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Studies on genetic variability, correlation and path analysis for yield and its contributing traits in barley *(Hordeum vulgar* L.*)* under rainfed environment.

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Abstract

A study was undertaken to analyze the genetic variability, correlation and path coefficient analysis of yield and its contributing traits in 14 parents and their 40 F1 crosses for twelve component characters, grown at BHU Agricultural Research Farm, during Rabi season of 2013-14. High GCV and PCV were observed for number of effective tiller per plant, stomatal conductance, spike length and awn length. High heritability coupled with high genetic advance was obtained with number of grains per plant, effective tillers per plant, stomatal conductance, spike length and awn length. Number of effective tiller per plant, stomatal conductance, harvesting indix and awn length were the most important characters which possessed positive association with grain yield, while only plant height showed negative association. Path coefficient analysis revealed that among the different yield contributing characters, number of effective tiller per plant, harvesting index, 1000 grain weight and number of grains per panicle influenced grain yield per plant directly. The direct effects of these characters on grain yield were positive and considerably high.

Keywords: yield, rainfed, correlation, heritability and traits.

Introduction:

Barley (*Hordeum vulgar* L.) is the world's fourth most important cereal after wheat, rice, and corn. The annual world harvest of barley in the late century was approximately 140 million tonnes from about 55 million ha. Average productivity in India is 19.3 q/ha as compared to 24.7 q/ha of worlds average. The greatest share of the world's barley grain is used for animal feed, followed by malting and human food. Archaeologists and scientists who have attempted to reveal more of the historical developments of human and their attempts at cultivating barley do not conclusively agree on exactly where these events occurred (De Candolle, 1895). Barley is a tolerant crop that was adapted to dry conditions and environmental stresses and having attributes such as green pastures at tillering stage, grain yield and its use in the food industry, cropping systems in arid regions of the world (Abay *et al.* 2008). Therefore, morphological and phenological evaluation of barley is necessary to determine their importance on grain yield increasing.

Grain yield is a complex quantitative character, highly influenced by environmental fluctuations. Therefore, before embarking on grain yield improvement it is necessary to understand the relationships existing between grain yield and other metric traits of the crop (Eleweanya *et al.* 2005). There is a need for the development of new barley cultivars that tolerate abiotic and biotic stresses for the improvement of crop productivity (Ellis *et al*. 2000). This will require good understanding of the available genetic variation in both wild and cultivated barley. The rate of progress, however, will depend on the occurrence of desirable genetic variation and the availability of precise methods of identification, selection and transfer of superior genes (Ellis *et al*. 2000). Therefore it is required that precise and

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comprehensive information of the genetic parameters controlling the components of yield is collected and used for making decisions on the selection of an appropriate breeding method. Therefore, in view of this fact 14 parents and their 40 F1 crosses for twelve component characters were evaluated in this study, with an objective of the screening genetic variability present in the genotypes for yield and its contributing characters.

Materials and methods

Genetic materials, for the present investigation comprised of four testers (RD 2508, K 603, BH 902 and Lakhan) and ten lines (Morac 9-75, Rihane, Pristage, Yardu, Himani, Athoulpa, V Morles, Kheel, BHSH 126 and Marriya). Line x Tester fashion was followed for making 40 F_{1s}, using testers as female and lines as male parents. These 40 F_{1s} were evaluated with parents in Randomized Block Design with 3 replications during 2012-13 and 2013– 2014 at the Institute of Agricultural Sciences, Agricultural Research Farm of Banaras Hindu University, Varanasi, India (25˚18 N lat., 83˚03 E long. and 75 m amsl.). Single row 5.0 m in length at the distance between rows was 0.25 cm was followed for sowing of F_{1s} and parents. All the recommended cultural practices were applied to raise a good crop. Ten random plants were selected and tagged for recording the data on twelve yield and its contributing traits viz., days to heading, days to maturity, number of tillers per plant, plant height, grains per spike, spike length, awn length, 1000 grain weight, chlorophyll content, harvest index, proline content and grain yield per plant.

Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated by the method suggested by Burton (1952). Correlation coefficients were calculated for all the character combinations at genotypic and phenotypic levels as per the formula given by Miller *et al.* (1958). Wright (1921) proposed the original technique but the analysis was carried out by modified method devised by Dewey and Lu (1959). Path coefficients were rated based on the scales given by Lenka and Mishra (1973). The mean range, phenotypic and genotypic coefficient of variation, heritability estimate genetic advance percent of mean are presented in Table 1.

Results and discussion

In the present investigation, analysis of variances for genetic advance showed highly significant difference among the genotypes for all the twelve characters studied, including appreciable amount of variability between the genotypes. During the study of genotypic and phenotypic coefficient of variance were observed high for number of effective tiller per plant, stomatal conductance, spike length and awn length. High heritability coupled with high genetic advance was obtained with number of grain yield per plant, effective tiller per plant, stomatal conductance, spike length and awn length (Table 1). These finding are in agreement with those of Jalata *et al*. (2011), Singh et al. (2014) and Shahinnia *et al.* (2005). Heritability in broad sense was high for all the observed twelve studied characters under moisture stress and no any trait showed moderate of low heritability. High heritability coupled with high genetic advance were exhibited for character *viz.,* grain yield per plant, number of effective per plant, Stomatal conductance, spike length, awn length, number of grains per plant and chlorophyll content. This indicated predominantly the presence of additive gene action in the expression of these traits and consequently greater chance of improving these traits through simple selection. These results are in agreement with the finding of Singh (2011), Addisu and Shumet (2015) and Manoj *et al.* (2013).

