

Genetic variability, correlation and path analysis in wheat germplasm (*Triticum aestivum* L.)

Salahuddin Wahidy, Dr. Suresh BG, Dr. Lavanya GR

Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India.

Abstract

The present study was undertaken with 30 wheat genotypes during *Rabi* 2014-15 in randomized block design having three replications at Field Experimentation Centre of Department of Genetics and Plant Breeding, Allahabad School of Agriculture, SHIATS to identify the suitable bread wheat genotypes and to assess the magnitude of genetic variability parameters for different quantitative traits in wheat (*Triticum aestivum* L.). Twelve traits were included in the study. Number of grains /spike, biological yield, harvest index, plant height and number of tillers moderate estimates for PCV & GCV. Number of grains /spike, flag leaf width, biological yield /plant and harvest index. High heritability along with high genetic advance as percent of mean was recorded for plant height and harvest index. Positive and highly significant correlation were obtained for biological yield /plant, harvest index, days to (50%) flowering and number of grains /spike with grain yield at both genotypic as well as phenotypic levels. Flag leaf length, flag leaf width, days to maturity, number of tillers, biological yield /plant and test weight (1000 grain) had positive direct effect on seed yield per plant. These traits should be given emphasis for future bread wheat yield improvement program through selection breeding.

Keywords: Wheat, heritability, genetic advance, correlation and path coefficient

Introduction

Wheat is the world's most important crop that excels all other cereal crops both in area and production, thereby providing about 20.0 per cent of total food calories for the people of the world. The extent of genetic variability has been considered as an important factor which is an essential pre-requisite for a successful hybridization aimed at producing high yielding progenies. The selection of parents becomes more difficult if the improvement is made for a polygenetically controlled complex character like grain yield. Since, efficient selection of genetically superior individuals requires adequate phenotypic variance in the base population and sufficient high heritability. Correlation studies along with path analysis provide a better understanding of the association of different characters with grain yield. Correlation is useful in disclosing the magnitude and direction of the relationship between various yield contributing traits and yield. While path coefficient (or) standardized partial regression coefficient that measures the direct effect of a predictor variable upon its response variable and the second component being the indirect effect(s) of a predictor variable (Dewey and Lu, 1959) [3].

Therefore the efforts were made to study the extent of variability, heritability and possible amount of genetic gain expected to occur during the selection for yield improvement. Similarly, an attempt was made to analyze grain yield and its attributing traits of wheat by correlation and path coefficient analysis.

Materials and methods

The experiment was conducted during *Rabi* seasons of 2014–2015 at Sam Higginbottom Institute of Agriculture, Technology & Sciences, Allahabad, Research Farm in Department of Genetic and Plant breeding. The experiment

comprising of 30 genotypes were conducted in a randomized block design with three replications. Each genotypes was accommodated in a single row two meters length spaced at 25 cm with an approximate plant to plant spacing 4 cm and data were recorded on five randomly selected plants from each treatment and each replication for days to 50% flowering, flag leaf length, flag leaf width, plant height, number of tillers per plant, spike length, days to maturity, number of grains per spike, biological yield per plant, harvest index, test weight and seed yield per plant. The genetic parameters of variability, estimation of heritability and genetic advance were computed according to the method suggested by Johnson *et al.*, (1955). The character association was estimated from variance and covariance components as given (Fisher, 1954 and Al-Jibouri *et al.*, 1958) [4, 2]. While the direct and indirect effects of component traits up on grain yield were measured by path analysis as described by Dewey & Lu (1959) [3].

Results and discussion

The analyses of variance for different 12 characters are present in Table 1. The result showed significant difference for mean sum of square at 1% level for all the characters except for flag leaf width under study among 30 genotypes. These characters are days to (50%) flowering, flag leaf length (cm), flag leaf width (cm), days to maturity, plant height (cm), number of tillers /plant, spike length (cm), number of grains /spike, biological yield /plant, test weight (1000 grain), harvest index (%), and yield /plant (g). This suggested that the genotype selected for research were quite variable and constant levels of variability are present among them. Thus indicating amply scope for selection of different qualitative characters in wheat improvement.

In the present investigation in Table 2. Showed that estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV), indicating that the little influence of environment on the expression of these characters. However, good correspondence was observed between genotypic coefficient of variation and phenotypic coefficient of variation in all the characters. The results are summarized as under: A wide range of phenotypic coefficient of variation (PCV) was observed for all the traits ranged from days to maturity (2.79) to yield /plant (34.82). Higher magnitude of phenotypic coefficient of variation was recorded for yield /plant (34.82), number of grains/spike (32.46), flag leaf width (26.35), biological yield /plant (25.20), harvest index (23.07), while moderate estimates were observed for plant height (19.7), number of tillers plant (16.44), spike length (16.38), flag leaf length (14.87), test weight (1000 grain) (10.53) and low estimates of phenotypic coefficient of variation was observed for days to 50 % flowering (7.40) and days to maturity (2.79). A wide range of genotypic coefficient of variation (GCV) was observed for all the traits ranged from (2.62) days to maturity to (32.19) yield /plant. Higher magnitude genotypic coefficient of variation was recorded for yield /plant (32.19), number of grains /spike (28.49), biological yield /plant (23.41), harvest index (21.45), plant height (19.43), number of tillers /plant (15.71), and moderate magnitude genotypic coefficient of variation was observed spike length (14.92), flag leaf width (14.062), flag leaf length (12.04), while low estimates of genotypic coefficient of variation values was observed for test weight (1000 grain) (9.04), days to 50 % flowering (6.92) and 2.62 (days to maturity). Earlier wheat researchers (Monpara, 2011, Singh *et al.*, 2012 and Tsegaye *et al.*, 2012) [5, 9] also reported similar results.

