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Correlation and Path Analysis for Seed Yield and Its Contributing Character in Barley (*Hordeum vulgare* L.)

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ABSTRACT

A trial was conducted to study selection parameters for grain yield and related characters in a diallel cross set 10 parents, 45 F_{1S} and 45 F_{2S} barley were evaluated in randomized complete block design with three replications. Grain yield per plant exhibited positive and highly significant correlation with plant height, number of productive tillers per plant, length of spike, 1000- grain weight, biological yield per plant and harvest index. while it showed positive and non- significant correlation with days to maturity, Canopy temperature depression, leaf area index and number of grains per spike. The negative and non-significant correlation with days to 50% flowering and grain weight per spike at phenotypic levels. Highest positive and substantial direct on grain yield per plant were exerted by biological yield per plant and harvest index at phenotypic level. Low values of direct were recorded for remaining characters and indicated that direct contribution of these characters was low. The path coefficient analysis helps in partitioning of the total correlation into its direct and indirect components. The correlation coefficient measuring the degree of symmetrical association among two or more variable, which helps in understand the nature and quantify of association between yield and its attributes the significance genotype correlation could not be tested as an any suitable statically test is not available, yet there magnitude is considered in relation to the corresponding phenotype estimates.

Key words: *Barley, Correlation co-efficient, Path co-efficient, Grain yield per plant.*

INTRODUCTION

In European countries it is used as a breakfast food. Due to low gluten, it is easily digestible as compared to wheat. The Near East i.e. Java Island is considered to be the origin of common barley. Barley together with emmer wheat was the first cereal to be domesticated in the Middle East, at least 9000 years ago. The first archaeo botanical material of barley was two rowed barley which closely resemble with some races of wild barley, i.e., *Hordeum spontaneum.*

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Barley must have been introduced in India soon after the coming of the Aryans. In India it is grown to a limited area particularly in states of Rajasthan, UP, MP, Haryana, Punjab, Bihar, Himanchal, Uttarakhand & Jammu & Kashmir. The mean values, genotypic and phenotypic variances, correlation coefficients and path coefficient analysis of the traits are some of the key parameters which determine the efficiency of a breeding program. The phenotypic variance includes total variance among genotypes tested for variance traits. Total genotypic variance explains heritable portion of phenotypic variance. It encompasses the phenotypic variance attributable to genetic causes which have a predictive function in plant breeding leading to permanent genetic improvement. Coefficient of correlations help to measure the level of relationships between the traits. The correlations also give reliable and useful information on nature, extent and direction of selection. Path analysis showed direct and indirect effects of cause variables on effect variables. In this method, the correlation coefficient between two traits is separated into the components which measure the direct and indirect effects. Generally, this method provides more information among variables than do correlation coefficients since this analysis provides the direct effects of specific yield components on yield, and indirect effects via other yield components. This study aimed at understanding the genetic parameters which determine the relationship between barley yield and other related traits.

MATERIAL AND METHODS

Basic material of the trial was taken on the basis of morphological differences for various characters in genotype from the genetic stock of barley, maintained by breeder at AICRP plan of the university. Genetic stock of barely maintained through natural self pollination of section of rabi cereal, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. Each parent, F_{1s} and F_{2s} treatment was sown in RBD (RANDOMIESD BLOCK DESIGN) in single and double rows of 3m length along with row to row and plant to plant spacing of 22.5 cm and 5 cm, respectively. Recommended package of practice was applied to raise healthy crop. The data was recorded for days to 50% flowering, days to maturity, plant height (cm), number of productive tillers per plants, canopy temperature depression (^{0}C), length of spike (cm), leaf area index, number of grains per spike, grain weight per spike (g), 1000-grain weight (g), biological yield per plant (g), harvest index (%), and grain yield per plant(g) Mean data were used for statistical analysis

RESULTS AND DISCUSSION

Correlation and path coefficient analysis

Analysis of variance revelled significant coefficient difference among the parents F_1 s , F_2 s , parent vs F_1 s and parents vs F_2 s indicating considerable variability among the genotypes for studied characters. The combined correlation coefficient at genotypic and phenotypic levels were worked out among pair of 13 characters and presented in table 1.