The phenotypic correlations for morpho-agronomic traits are presented in Table 2. Number of effective tiller per plant, stomatal conductance, harvesting index, awn length days to heading, number of grains per panicle and 1000 grain weight were the most important characters which showed possessed positive association with grain yield, while only plant height showed negative association. new levels of productivity in barley. The significant positive correlation of tillers per plant with yield per plant has been reported by Mondal et al. (1997) and Jalal (2012). The path coefficient analysis (Table 3) revealed that number of effective tiller per plant, harvesting index, 1000 grain weight, number of grains per panicle and stomatal Since these traits assume importance in efforts to attain conductance had positive direct effect on grain yield per plant and therefore these traits will be given due importance while practicing selection aimed to improve grain yield in barley. Plant height and days to maturity showed negative direct effect on grain yield per plant.

Table 1. Genetic parameter for yield and its component traits

S.No.	Character	Mean	Range	PCV	GCV	Heritability in broad sense %	Genetic advance as % of mean
1	Days to heading	82.39	75.06-88.11	3.81	3.79	99.27	7.79
2	Days to Maturity	113.71	108.33-118.66	2.32	2.24	93.32	4.46
3	No. of effective tiller/plant	13.19	6.20-30.03	36.18	36.14	99.79	74.38
4	Plant Height(cm)	100.04	84.40-114.05	6.23	6.22	99.60	12.78
5	No. of grains/ear	75.83	54.77-95.96	12.62	12.60	99.71	25.92
6	Spike length (cm)	9.75	6.76-11.71	14.01	13.97	99.49	28.71
7	Awn length (cm)	14.45	10.59-18.17	14.04	14.00	95.66	28.75
8	1000 grain weight(g)	48.49	37.15-56.47	8.88	8.86	99.61	18.23
9	Chlorophyll content	42.43	29.38-51.26	11.10	10.96	97.51	22.30
10	Stomatal conductance	786.44	397.55-1197.66	24.47	24.34	89.75	49.87
11	Harvesting index	45.106	34.69-58.44	9.47	9.45	99.56	19.47
12	Grain yield/plant(g)	40.98	12.98-90.99	40.51	40.50	95.78	83.42

Table 2. Correlation coefficient analysis for yield and its components

	DTH	DTM	NOET	PH	NOGPP	SL	AL	1000 GW	CC	SC	HI	GY
DTH	1.000	0.7470	0.1464	-0.2513	-0.0051	0.0586	0.0814	-0.1561	-0.0060	0.2705	0.0011	0.1596
DTM		1.000	0.0627	-0.1515	-0.0683	-0.0345	-0.0459	-0.1135	0.0676	0.0977	-0.0472	0.0467
NOET			1.000	0.1168	0.0642	0.2335	0.1615	0.1237	0.2767	0.2290	-0.0424	0.4545
PH				1.000	0.1932	0.2422	0.2895	0.4508	0.3100	-0.2089	0.1128	-0.0692
NOGPP					1.000	0.7595	0.5624	0.1037	0.0873	0.2065	0.2037	0.1480
SL						1.000	0.5826	0.2295	0.1020	0.3321	0.2651	0.1883
AL							1.000	0.1590	0.2912	0.2941	0.2092	0.2148
1000 GW								1.000	0.1451	-0.0006	0.0278	0.1172
CC									1.000	0.2018	-0.08310	0.1497
SC										1.000	0.1007	0.3238
HI											1.000	0.2412
GY												1.000

Abbreviation- DTH- days to heading, DTM- days to maturity, NOET- number of effective tiller, PH- plant height, NOGPP- number of grains per panicle, SL- spike length, AW- awn length, 1000 GW- 1000 grain weight, CC- chlorophyll content, SC- Stomatal conductance, HI- harvesting index, GY- grain yield

Table 3 : Path coefficient analysis for yield and its components

	DTH	DTM	NOET	PH	NOGPP	SL	AL	1000 GW	CC	SC	HI
DTH	**0.0656**	0.0490	0.0096	-0.0165	-0.0003	0.0038	0.0053	-0.0102	-0.0004	0.0177	0.0001
DTM	-0.02910	**-0.0390**	-0.0024	.0059	0.0027	0.0013	0.0018	0.0044	-0.0026	-0.0038	0.0018
NOET	0.0644	0.0276	**0.4400**	0.0514	0.0283	0.1028	0.0711	0.0544	0.1217	0.1008	-0.0187
PH	0.0522	0.0315	-0.0243	**-0.2078**	-0.0402	-0.0503	-0.0602	-0.0937	-0.0644	0.0434	-0.0234
NOGPP	-0.0008	-0.0104	0.0098	0.0294	**0.1520**	0.1154	0.0855	0.0158	0.0133	0.0314	0.0310
SL	-0.0115	0.0068	-0.0457	-0.0474	-0.1486	**0.0017**	-0.1140	-0.0449	-0.0200	-0.0650	-0.0519
AL	0.0073	-0.0041	0.0144	0.0258	0.0501	0.0520	**0.0892**	0.0142	0.0260	0.0262	0.0187
1000 GW	-0.0254	0.0185	-0.0202	0.0735	0.0169	0.0374	0.0259	**0.1630**	0.0237	-0.0001	0.0045
CC	-0.0003	0.0032	0.0131	0.0147	0.0041	0.0048	0.0138	0.0069	**0.0473**	0.0095	-0.0039
SC	0.0369	0.0133	0.0313	-0.0285	0.0282	0.0453	0.0402	-0.0001	0.0275	**0.1365**	0.0137
HI	0.0003	-0.0127	-0.0114	0.0304	0.0549	0.0714	0.0563	0.0075	-0.0224	0.0271	**0.2693**

R SQUARE = 0.3619 RESIDUAL EFFECT = 0.7988

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