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Correlation and Path analysis for Seed Yield in Bread Wheat (*Triticum aestivum* L.)

Patel Dipika P.[*], Kulkarni G. U., Ghadage N. C. and Sharma L. K.

Department of Genetics and Plant Breeding College of Agriculture
Junagadh Agricultural University Junagadh – 362 001, Gujarat, India
*Corresponding Author E-mail: ptldipu123@gmail.com
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ABSTRACT

The present investigation was undertaken to study the genetic variability, correlation and path coefficient analysis, for grain yield and its attributes with a set of 50 genotypes of bread wheat (Triticum aestivum L.) at Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh during Rabi 2018-19 in randomized block design with three replications. The characters studied were days to 50% flowering, grain filling period, days to maturity, plant height, number of productive tillers per plant, ear length, number of grains per main spike, grain weight per main spike, grain yield per plant, biological yield per plant, harvest index and 1000-grain weight. The analysis of variance revealed highly significant differences among the mean square due to genotypes for all the characters studied. High genotypic and phenotypic coefficient of variation were observed for 1000-grain weight followed by grain weight per main spike. High heritability coupled with high to moderate genetic advance expressed as per cent of mean were observed for 1000-grain weight, grain weight per main spike, days to 50% flowering, number of grains per main spike, plant height. Grain yield per plant had significant and positive correlation with ear length, grain weight per main spike, harvest index, number of grains per main spike and plant height at both the genotypic and phenotypic levels. The phenotypic path coefficient analysis revealed that the harvest index, biological yield per plant, grain weight per main spike exhibited high and positive direct effects on grain yield per plant. On the basis of all the above studies, it can be concluded that due weightage should be given to 1000-grain weight, days to 50% flowering, ear length grain weight per main spike, number of grains per main spike, harvest index and plant height while imposing selection for genetic improvement in bread wheat.

Keywords: Variability, Heritability, Genetic advance, Correlation, Path analysis, Bread wheat.

INTRODUCTION

Wheat is highly self pollinated & second most important staple food next to rice. Three species of wheat *viz.*, *Triticum aestivum* L. (bread wheat), *Triticum durum* Desf. (macroni wheat) and *Triticum dicoccum* Schulb. (emmer wheat) are presently grown as commercial crop in India.

Triticum aestivum is most extensively grown crop among cereals in the world, giving food to about 40% of world population and supplying 20% of the total food calories and protein in human diet (Bhutto et al., 2016). Wheat is a unique gift of nature to the mankind as it can be moulded into innumerable products like chapatis, breads, cakes, biscuits, pasta and many hot and ready-to-eat breakfast foods. Wheat grain contains starch (60-68%), protein (6-21%), Fat (1.5-2.0%), cellulose (2-2.5%), mineral (1.8%) and vitamins.

Therefore, study of genetic variability of seed yield and its component character among the different species and varieties provide a strong basis for selection of desirable genotypes for augmentation of yield and other agronomic characters. Different components of seed yield very often exhibit varying degree of associations with seed yield as well as among themselves. In order to accumulate optimum combination of seed yield contributing characters in a single genotype, it is essential to know the relationships among themselves. Character association studies provide better understanding of yield components which helps the plant breeders to improved with yield. Further, various component directly and or indirectly influence the seed yield via other traits that create a complex situation before a breeder for making desirable selection. Therefore, path coefficient analysis provide a more realistic picture of the inter relationship, as it partitions the correlation coefficient in direct and indirect effect of the variables. Dewey and Lu (1959) employed this for the first time in plant to dissent angle the direct and indirect influences on the component of the seed yield. Thus, character association and path analysis will provide the information of yield contributing characters. Breeder can practice selection using this information for the isolation of superior accession from gene bank. Correlation and path analysis could be used as an important tool to bring information about appropriate cause and effects relationship between yield and some yield

components (Khan et al., 2003). Path coefficient analysis, a method developed by Wright (1921) is an important tool.

The objectives of this study were to: To estimate genetic variability for grain yield and its contributing characters. (2) To estimate the genotypic and phenotypic correlation between grain yield and other yield contributing characters. (3) To determine the direct and indirect effect of different characters on grain yield per plant using path coefficient analysis.

