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Evaluation of correlation and path analysis for yield contributing traits in Barley (*Hordeum vulgare* L.)

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ABSTRACT

Aim: The study was conducted to estimate the correlation among the yield and yield contributing traits and their path analysis in barley in Randomize Block Design with 3 replications for 27 genotypes of barley.
Materials and Methods: Observations were recorded and analyzed based on quantitative characters viz; days to 50 % ear emergence, days to 75 % maturity, number of productive tillers per plant, spike length, number of grains per spike, biological yield per plant, 1000 grain weight, harvest index and grain yield per plant.
Results: Correlation and path analysis helped in determining the yield components. The grain yield per plant was found to be positively and significantly associated with number of grains per spike, biological yield per plant, number of tillers per plant, ear length and harvest index, whereas significantly and negatively associated with days to maturity.
Conclusion: It was concluded that high positive direct contributions to grain yield per plant was exhibited by grains per spike, harvest index, spike length and biological yield per plant and negative direct effect by days to maturity.

Keywords: Barley, correlation coefficient, genotypic correlation coefficient, path coefficient and yield attributing traits.

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Introduction

Barley (*Hordeum vulgare* L.) is a self pollinated crop and world's most important cereal ranked fourth after wheat, maize and rice. Genus and family of barley is *Hordeum* and poaceae and diploid chromosome number 2n = 2x = 14 which is grown ecofriendly worldwide as winter crop (Kumari et al., 2020). It has long hairless clasping auricles and long awns (helps in photosynthesis). It is grown to a limited area particularly in states of Rajasthan, Uttar Pradesh, Haryana, Punjab, Uttarakhand, Bihar, Jammu and Kashmir, Madhya Pradesh and Himanchal Pradesh in India. It is used for animal feed and as a source of fermentable material for beer and certain distilled beverages and for human consumption (Brown, 1992 and Von Bothmer *et al*., 2003). Nutritional qualities like presence of acetylcholine substance, beta-glucan, low gluten, soluble and digestible fibers, lysine, riboflavin and thiamine, vitamin B5 are evident in barley (Kumar *et al*., 2013).

It is mostly eaten as whole grain, has higher biological and medicinal value, has less loss of nutrients during processing and rich source of thiamine, riboflavin and high fiber content as compared to wheat and reduces risk of diabetes and heart disease by lowering the level of cholesterol in human body. It is a main source of calories and improves micronutrient malnutrition and hormonal imbalance and used for treatment of osteoarthritis, gastric ulcers, blood pressure, memory loss and kidney stone.

In plant breeding programme, the study of degree of association between yield and other attributing traits help in improvement of yield through correlation analysis. Grain yield is a complex character which results from interactions of several independent quantitative traits and some environmental factors. Correlation coefficients are estimated from variances and covariances in plant breeding which is useful to determine the yield components. Degree of association and genetic or non genetic relationships between two or more characters is ensured that help for selection (Shrimali *et a*l., 2017). Path analysis splits the correlation coefficient into direct and indirect

effects of independent traits on yield (dependent trait). Thus, path coefficients are worked out from simple correlation coefficients. Hence, the experiment was carried out to study the correlation coefficients and path analysis for the improvement of yield in yield contributing traits of barley (*Hordeum vulgare*).

Materials and Methods

The research was carried out at Genetics and Plant Breeding Research Farm, Kumarganj, Faizabad to evaluate the status of character association and direct and indirect effects of traits on grain yield among 27 genotypes of HUB-240, RD-2899, RD-2909, NDB-1618, NDB-1057, RD-2768, NDB-3, NDB-943, NDB-1173 and their crosses during *rabi* 2015-16 and 2016-17 in Randomized Block Design with 3 replications. Distance of plant to plant and row to row was maintained 10cm and 23cm, respectively. The experiment was conducted in normal fertile soil (pH=7.5) and saline sodic (pH=8.9-9.1) soils (latitude 26°47' North, longitude 82°12' East and with an altitude of 113 meters above the mean sea level). The research location falls under sub-tropical climatic zone and total rainfall nearly 80%. Data were recorded from 10 competitive plants that selected randomly for nine characters viz. number of productive tillers per plant, number of grains per spike, spike length (cm), biological yield per plant, harvest index, 1000 grain weight and grain yield per plant (g) while two characters viz., days to ear emergence and days to maturity were recorded on the plot basis from each genotype. The analysis of correlation coefficients was calculated by using the genotypic and phenotypic variances and covariances according to Singh *et al*. (1985) and Searle (1961). The path coefficient analysis was calculated as the direct and indirect effects suggested by Wright (1921) and Dewey and Lu (1959).

