.9	18.546
7	BYP	100.533	160.933	136.15	7.88	16.901	21.7	7.569
8	ETPP	16	27.93	21.3	9.58	19.28	24.68	9.805
9	GPP	44.733	60.6	52.814	7.318	10.7	46.77	10.309
10	1000GW	38.266	63.033	42.278	9.179	14.53	39.9	11.944
11	HI	24.42	36.86	31.68	10.528	14.545	52.4	15.699

PCV (%) - Phenotypic coefficient of variation, GCV (%) - Genotypic coefficient of variation, H^2- Heritability, GA (%) - Genetic advance as per mean

weight (9.17), effective tillers per plant (9.58), biological yield (7.88), grains per spike (7.31), plant height (6.97), awn length (6.24), spike length (6.13) and days to maturity (2.26). Similar finding was observed by Mittal *et al.,* (2009). A high value of GCA is magnitude of high variability present in genetic population between the genotypes and thus the future purpose scope development of the genetic improved characters by the simple selection would be better to the plant breeder. PCV ranged from 21.97% to 2.54%. Highest magnitude of PCV were observed for the effective tillers per plant (19.28) followed by grain yield per plant (21.97%) and biological yield (16.90), similarly results founded by Wondimu *et al.,* (2011), and Pal *et al.,* (2010) whereas low amount of PCV were recorded for harvest index (14.54), 1000 grain weight (14.53), awn length (11.9), plant height (10.64), spike length (10.11) and days to maturity (4.58). Identify similar results showed the Jalal (2012), Jaydev *et al.,* (2017) and Shrimali *et al.,* (2017).



Graph 1: Parameters of genetic variability of 11 morphological characters of barley genotype

However estimates of heritability were moderate (30 to 60%) to low (<20) for all the studied character, also reported by Baranwal *et al.,* (2014). The estimates of heritability (%) in broad sense for 11 characters studied, which range from high to low (52.4 % to 21.7%) respectively. Out of eleven characters nine characters observed for moderate heritability *viz.*, harvest index (52.4), grain per spike (46.77), plant height (42.9), grain yield per plant (40.9), 1000 grain weight (39.9), spike length (36.79), awn length (27.53), days to maturity (24.36), effective tillers per plant (24.68), biological yield (21.7) and days to 50% flowering (20.53). As suggested by Jafar *et al.,* (2016). Were showed overall mean genotypic values increased over the selected parent genotypes. The greater the genetic variability the higher is the genetic advance vice versa.

Were studied genetic advance of 11 characters studied, Expected genetic advance (GA) as percentage of mean which range from 1.07% to 18.54%. Moderate genetic advance were recorded for grains per spike (10.30) followed by grain yield per plant (18.54), harvest index (15.69) and 1000 grain weight, (11.94). Low estimates of genetic advance were observed for effective tillers per plant (9.80), plant height (9.41), spike length per plant (7.66), biological yield per plant (7.56), awn length (6.75), days to maturity (2.30) and days to 50% flowering (1.07) (table 4). Moderate heritability showed for characters *viz.*, plant height, effective tillers per plant, awn length, days to maturity, spike length, and biological yield. Which shows that these traits could be considered as indices for selection and responses of this trait could be expected from selection as suggested by the Aidun *et al.,* (1989), Ram *et al.,* (2010), Hashash *et al.*, (2018).

Conclusion

The present study revealed that were ANOVA showed significant for all the traits studied. expect harvest index it was useful for the breeder for direct selection of the good range of genotypes. The values of variation both genotypic and phenotypic coefficient of variations moderately recorded for harvest index, grain yield per plant. Moderate heritability coupled with moderate genetic advance for these characters *viz.,* plant height, spike length, biological yield, and effective tillers per plant. In this investigation relationships of yield and yield contributing traits and selection would be better genotypes of barley and improvements of cultivars.

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