MATERIALS AND METHODS

The experimental material consisted of 70 bread wheat genotypes evaluated in randomized block design with three replication at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh during *rabi* 2018-2019. Each line was sown in a single row plot of 3.0 m length with a spacing of 20 cm × 10 cm. The genotypes were randomly allotted to the plots in each replication. All the recommended agronomical practices along with necessary plant protection measures were followed timely for the successful raising of the crop. The observations on twelve metric traits *viz.*, days to 50% flowering (days), days to maturity (days), grain filling period (days) plant height (cm), number of productive tillers per plant, ear length (cm), number of grains per main spike, grain weight per main spike (g), grain yield per plant (g), biological yield per plant (g) and harvest index (%) and 1000 grain weight (g) were recorded at appropriate crop growth stage. Five randomly selected plants with in each replication except days to 50% flowering, days to maturity and 1000 grain weight which are recorded on plot basis. Analysis of variance for randomized block design (RBD) was done as per Panse and Sukhatme (1985). Phenotypic co-efficient of variation (PCV) and genotypic co-efficient of variation (GCV) were calculated as per the formula suggested by Burton and De Vane (1953). Heritability and genetic advance were estimated using the formula suggested by Allard (1960). Phenotypic and genotypic

correlation coefficient for all the pair wise characters was worked out as per Al-Jibouri et al. (1958). Path coefficient analysis was carried out as per the procedure suggested by Dewey and Lu (1959), respectively.

RESULTS AND DISCUSSION

Genetic variability parameters

The analysis of variance revealed that mean square due to genotypes was highly significant for all the 11 characters and significant for number of productive tillers per plant character indicating the presence of sufficient amount of variability in the experimental material used. Therefore, the effectiveness of selection depends upon the nature and magnitude of genetic variability present in the experimental material. The analysis of variance for all the twelve characters studied is presented in Table 1.

The estimates of genetic variability parameters for all the characters are presented in Table 2. The estimates of genotypic and phenotypic coefficient of variability indicated that the values of phenotypic coefficient of variation were slightly higher than that of genotypic coefficient of variation for most of the traits studied, indicating less effect of environment on the expression of characters studied. These results showed close resemblance with the reports of Kumar et al. (2018) and Kumar et al. (2019). This indicated the presence of wide genetic variation for these characters.

The moderate values of genotypic and phenotypic coefficient of variation were observed for number of grains per main spike, harvest index and grain yield per plant, while low values of genotypic and phenotypic coefficient of variation were observed for indicated narrow genetic variation for these traits. These findings of low values of genotypic and phenotypic coefficient of variation for ear length (cm), days to 50% flowering, plant height, biological yield per plant grain filling period (days), biological yield per plant (g), number of productive tillers per plant, days to maturity. The results are in accordance with the findings of Patel and Raval (2018).

High heritability estimates were observed for 1000-grain weight (97.77%), grain weight per main spike (94.82%), days to 50% flowering (93.92%), number of grains per main spike (93.87%) and plant height (89.37%). These results are in agreement with the findings of Kumar et al. (2018). Medium heritability estimates were observed for harvest index (76.01%), grain filling period (74.44%), ear length (71.32%), days to maturity (59.87%) and grain yield per plant (53.73%). The low heritability estimates were observed for biological yield per plant (48.26%) and number of productive tillers per plant (37.63%). These results are in agreement with the findings of Kumar et al. (2018).

High heritability coupled with high to moderate genetic advance expressed as per cent of mean were observed for 1000-grain weight, grain weight per main spike, days to 50% flowering, number of grains per main spike, plant height. Therefore, suggesting the existence of sufficient heritable variation and wider scope for effective selection. These results showed close resemblance with the report of Arya et al. (2017) and Vichitra Kumar et al. (2017).

Correlation

Genotypic correlation coefficients were relatively higher than their corresponding phenotypic correlations in most of the cases (Table3). The grain yield per plant was significant and positively correlated with ear length, grain weight per main spike, harvest index, number of grains per main spike and plant height at both genotypic and phenotypic levels, indicating that these attributes were more influencing the grain yield in bread wheat and therefore, these were important for bringing genetic improvement in grain yield. Such positive interrelationship had been reported earlier in wheat by Mecha et al. (2017) and Kumar et al. (2018).

