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Dissection of Genetic Variability, Correlation and Path Analysis in Wheat (*Triticum aestivum* L.) Genotypes for Yield and Its Attributes

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ABSTRACT

The present investigation was undertaken to study the genetic variability, correlation and path coefficient analysis for 10 metric traits in 46 wheat genotypes under normal sown irrigated conditions at CCS HAU, Regional Research Station, Bawal (Haryana) during rabi 2013-14. Significant genotypic differences were observed for all the traits studied indicating considerable amount of variation among genotypes for each trait. Phenotypic and genotypic coefficients of variation were highest in number of grains per spike followed by number of tillers per meter row, harvest index, biological yield and grain yield. Moderate to high heritability in broad sense estimated for all the traits except biological yield which exhibited low heritability. Moderate to high heritability coupled with high genetic advance as per cent of mean was observed for number of grains per spike, number of tillers per meter row, grain yield, harvest index and 1000-grain weight, indicating the importance of these traits in selection and crop improvement. Grain yield was significant and positively correlated with harvest index, biological yield and 1000-grain weight. Path coefficient analysis revealed highest positive direct effect of harvest index and biological yield on grain yield. Hence, due emphasis should be given to harvest index, biological yield and 1000-grain weight for genetic improvement of grain yield in wheat.

Key words: *Genetic variability, Correlation, Path analysis, Wheat*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop of India after rice, occupies an area of 30.72 million hectares with the production and productivity of 97.44 million tons and 3172 kg/ha, respectively. Haryana state has achieved a productivity level of 4.39 tons/ ha on 2.54 million hectares[5]. It is an important staple food of many countries in the world and occupies a unique position as it is used for the preparation of a wide range of food stuffs. It is a challenging task before the breeders to enhance the present level of production as the growing population of the country will require much more food as compared to the present day requirement.

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It is not possible to increase the area under production. Hence, only alternative is left to increase the productivity by evolving superior varieties and better management of crop production to cope up with increasing demands of food. A major cause of concern to a plant breeder is the constant improvement of the best available genotypes for further enhancement in their yield potential either directly or through improvement of various factors which contribute indirectly to high yield. The breeding methodology, therefore, should be such, which in essence could incorporate the favorable changes either through selection or through hybridization of superior genotypes. In this regards, information on nature and magnitude of genetic variability is of immense value for starting any systematic breeding programme in crops. The presence of considerable genetic variability in the base material ensures better chances of evolving desired plant types. The knowledge of genetic parameters *viz.*, heritability and genetic advance among characters under selection is very useful for predicting genetic progress in breeding programme and developing efficient breeding strategies.

Therefore, the efforts were made to study the extent of genetic variability, correlation and path coefficients among wheat genotypes to determine criteria for selection that could be effectively used to identify the desirable genotypes with high yield potential.

MATERIAL AND METHODS

The experimental material consisted of 46 bread wheat genotypes evaluated in randomized block design with three replications at CCS HAU, Regional Research Station, Bawal (Haryana) during *rabi* 2013-14 under normal sown irrigated conditions. Each genotype was grown in four rows with a plot size of 5 x 0.80 m^2. Recommended agronomic practices were followed to raise good crop. The observations on ten metric traits *viz*., days to heading, days to maturity, plant height (cm), number of tillers per meter row, ear length (cm), number of grains per spike, 1000-grain weight (g), biological yield (kg/plot), harvest index (%) and grain yield (kg/plot) were recorded at appropriate crop growth stage. Five randomly selected competitive plants in each replication were recorded for all the traits under study except of days to heading, days to maturity, biological yield and grain yield which were recorded on plot basis. Harvest index was calculated as per formula given by Donald and Humblin[13].

The mean performance of each genotype was subjected for statistical analysis. Analysis of variance to test the significance for each character was carried out as per methodology given by Panse and Sukhatme.[18] Genotypic and phenotype coefficients of variation (GCV and PCV) were calculated by formula given by Burtan[7], heritability in broad sense (h^2) by Burtan and Vane[8] and genetic advance as given by Johnson *et al.*[16] Correlation and path coefficients were worked out as per method suggested by Al-Jibouri *et al.*[4] and Dewey and Lu[11], respectively.