Results and Discussion

For different yield contributing characters correlation coefficients were estimated in barley genotypes (Table 1).

Table 1: Estimation of phenotypic (P) and genotypic (G) correlation coefficients among different characters in barley

No	Character		Days to 50% Ear Emergence	Days to Maturity (75%)	Productive Tillers Plant^{-1}	Ear Length (cm)	Grains Spike^{-1}	Biological Yield Plant^{-1} (g)	Grain Yield Plant^{-1} (g)	Harvest Index (%)	1000 Grain Weight (g)
1	**Days to 50% Ear Emergence**	P	**1.0000**	0.1760	0.1642	-0.0117	0.2084	0.0557	0.1785	-0.0004	-0.1401
		G	**1.0000**	-0.0037	0.3761	0.0548	0.4218	-0.0560	0.4681	0.0418	-0.2496
2	**Days to Maturity (75%)**	**P**		**1.0000**	0.0674	-0.1223	-0.2284*	-0.0766	-0.2618*	-0.1055	-0.3021**
		G		**1.0000**	-0.0744	-0.2830	-0.4975	-0.4613	-0.6499	-0.1582	-0.6512
3	**Productive Tillers Plant^{-1}**	P			**1.0000**	0.1315	0.2225*	0.4092***	0.1818	0.1681	-0.0785
		G			**1.0000**	0.2946	0.3583	0.6164	0.4026	0.3335	-0.1613
4	**Ear Length (cm)**	P				**1.0000**	0.3790***	0.1807	0.2575*	0.3288**	0.0792
		G				**1.0000**	0.3840	0.3835	0.4656	0.4073	0.1057
5	**Grains Spike^{-1}**	P					**1.0000**	0.3076**	0.5649***	0.3332**	0.2042
		G					**1.0000**	0.3373	0.7038	0.4755	0.2187
6	**Biological Yield Plant^{-1} (g)**	P						**1.0000**	0.4537***	0.2623*	0.1386
		G						**1.0000**	0.6399	0.6343	0.1382
7	**Grain Yield Plant^{-1} (g)**	P							**1.0000**	0.2334*	0.1842
		G							**1.0000**	0.6680	0.2758
8	**Harvest Index (%)**	P								**1.0000**	0.2447*
		G								**1.0000**	0.4024
9	**1000 Grain Weight (g)**	P									**1.0000**
		G									**1.0000**

*, ** Significant at 5% and 1% probability levels respectively.

Table 2: Direct and indirect effect of 9 characters on grain yield per plant at phenotypic (P) and genotypic (G) level in barley