Days to 50 per cent flowering had highly significant and positive association with days to maturity and grain filling period at genotypic and phenotypic levels and it is an important component in identifying and deciding the duration and dwarfness of the

wheat crop. Similar relationship has been reported by Mecha et al. (2017).

The days to maturity exhibited highly significant and negative association with number of productive tillers per plant at both genotypic and phenotypic levels. Grain filling period exhibited highly significant and positive association with days to maturity. Plant height exhibited highly significant and positive association with ear length, grain weight per main spike, number of grains per main spike and harvest index. Number of productive tillers per plant also exhibited highly significant and positive relationship with biological yield per plant at genotypic and phenotypic levels. Similarly, ear length also had highly significant and positive association with grain weight per main spike, number of grains per main spike, harvest index and 1000-grain weight at genotypic and phenotypic levels. Number of grains per spike also had significant and positive association with grain weight per main spike, 1000-grain weight and harvest index at genotypic and phenotypic levels. Likewise, grain weight per main spike exhibited significant and positive relationship with harvest index and 1000-grain weight at genotypic and phenotypic levels.

The present results on correlation coefficients revealed that grain yield per plant were observed with ear length, grain weight per main spike, harvest index, number of grains per main spike and plant height were the most important traits and may contribute considerably towards higher grain yield.

Path coefficient analysis

The phenotypic path coefficient analysis revealed that the harvest index, biological yield per plant, grain weight per main spike exhibited high and positive direct effects on grain yield per plant is present in Table 4. Similar result has been reported by Mecha et al. (2017); Ramanuj et al. (2018); Kumar et al. (2019) and Verma et al. (2019). These traits turned out to be major components of grain yield for direct selection. The ear length, days to maturity exhibited moderate and positive direct effect towards grain yield per plant. Similar results were obtained by Iftikhar et al. (2012). The residual effect (0.3358) was high in magnitude suggesting that the majority of the yield attributes have been included in the path analysis.

In the present research, ear length, grain weight per main spike, harvest index, number of grains per main spike and plant height had highly significant and positive correlation with grain yield per plant and the direct effects of both components were also positive and highest. This suggested that there were little or no indirect effects of these traits on grain yield and whatever relationship existed with grain yield was direct. Singh and Chaudhary (1977) suggested that if the correlation coefficient between a causal factor and the effect is almost equal to its direct effect, the correlation explains the true relationship and the direct selection through both these traits is effective. Therefore, these traits could be used as selection criteria for improving wheat grain yield. Bhushan et al. (2013) also reported similar results.

Days to 50% flowering, grain filling period, plant height and number of grains per main spike expressed negative direct effects of low magnitude on grain yield per plant. However, among these four characters, plant height and number of grains per main spike had highly significant and positive association at phenotypic level with grain yield, because of the cumulative minor positive indirect effect via rest of the characters.

It was apparent from the phenotypic path analysis that higher direct effects as well as appreciable indirect influences were exerted by harvest index, grain weight per main spike, biological yield per plant, ear length, number of productive tillers per plant, days to maturity, 1000-grain weight, days to 50 % flowering and grain filling period towards grain yield per plant.

Table 1: Analysis of variance for 12 characters in 50 genotype of bread wheat

Source of variation	d.f.	Days to 50% flowering	Grain filling period (days)	Days to maturity	Plant height (cm)	No. of productive tillers per plant	Ear length (cm)
Replication	2	13.020	3.376	54.166	10.339	0.310	1.321
Genotypes	49	72.991**	11.381**	66.057**	96.777**	0.651*	2.050**
Error	98	4.434	3.507	26.506	10.290	0.406	0.588

Source of variation	d.f.	No. of grains per main spike	Grain weight per main spike(g)	Grain yield per plant(g)	Biological yield per plant(g)	Harvest index (%)	1000-grain weight (g)
Replication	2	3.142	0.025	1.261	9.375	9.685	0.686
Genotypes	49	24.444**	0.508**	2.067**	11.404**	63.115**	236.745**
Error	98	1.498	0.026	0.956	5.900	15.141	5.285