RESULTS AND DISCUSSION

Significant differences were observed among the genotypes for all the character studied indicating considerable amount of variability among them. The estimates of genetic variability parameters for all the characters are presented in Table 1. In general, the results revealed wide range for all the traits under investigation. Phenotypic coefficients of variation (PCV) were greater than genotypic coefficients of variation (GCV) for all the characters which reflect the influence of environment on the expression of traits. Phenotypic and genotypic coefficients of variation were highest in number of grains per spike followed by number of tillers per meter row, harvest index, biological yield and grain yield indicating availability of sufficient genetic variability and thus exhibited scope for genetic improvement through selection. However, days to heading and maturity exhibited least phenotypic and genotypic coefficients of variation. Similar findings were also reported by Parnaliya *et al.*[19], Ali and Abdulla[3], Arya *et al.*[6], Meles *et al.*[17] and Rathwa *et al*.[20] in wheat.

Moderate to high heritability in broad sense estimated for all the traits except biological yield which exhibited low heritability. The estimates of heritability ranged from 38 per cent for biological yield to 91 per cent for number of grains per spike. These results are in agreement with the findings of Rathwa *et al*.[20]; and Hakimi *et al.*[15] except for harvest index. Ali and Shakor[2] observed higher magnitudes of heritability whereas moderate estimates of heritability were reported by Abinasa *et al.*[1] in durum wheat. Low heritability for biological yield in bread wheat was also reported by Ali and Abdulla[3]. High heritability for number of grains per spike and days to heading indicated that these characters were less influenced by the environment. The estimates of heritability are more advantageous when expressed in terms of genetic advance. Moderate to high heritability coupled with high genetic advance as per cent of mean was observed for number of grains per spike, number of tillers per meter row, grain yield, harvest index and 1000-grain weight indicating the importance of these traits in selection and crop improvement. These results support the findings of Rathwa *et al*.[20] Similar results were also observed by Parnaliya *et al.*[19] except for biological yield; Hakimi *et al.*[15] except for harvest index and Arya *et al.*[6] except for days to maturity.

The estimates of genotypic correlation coefficients among 10 traits are depicted in Table 2. The grain yield was significant and positively correlated with harvest index, biological yield and 1000-grain weight; and positively with plant height and number of tillers per meter row. These results showed close resemblance with the report of Ali and Shakor[2], Parnaliya *et al*.[19], Ali and Abdulla[3], Meles *et al.*[17] and Hakimi *et al*[15]. The negative association of grain yield with days to heading and maturity suggests that early maturing genotypes may result in higher grain yield, which confirmed the findings of Degewione *et al.*[10] and Meles *et al.*[17] in wheat. Significant and positive correlations were also observed for days to heading with days to maturity and plant height; plant height with ear length and biological yield; ear length with number of grains per spike, 1000-grain weight and biological yield; and 1000-grain weight with harvest index, thereby indicating that these traits may be improved simultaneously. Some authors also reported significant positive correlation of days to heading with days to maturity and plant height[15]; plant height with spike length and biological yield[15,19]; ear length with grains per spike and biological yield[3] and with 1000-grain weight[15]; 1000-grain weight with harvest index[3].

Significant negative association was observed for days to heading with biological yield; plant height and ear length with harvest index; number of grains per spike with number of tillers per meter row; biological yield with harvest index. Similar findings were also reported for plant height with harvest index[21]; spike length with harvest index[14]; and harvest index with biological yield[1]. Negative association of tillers per plant with number of grains per spike; and days to heading with biological yield was also reported by Dharmendra and Singh[12] and Dawit *et al*.[9], respectively.

The results of path coefficient analysis (Table 3) revealed that harvest index (1.050) exerted the highest positive direct effect on grain yield followed by biological yield (0.783). Similar results were also reported by Tripathi *et al.*[21] and Ali and Abdulla[3]. The highest negative direct effect on grain yield was recorded for days to maturity (-0.070). Parnaliya *et al.*[19] also reported the negative direct effect of days to maturity, number of tillers per plant and ear length on grain yield, which support our finding. The low residual effect (0.058) indicated that most of the variability in grain yield for the genotypes under study has been explained by the independent variables included in the analysis.