The correlation coefficient measuring the degree of symmetrical association among two or more variable in table 2 and 3, which helps in understand the nature and quantify of association between yield and its attributes. Grain yield per plant exhibited positive and highly significant correlation with plant height, number of productive tillers per plant, length of spike, 1000-grain weight , biological yield per plant and harvest index. while it showed positive and non- significant correlation with days to maturity canopy temperature depression, leaf area index and number of grain per spike. The negative and non-significant correlation with days to 50% flowering and grain weight per spike at phenotypic levels. similar traits of correlation was observed at phenotype level. plant height showed positive and significant correlation with number of productive tillers per plant and biological yield per plant. it also showed positive but non-significant association with all characters except days to 50% flowering, number of productive tillers per plant had positive and significant association with

biological yield per plant and harvest index. number of productive tillers per plant were negatively correlated only with days to 50% flowering , length of spike was positively and significantly correlated with leaf area index, number of grains per spike, and biological yield, while it was negatively associated with days to 50% flowering, 100 -grain weight was significantly correlated in desired direction with biological yield, while it was positively correlated with other characters except harvest index and days to 50% flowering.

The path coefficient measures direct and indirect effect of independent characters on dependent character, which in the present case is grain yield per plant. The path coefficient analysis helps in partitioning of the total correlation into its direct and indirect components. The direct and indirect effect of characters on grain yield per plant at genotypic and phenotypic level were studied. Estimates of direct effect and indirect effect of different characters on grain yield per plant of phenotypic and genotypic level given in table, highest positive and direct effect on grain yield per plant was exerted by biological per plant followed by harvest index at both levels. Low values of direct were recorded for remaining characters and indicated that direct contribution of these characters was to low. Negative and high direct effect on grain yield per plant were exerted by plant height . it is concluded that plant height , number of productive tillers per plant, length of spike , 1000-grain weight, harvest index and biological yield per plant are major yield contributing characters, therefore due emphasis should be given on these character during selection of plants for yield improvement.

Table 1: Analysis of variance for thirteen quantitative characters in 10 diallel parent , F_{1S} and F_{2S} in barley

source of variation	d. f.	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of productive tillers/plants	C.T.D.(^{0}C)	Length of spike(cm)	Leaf area index	Number of grains /spike	Grain weight/spike (g)	1000-grain weight (g)	Biological yield /plant(g)	Harvest index(%)	Grain yield/ plant (g)
Replication	2	6.54*	8.86*	0.29	1.21	0.09	0.02	0.006	1.27	0.0002	0.01	1.93**	0.57	0.67
Treatment	99	20.06**	29.37**	76.70**	4.85**	2.75**	1.48**	0.16**	84.18**	0.01**	31.44**	23.81**	38.59**	6.73**
Parents	9	4.96**	14.88**	136.99**	3.65**	3.40**	0.77**	0.16**	25.25**	0.02**	35.01**	43.96**	13.18**	7.23**
F1s	44	10.07**	26.77**	84.35**	5.92**	2.78**	1.55**	0.19**	75.22**	0.01**	30.23**	27.13**	34.75**	8.00**
F2s	44	13.21**	31.44**	56.73**	4.07**	2.31**	1.27**	0.12**	68.98**	0.01**	25.39**	15.53**	46.59**	5.67**
Parents vs crosses(F_1 s)	1	789.21**	58.82**	118.89**	7.12**	10.66**	13.46**	1.10**	1439.11**	0.001**	344.00**	84.85**	105.58**	0.57
Parents vs crosses(F_2 s)	1	869.51**	179.42**	29.57**	6.41**	17.46**	14.39**	0.65**	1712.24**	0.0007*	277.38**	56.97**	116.75**	0.03
Error	198	1.67	2.37	3.07	0.46	0.35	0.05	0.01	2.04	0.0002	1.36	0.33	0.25	0.49

*Significant at p=0.05 per cent level and **Significant at p=0.01 per cent level.