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

Table 2: Phenotypic range, coefficient of range, mean, phenotypic and genotypic coefficient of variation, heritability, genetic advance and genetic advance expressed as per cent of mean for various characters of bread wheat

Character	Phenotypic rage	Coefficient of range (%)	Mean	Phenotypic coefficient of variation (%)	Genotypic coefficient of variation (%)	Heritability in broad sense (%)	Genetic advance (GA)	GA (as percentage of mean)
Days to 50% flowering	39.67-58.67	19.32	52.46	9.40	9.11	93.92	9.54	18.19
Grain filling period (days)	44.00-52.66	8.96	48.33	7.54	6.51	74.44	5.68	11.57
Days to maturity	91.33-111.33	9.87	101.56	4.62	3.57	59.87	5.78	5.69
Plant height (cm)	49.13-79.67	23.71	64.09	8.86	8.37	89.37	10.45	16.31
No. of productive tillers per plant	6.33-8.13	12.45	7.05	6.60	4.05	37.63	0.36	5.12
Ear length (cm)	6.12-11.27	29.61	8.33	9.92	8.37	71.32	1.21	14.57
No. of grains per main spike	11.33-28.73	43.43	20.32	14.04	13.60	93.87	5.51	27.15
Grain weight per main spike(g)	1.47-3.55	41.43	2.10	19.51	19.00	94.82	0.80	38.12
Grain yield per plant(g)	6.93-12.07	27.05	8.23	10.08	7.39	53.73	0.91	11.15
Biological yield per plant(g)	19.89-28.8	18.30	23.96	8.13	5.65	48.26	1.93	8.09
Harvest index (%)	29.22-50.49	26.68	35.06	13.08	11.40	76.01	7.18	20.48
1000-grain weight (g)	30.67-61.00	33.08	44.75	19.84	19.62	97.77	17.89	39.97

Table 3: Estimates of genotypic (r_g) and phenotypic (r_p) correlation coefficients among 12 characters in bread wheat

Characters		Days to 50% flowering (days)	Grain filling period (days)	Days to maturity (days)	Plant height (cm)	No. of productive tillers per plant	Ear length (cm)	No. of grains per main spike	Grain weight per main spike(g)	Biological yield per plant(g)	Harvest index (%)	1000-grain weight (g)
Grain yield per plant (g)	r_p	0.0058	-0.0748	-0.0446	0.5080**	0.0132	0.8037**	0.6400**	0.7385**	0.0618	0.7214**	0.2462
	r_g	0.0493	-0.1367	-0.1001	0.6640**	0.0340	1.1018**	0.8327**	1.0414**	0.1107	1.0041**	0.3420*
Days to 50% flowering	r_p	1.0000	0.9134**	0.9193**	0.0447	-0.1730	0.1254	0.1145	0.0544	-0.0580	0.0469	0.1553
	r_g	1.0000	0.9475**	1.2327**	0.0464	-0.3067*	0.1781	0.1245	0.0603	-0.1073	0.0783	0.1598
Grain filling period (days)	r_p		1.0000	0.9001**	0.0711	-0.1615	0.0641	0.0576	-0.0267	-0.0305	-0.0223	0.0962
	r_g		1.0000	1.2087**	0.0796	-0.2996*	0.0642	0.0659	-0.0233	-0.0773	-0.0283	0.0962
Days to maturity	r_p			1.0000	0.0545	-0.2144	0.1001	0.0571	0.0129	-0.0296	-0.0321	0.1303
	r_g			1.0000	0.0732	-0.5092**	0.1652	0.0674	0.0078	0.1046	0.0119	0.1796
Plant height (cm)	r_p				1.0000	0.0212	0.6378**	0.4638**	0.5174**	0.1420	0.3814**	0.1965
	r_g				1.0000	0.0875	0.8146**	0.5031**	0.5607**	0.1941	0.4599**	0.2191
No. of productive tillers per plant	r_p					1.0000	-0.1419	-0.0843	-0.1019	0.8269**	-0.4377**	-0.1886
	r_g					1.0000	-0.3183*	-0.1178	-0.1916	1.2792**	-0.7306**	-0.3066*
Ear length (cm)	r_p						1.0000	0.8374**	0.8967**	0.0855	0.5615**	0.5079**
	r_g						1.0000	0.9543**	1.0897**	0.1563	0.6715**	0.6064**
No. of grains per main spike	r_p							1.0000	0.8637**	0.0488	0.4322**	0.4746**
	r_g							1.0000	0.9068**	0.0814	0.4861**	0.4907**
Grain weight per main spike(g)	r_p								1.0000	0.0741	0.4658**	0.5035**
	r_g								1.0000	0.0758	0.5500**	0.5213**
Biological yield per plant(g)	r_p									1.0000	-0.5471**	0.0913
	r_g									1.0000	-0.8316**	0.1266
Harvest index (%)	r_p										1.0000	0.0148
	r_g										1.0000	0.0073
1000-grain weight (g)	r_p											1.0000
	r_g											1.0000