Table 1: Estimates of mean, coefficient of variation, heritability and genetic advance for different characters in wheat

Characters	Mean ± SE (d)	Range	Coefficients of variation (%)		Heritability (bs) (%)	Genetic advance (% mean)
			PCV	GCV		
Days to heading	99.27 ± 0.74	90.0-105.0	2.84	2.69	90	5.26
Days to maturity	138.84± 0.78	133.0-142.0	1.44	1.29	78	2.34
Plant height (cm)	100.02 ± 3.51	82.0-116.0	6.35	4.68	54	7.09
No. of tillers per meter row	112.21 ± 10.54	70.0-166.0	17.42	13.08	56	20.24
Ear length (cm)	11.61 ± 0.57	8.70-14.70	10.16	8.20	65	13.65
No. of grains per spike	47.03 ± 2.09	30.10-68.70	17.76	16.90	91	33.15
1000-grain weight (g)	36.96 ± 1.21	29.50-44.70	8.64	7.66	79	13.98
Biological yield (kg/plot)	5.99 ± 0.48	4.22-7.52	12.53	7.71	38	9.77
Harvest index (%)	36.81 ± 3.00	26.22-49.22	14.58	10.60	53	15.89
Grain yield (kg/plot)	2.18 ± 0.13	1.39-2.89	12.20	9.83	65	16.32

Table 2: Estimates of genotypic correlation coefficients among 10 characters in wheat

Characters	Days to heading	Days to maturity	Plant height (cm)	No. of tillers per meter row	Ear length (cm)	No. of grains per spike	1000-grain wt. (g)	Biological yield (kg/plot)	Harvest index (%)	Grain yield (kg/plot)
Days to heading	1.000	0.854**	0.205*	0.054	0.036	-0.025	-0.110	-0.273**	0.078	-0.154
Days to maturity		1.000	0.027	-0.108	0.094	-0.007	-0.129	-0.099	0.067	-0.048
Plant height (cm)			1.000	0.099	0.187*	0.133	-0.053	0.435**	-0.210*	0.138
No. of tillers per meter row				1.000	-0.134	-0.352**	-0.026	-0.032	0.133	0.115
Ear length (cm)					1.000	0.217*	0.324**	0.308**	-0.203*	-0.002
No. of grains per spike						1.000	-0.146	-0.084	0.021	-0.036
1000-grain wt. (g)							1.000	0.147	0.200*	0.320**
Biological yield (kg/plot)								1.000	-0.435**	0.321**
Harvest index (%)									1.000	0.710**
Grain yield (kg/plot)										1.000

*, ** Significant at 0.05 and 0.01 level, respectively

Table 3: Direct (diagonal) and indirect effects of different characters on grain yield in wheat at genotypic level

Characters	Days to heading	Days to maturity	Plant height (cm)	No. of tillers per meter row	Ear length (cm)	No. of grains per spike	1000-grain wt. (g)	Biological yield (kg/plot)	Harvest index (%)	rg with Grain yield (kg/plot)
Days to heading	**0.0355**	0.0303	0.0073	0.0019	0.0013	-0.0009	-0.0039	-0.0097	0.0028	-0.154
Days to maturity	-0.0596	**-0.0698**	-0.0019	0.0075	-0.0066	0.0005	0.0090	0.0069	-0.0047	-0.048
Plant height (cm)	0.00439	0.0005	**0.0189**	0.0019	0.0035	0.0025	-0.0010	0.0082	-0.0040	0.138
No. of tillers per meter row	-0.0006	0.0012	-0.0011	**-0.0112**	0.0015	0.0039	0.0003	0.0004	-0.0015	0.115
Ear length (cm)	-0.0012	-0.0031	-0.0062	0.0044	**-0.0331**	-0.0072	-0.0107	-0.0102	0.0067	-0.002
No. of grains per spike	-0.0002	0.0001	0.0013	-0.0034	0.0021	**0.0097**	-0.0014	-0.0008	0.0002	-0.036
1000-grain wt. (g)	-0.0003	-0.0003	-0.0001	-0.0001	0.0009	-0.0004	**0.0027**	0.0004	0.0005	0.320**
Biological yield (kg/plot)	-0.2139	-0.0774	0.3405	-0.0252	0.2414	-0.0655	0.1150	**0.7829**	-0.3407	0.321**
Harvest index (%)	0.0820	0.0705	-0.2205	0.1393	-0.2127	0.0217	0.2103	-0.4572	**1.050**	0.710**

Residual effect: 0.058; rg = genotypic correlation; *, ** Significant at 0.05 and 0.01 level, respectively

CONCLUSION

It can be concluded from present investigation that harvest index, biological yield and 1000-grain weight are the most important yield attributes and due emphasis should be given to these traits for genetic improvement of grain yield in wheat under normal sown irrigated conditions.

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