No	Character		Days to 50% Ear Emergence	Days to Maturity (75%)	Productive Tillers Plant^{-1}	Ear Length (cm)	Grains Spike^{-1}	Biological Yield Plant^{-1} (g)	Grain Yield Plant^{-1} (g)	Harvest Index (%)	1000 Grain Weight (g)
1	**Days to 50% Ear Emergence**	**P**	**2.6177**	0.1760	0.1642	-0.0117	0.2084	0.0557	0.1785	-0.0004	-0.1401
		G	**1.0449**	-0.0037	0.3761	0.0548	0.4218	-0.0560	0.4681	0.0418	-0.2496
2	**Days to Maturity (75%)**	P	0.4552	**2.5570**	0.0674	-0.1223	-0.2284*	-0.0766	-0.2618*	-0.1055	-0.3021**
		G	-0.0033	**0.7343**	-0.0744	-0.2830	-0.4975	-0.4613	-0.6499	-0.1582	-0.6512
3	**Productive Tillers Plant^{-1}**	P	0.3173	0.1288	**1.4264**	0.1315	0.2225*	0.4092***	0.1818	0.1681	-0.0785
		G	0.3606	-0.0598	**0.8801**	0.2946	0.3583	0.6164	0.4026	0.3335	-0.1613
4	**Ear Length (cm)**	P	-0.0119	-0.1224	0.0983	**0.3913**	0.3790***	0.1807	0.2575*	0.3288**	0.0792
		G	0.0250	-0.1083	0.1234	**0.1994**	0.3840	0.3835	0.4656	0.4073	0.1057
5	**Grains Spike $^{-1}$**	P	1.5019	-1.6271	1.1837	1.0561	**19.8426**	0.3076**	0.5649***	0.3332**	0.2042
		G	1.5932	-1.5751	1.2419	0.6336	**13.6525**	0.3373	0.7038	0.4755	0.2187
6	**Biological Yield Plant^{-1} (g)**	P	0.1677	-0.2279	0.9097	0.2104	2.5504	**3.4651**	0.4537***	0.2623*	0.1386
		G	-0.0728	-0.5026	0.7353	0.2177	1.5844	**1.6167**	0.6399	0.6343	0.1382
7	**Grain Yield Plant^{-1} (g)**	P	0.2146	-0.3110	0.1613	0.1197	1.8694	0.6274	**0.5519**	0.2334*	0.1842
		G	0.2473	-0.2878	0.1952	0.1075	1.3439	0.4205	**0.2671**	0.6680	0.2758
8	**Harvest Index (%)**	P	-0.0010	-0.2986	0.3551	0.3639	2.6256	0.8639	0.3067	**3.1298**	0.2447*
		G	0.0481	-0.1527	0.3523	0.2048	1.9784	0.9082	0.3888	**1.2680**	0.4024
9	**1000 Grain Weight (g)**	P	-0.6984	-1.4889	-0.2889	0.1528	2.8039	0.7950	0.4219	1.3342	**9.4993**
		G	-0.7074	-1.5472	-0.4196	0.1309	2.2407	0.4871	0.3951	1.2562	**7.6863**

Bold diagonal values indicate the direct effect

The genotypic correlation coefficients were higher than phenotypic correlation coefficient in correlation estimation which means that there is strong association of the characters. Similarly, Shrimali *et al*., (2017) advocated higher genotypic correlation coefficient. In present study, highest positive and significant correlation was found in grains per spike with grain yield per plant. Grain yield per plant was exhibited highly significant and positive association with ear length, number of grains per spike, biological yield per plant and harvest index. Amardeep *et al*. (2017) and Kumari *et al*. (2019) also recorded similar findings with grain yield per plant. Days to 75% maturity had significant and negative association with grains per spike and grain yield per plant.

In present study, direct and indirect effects of various characters on grain yield per plant were recorded (Table 2). Almost the studied characters had shown positive direct and indirect effect on grain yield per plant except days to 75 % maturity. In present study phenotypic correlation coefficients were recorded higher than genotypic correlation coefficients in days to maturity, biological yield per plant and 1000 grain weight for days to 50 % ear emergence that means there is apparent association between two characters is due to effect of genes and favorable influence of environment. At phenotypic level, grains per

spike had highly and positive significant direct effects with biological yield per plant, grain yield per plant and harvest index. Similarly, Amardeep *et al*. (2017) also reported the positive direct effects of grains per spike on grain and biological yield per plant. Ear length showed positive and significant direct effect with grains per spike, grain yield per plant and harvest index. Grains per spike and biological yield per plant had showed positive and significant direct contributions to productive tillers per plant. Harvest index had direct significant and positive contribution with 1000 grain weight. Biological yield per plant had significant and positive direct effects on grain yield per plant and harvest index. Singh *et al*. (2007) and Hailu *et al*. (2016) also corroborated similar findings with biological yield per plant. Days to 75 % maturity had negative and significant association with grains per spike, grain yield per plant and 1000 grain weight at phenotypic correlation coefficient level. The research analysis concluded that ear length, biological yield per plant, grains per spike and harvest index direct contribute to the grain yield per plant via indirect effects of other component traits. Hence, these traits were the major yield contributing traits. Path analysis identified grains per spike and biological yield per plant had highest positive significant with grain yield so these traits are important as direct yield contributing characters.

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