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

Table 4: Phenotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of different characters on grain yield per plant in 50 genotypes of bread wheat

Characters	Days to 50% flowering	Grain filling period (days)	Days to maturity	Plant height (cm)	No. of productive tillers per plant	Ear length (cm)	No. of grains per main spike	Grain weight per main spike(g)	Biological yield per plant(g)	Harvest index (%)	1000-grain weight (g)	Phenotypic correlation with grain yield per plant
Days to 50% flowering	**-0.0995**	-0.0715	0.1481	-0.0043	-0.0164	0.0208	-0.0104	0.0143	-0.0252	0.0407	0.0092	0.0058
Grain filling period (days)	-0.0909	**-0.0783**	0.1450	-0.0069	-0.0153	0.0106	-0.0052	-0.0070	-0.0133	-0.0194	0.0057	-0.0748
Days to maturity	-0.0915	-0.0704	**0.1611**	-0.0053	-0.0203	0.0166	-0.0052	0.0034	-0.0129	-0.0279	0.0077	-0.0446
Plant height (cm)	-0.0044	-0.0056	0.0088	**-0.0968**	0.0020	0.1059	-0.0421	0.1358	0.0617	0.3312	0.0116	0.5080**
No. of productive tillers per plant	0.0172	0.0126	-0.0346	-0.0020	**0.0945**	-0.0236	0.0076	-0.0267	0.3593	-0.3801	-0.0112	0.0132
Ear length (cm)	-0.0125	-0.0050	0.0161	-0.0618	-0.0134	**0.1660**	-0.0760	0.2354	0.0372	0.4877	0.0300	0.8037**
No. of grains per main spike	-0.0114	-0.0045	0.0092	-0.0449	-0.0080	0.1390	**-0.0907**	0.2267	0.0212	0.3754	0.0281	0.6400**
Grain weight per main spike(g)	-0.0054	0.0021	0.0021	-0.0501	-0.0096	0.1488	-0.0784	**0.2625**	0.0322	0.4046	0.0298	0.7385**
Biological yield per plant(g)	0.0058	0.0024	-0.0048	-0.0138	0.0782	0.0142	-0.0044	0.0195	**0.4345**	-0.4752	0.0054	0.0618
Harvest index (%)	-0.0047	0.0017	-0.0052	-0.0369	-0.0414	0.0932	-0.0392	0.1223	-0.2377	**0.8685**	0.0009	0.7214**
1000-grain weight (g)	-0.0155	-0.0075	0.0210	-0.0190	-0.0178	0.0843	-0.0431	0.1322	0.0397	0.0128	**0.0591**	0.2462

*,** Significant at 5 and 1% levels, respectively. (Residual effect = 0.3358)

CONCLUSION

It can be concluded from the present findings that additive gene action was operating for ear length, grain weight per main spike, harvest index, number of grains per main spike and plant height, days to 50% flowering, grain weight per main spike, grain yield per plant, 1000 grain weight, harvest index, number of grains per main spike, number of productive tillers per plant and plant height. Besides, correlation and path coefficient analysis also revealed the importance of these traits. Therefore, due weightage should be given to these traits for genetic improvement in bread wheat.

REFERENCES

Al-Jibouri, H. A., Miller, P. A., & Robinson, H. F. (1958). Genotypic and environmental variances in upland cotton cross of interspecific origin. *Agron. J., 50*(10), 633-635.