Table 2: Genotypic correlation 13 character of 10 diallel parent, F_{1S} and F_{2S} in barley

Characters	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of productive tillers/plants	C.T.D.(^{0}C)	Length of spike(cm)	Leaf area index	Number of grains / spike	Grain weight /spike (g)	1000-grain weight (g)	Biological yield / plant(g)	Harvest index(%)	Grain yield/ plant (g)
Days to 50% flowering	**1.000**	0.147	-0.274	-0.260	0.058	-0.346	-0.191	-0.333	0.060	-0. 177	-0.189	0.060	-0.111
Days to maturity		**1.000**	0.192	0.054	0.060	-0.010	0.047	-0.053	0.145	0.056	0.178	0.061	0.208
Plant Height(cm)			**1.000**	-0.420	0.032	0.168	0.227	0.059	0.114	0.084	0.385	0.043	0.342
Number of productive tillers/plants				**1.000**	-0.009	0.168	0.196	-0.164	-0.229	0.165	0.332	0.254	0.451
C.T.D.(^{0}C)					**1.000**	-0.020	0.048	0.054	-0.134	0.162	0.190	0.087	0.232
Length of spike(cm)						**1.000**	0.596	0.353	0.070	0.123	0.295	0.121	0.344
Leaf area index							**1.000**	0.160	-0.145	0.148	0.100	0.075	0.150
Number of grains /spike								**1.000**	-0.137	0.063	0.074	0.135	0.770
Grain weight/ spike(g)									**1.000**	-0.116	0.009	-0.258	-0.155
1000-grain weight(g)										**1.000**	0.519	-0.214	0.278
Biological yield/plant(g)											**1.000**	-0.051	0.784
Harvest index (%)												**1.000**	0.622
Grain yield/plant(g)													**1.000**

Table 3: Phenotypic correlation 13 character of 10 diallel parent , F_{1S} and F_{2S} in barley

Characters	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of productive tillers/plants	C.T.D.(^{0}C)	Length of spike(cm)	Leaf area index	Number of grains/ spike	Grain Weight /spike (g)	1000 - grain weight (g)	Biological yield / plant(g)	Harvest index(%)	Grain yield/ plant (g)
Days to 50% flowering	**1.000**	**0.109**	**-0.240***	**-0.221***	**0.050**	**-0.295****	**-0.161**	**-0.285****	**0.056**	**-0.126**	**-0.167**	**0.052**	**-0.072**
Days to maturity		**1.000**	**0.171**	**0.054**	**0.037**	**-0.003**	**0.075**	**-0.041**	**0.124**	**0.132**	**0.165**	**0.057**	**0.177**
Plant Height(cm)			**1.000**	**0.364****	**0.031**	**0.148**	**0.189**	**0.048**	**0.099**	**0.072**	**0.355****	**0.043**	**0.302****
Number of productive tillers/plants				**1.000**	**0.001**	**0.141**	**0.169**	**-0.130**	**-0.199**	**0.142**	**0.282****	**0.228***	**0.345****
C.T.D.(^{0}C)					**1.000**	**-0.008**	**0.053**	**0.029**	**-0.112**	**0.113**	**0.144**	**0.059**	**0.172**
Length of spike(cm)						**1.000**	**0.499****	**0.322****	**-0.067**	**0.103**	**0.275****	**0.110**	**0.278****
Leaf area index							**1.000**	**0.156**	**-0.130**	**0.120**	**0.091**	**0.068**	**0.121**
Number of grains /spike								**1.000**	**-0.124**	**0.053**	**0.076**	**0.134**	**0.147**
Grain weight/ spike(g)									**1.000**	**-0.103**	**0.007**	**-0.249***	**-0.143**
1000-grain weight(g)										**1.000**	**0.474****	**-0.201***	**0.219***
Biological yield/plant(g)											**1.000**	**-0.028**	**0.717****
Harvest index (%)												**1.000**	**0.567****
Grain yield/plant(g)													**1.000**

*Significant at p=0.05 per cent level and **Significant at p=0.01 per cent level.

Table 4: Genotypic path coefficient 13 character of 10 diallel parent F_{1S} and F_{2} s in barley

Characters	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of productive tillers/plants	C.T.D.(^{0}C)	Length of spike(cm)	Leaf area index	Number of grains spike	Grain Weight /spike (g)	1000-grain weight (g)	Biological yield per plant(g)	Harvest index(%)	Correlation coefficient with Grain yield/ plant (g)
Days to 50% flowering	**0.017**	0.004	0.006	-0.011	0.001	-0.007	-0.001	-0.011	0.001	0.003	-0.052	0.039	-0.111
Days to maturity	0.003	**0.025**	-0.084	0.002	0.002	0.000	0.000	-0.002	0.003	-0.002	0.143	0.039	-0.208*
Plant height(cm)	-0.005	0.005	**-0.022**	0.017	0.001	0.003	0.002	-0.002	-0.002	-0.001	0.310	0.028	0.342**
Number of productive tillers/plants	0.005	0.001	-0.009	**0.041**	0.000	0.003	0.001	-0.005	-0.005	-0.003	0.267	0.163	0.451**
C.T.D.(^{0}C)	0.001	0.001	-0.001	0.001	**0.026**	0.000	0.000	0.002	-0.003	-0.003	0.153	0.056	0.232*
Length of spike(cm)	-0.006	0.000	-0.004	0.007	-0.001	**0.020**	0.004	0.012	-0.001	-0.002	0.237	0.078	0.344**
Leaf area index	-0.003	0.001	-0.005	0.008	0.001	0.0012	**0.007**	0.005	-0.003	-0.002	0.081	0.048	0.150
Number of grains / spike	-0.006	-0.001	-0.001	-0.007	0.001	0.007	0.001	**0.033**	-0.033	-0.001	0.060	0.081	0.176
Grain weight/ spike(g)	0.001	0.004	-0.003	-0.009	-0.003	-0.001	-0.001	-0.004	**0.020**	0.002	0.007	-0.166	-0.155
1000- grain weight(g)	-0.003	0.004	-0.002	0.007	0.004	0.002	0.001	0.002	-0.002	**-0.016**	0.418	-0.137	0.278**
Biological yield/plant(g)	-0.003	0.004	-0.008	0.014	0.005	0.006	0.001	0.002	0.000	-0.008	**0.805**	-0.033	0.784**
Harvest index (%)	0.001	0.001	-0.001	0.011	0.002	0.002	0.001	0.004	-0.005	0.003	-0.041	**0.643**	0.622**

Table 5: Phenotypic path coefficient 13 character of 10 diallel parent F_{1S} and F_{2S} in barley

Characters	Days to 50% flowering	Days to maturity	Plant height(cm)	Number of productive tillers/plants	C.T.D.(^{0}C)	Length of spike(cm)	Leaf area index	Number of grains / spike	Grain weight /spike (g)	1000-grain weight(g)	Biological yield/ plant(g)	Harvest index(%)	Correlation coefficient with Grain yield/ plant (g)
Days to 50% flowering	**0.031**	0.002	-0.004	-0.003	0.002	-0.005	-0.001	-0.006	0.000	0.002	-0.121	0.030	**-0.072**
Days to maturity	0.003	**0.021**	0.003	0.001	0.001	0.000	0.000	-0.001	0.000	-0.002	0.119	0.032	**0.177**
Plant height(cm)	-0.007	0.004	**0.016**	0.005	0.001	0.002	0.001	0.001	0.000	-0.001	0.256	0.025	**0.302****
Number of productive tillers/plants	-0.007	0.001	0.006	**0.013**	0.000	0.002	0.001	-0.003	0.001	-0.003	0.204	0.129	**0.345****
C.T.D.(^{0}C)	0.002	0.001	0.001	0.000	**0.033**	0.000	0.000	0.001	0.000	-0.002	0.104	0.034	**0.172**
Length of spike(cm)	-0.009	0.000	0.002	0.002	0.000	**0.015**	0.002	0.007	0.000	-0.002	0.198	0.063	**0.278****
Leaf area index	-0.005	0.002	0.003	0.002	0.002	0.008	**0.003**	0.003	0.000	-0.002	0.066	0.039	**0.121**
Number of grains /spike	-0.009	-0.001	0.001	-0.002	0.001	0.005	0.001	**0.021**	0.000	-0.001	0.055	0.076	**0.147**
Grain weight/ spike(g)	0.002	0.003	0.002	-0.003	-0.004	-0.001	0.000	-0.003	**-0.004**	0.002	0.005	-0.142	**-0.143**
1000-grain weight(g)	-0.004	0.003	0.001	0.002	0.004	0.002	0.000	0.001	0.000	**-0.018**	0.342	-0.114	**0.219***
Biological yield/plant(g)	-0.005	0.003	0.006	0.004	0.005	0.004	0.000	0.002	0.000	-0.008	**0.722**	-0.016	**0.717****
Harvest index (%)	0.002	0.001	0.001	0.003	0.002	0.002	0.000	0.003	0.001	0.004	-0.020	**0.569**	**0.567****

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