Allard, R. W. (1960). Principles of Plant Breeding. John Willey and Sons, New York. pp: 8-481.

Ayer, D. K., Sharma, A., Ojha, B. R., Paudel, A., & Dhakal, K. (2017). Correlation and path coefficient analysis in advanced wheat genotypes. *SAARC J. Agric., 15*(1), 1-12.

Bhushan, B., Bharti, S., Ojha, A., Pandey, M., Gourav, S. S., Tyagi, B. S., & Singh, G. (2013). Genetic variability, correlation coefficient and path analysis of some quantitative traits in bread wheat. *J. Wheat Res., 5*(1), 21-26.

Bhutto, A. H., Rajpar, A. A., Kalhoro, S. A., Ali, A., Kalhoro, F. A., Ahmed, M., Raza, S., & Kalhoro, N. A. (2016). Corelation and regression analysis for yield traits in wheat (*Triricum aestivum* L.) genotypes. *Nat. Sci., 8*, 96-104.

Burton, G. W., & De Vane, E. H. (1953). Estimating heritability in tall Fescues (*Festuca arundinaceae*) from replicated clonal material. *Agron. J., 45*, 478-481.

Dewey, D. R., & Lu, K. H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J., 51*, 511-518.

Iftikhar, R., Khaliq, I., Kashif, M., Ahmad, A. M., & Samiullah. (2012). Study of morphological traits affecting grain yield in wheat (*Triticum aestivum* L.) under field stress condition. *Middle-East J. Sci. Res., 11*(1), 19-23.

Kumar , S., Choudhary, A. M., Purushottam, Singh, V., Chauhan, M. P., & Yadav, R. D. S. (2019). Studies of variability, heritability and genetic advance in some quantitative characters in bread wheat (*Triticum aestivum* L.). *J. Pharmacognosy and Phytochem.*, *8*(4), 402-404.

Kumar, Y., Bishnoi, O. P., & Singh, V. (2018). Dissection of genetic variability, correlation and path analysis in wheat (*Triticum aestivum* L.) genotypes for yield and its attributes. *Int. J. Pure App. Biosci. 6*(3), 32-37.

Khan, A. S., Ashfaq, M., & Asad, M. A. (2003). A correlation and path coefficient analysis for some yield components in bread wheat. *Asian J. Plant Sci.*, *2*(8), 582-584.

Mecha, B., Alamerew, S., Assefa, A., Assefa, E., & Dutamo, D. (2017). Correlation and path coefficient studies of yield and yield associated traits in bread wheat (*Triticum aestivum* L.) genotypes. *Adv. Plants Agric. Res.*, *6*(5), 226-235.

Panse, V. G., & Sukhatme, P. V. (1985). Statistical methods for agricultural workers. I.C.A.R., New Delhi, India, pp: 381.

Patel, N., & Raval, L. (2018). Selection indices for yield improvement in bread wheat (*Triticum aestivum* L.) under late sown condition. *J. Pharmacol. and Phytopathol.*, *7*(5), 1586-1588.

Ramanuj, B. D., Delvadiya, I. R., Patel, N. B., & Ginoya, A. V. (2018). Evalution of bread wheat (*Triticum aestivum* L.) genotypes for heat tolerance under timely and late sown conditions. *Int. J. Pure App. Biosci. 6*(1), 225-233.

Verma, S. P., Pathak, V. N., & Verma, O. P. (2019). Interrelationship between yield and its contributing traits in wheat (*Triticum aestivum* L). *Int. J. Curr. Microbiol. App. Sci., 8*(2), 3209-3215.

Wright, S. (1921). Correlation and causation. *J. Agril. Res.*, *20*, 557-585.

Singh, R. K., & Chaudhary, B. D. (1977). Variance and covariance analysis. *In*: "Biometrical methods in quantitative genetic analysis". *Kalyani Pub.,* New Delhi. pp: 39-68.

Vichitra Kumar, A., Jogendra, S., Lokendra, K., Rajendra, K., Punit, K., & Pooran, C. (2017). Genetic variability and heritability studies in relation to grain yield and its component traits in wheat. *Indian J. Agric. Res., 51*(2), 128-134.