The range observed for heritability in broad sense was from (28.479) to (97.25) per cent and maximum heritability was recorded for the character plant height followed by number of tillers /plant (91.28), days to maturity (88.6), days to 50 % flowering (87.40), harvest index (86.40), biological yield /plant (86.31), yield /plant (85.47), spike length (82.91), number of grains /spike (77.05), test weight (1000 grain) (73.71), flag leaf length (65.53), and low heritability was observed for flag leaf width (28.479). Present findings are in confirmation with Monpara, 2011 [5] and Singh *et al.*, 2012 [9].

The estimates of expected genetic advance genetic advance revealed that it was high for plant height (37.75), number of grains /spike (20.01), harvest index (15.68), days to 50 % flowering (10.44), biological yield /plant (9.79), test weight

(1000 grain) (7.02), yield /plant (5.24), spike length (4.78), flag leaf length (4.53), flag leaf width (0.25), days to maturity (5.89), number of tillers/plant (1.49). Similar results were reported by Sharma *et al.*, 2006 and Singh *et al.*, 2012 [9].

Correlation analysis (Table 3) revealed that the association between yield and yield contributing characters was found positive and significant only for four characters namely flag leaf width (0.893**), biological yield /plant (0.757**), harvest index (0.523**), number of grains /spike (0.415**) and days to 50 % flowering (0.255*). Selection for these characters can directly be followed for immediate yield improvement of wheat crop. The characters number of tillers/plant (0.164), days to maturity (0.099), flag leaf length (0.060), spike length (0.057), days to 50% flowering (0.052) and flag leaf width (0.028) also exhibited positive association with yield however the magnitude of correlation coefficient was less indicating that during selection these characters cannot be neglected. While the character spike length (-0.207) exhibited negative and non-significant association with grain yield, indicating that the direct selection for this character may not be helpful for improving the yield and for that indirect selection will have to be followed via test weight (-0.095) and flag leaf length (-0.060). And while it showed negative significant association only with plant height (-0.362**). Present findings are in confirmation with (Ahmed *et al.*, 2010 and Singh *et al.*, 2012) [1, 9].

Sharma *et al.*, 2006 [8] Ahmed *et al.*, 2007; Monpara and Kalariya, 2009; Singh *et al.*, 2010 [10] Sakhare and Ghawat, 2011 [7] and Singh *et al.*, 2012 [9] reported stronger or weaker association of yield with yield component traits in wheat and suggested that wheat crop grain yield potential can be effectively improved by obtaining the maximum expression of yield contributing characters showing the stronger association in desirable direction.

In conclusion from the present investigation can be concluded that genotypes SHBW131 (11.45g) and SHBW153 (10.82g /plant) were found best for grain yield and most of yield component traits. High heritability (>60) along with moderate to low genetic advance as % of mean were related for harvest index and plant height. Which indicates that additive gene action was responsible for their expression. Hence, selection can be exercised upon these characters. Further positive correlation of these characters with grain yield proved their genetic worth. In path analysis revealed that characters like flag leaf width, days to maturity, plant height, number of grains, biological yield /plant, test weight direct effect on seed yield these characters can be used as selection indices.

Table 1: Analysis of variance for different quantitative characters in wheat.

Characters	Mean sum of squares		
	Replications (df. =02)	Treatment d.f = 29	Error =58
Days to (50%) flowering	1.078	30.807**	4.239
Flag leaf length	10.508	8.691**	3.890
Flag leaf width	0.008	0.095	0.130
Days to maturity	0.544	9.626**	1.188
Plant height	0.878	348.563**	9.763
Number of tillers per plant	0.078	0.592**	0.055
Spike length	4.066	6.927**	1.336
Number of grains per spike	107.244	134.661**	36.486
Biological yield per plant	9.483	27.545**	4.148
Test weight (1000 grain)	4.812	17.605**	5.611
Harvest index	35.063	70.609**	10.560
Yield per plant	3.510	8.002**	1.288

** Significant at 1% levels of significance.

Table 2: Range, mean, genotypic and phenotypic coefficients of variation, heritability and genetic advance for different characters in wheat

Characters	Rang			GCV	PCV	Heritability (%)	GA	(GA as % of mean)
	Min	Max	Mean					
Days to 50 % flowering	74.00	84.00	78.39	6.92	7.40	87.40	10.44	13.32
Flag leaf length	19.93	26.40	22.59	12.04	14.87	65.53	4.53	20.08
Flag leaf width	1.39	2.28	1.62	14.062	26.350	28.479	0.250	15.459
Days to maturity	113.00	119.33	115.82	2.62	2.79	88.60	5.89	5.09
Plant height	76.33	116.00	95.66	19.43	19.70	97.25	37.75	39.46
Number of tillers/plant	4.00	6.00	4.82	15.71	16.44	91.28	1.49	30.91
Spike length	15.43	21.03	17.07	14.92	16.38	82.91	4.78	27.98
Number of grains / spike	27.67	54.33	38.84	28.49	32.46	77.05	20.01	51.52
Biological yield/plant	15.00	27.53	21.85	23.41	25.20	86.31	9.79	44.81
Test weight (1000 grain)	40.50	50.87	43.88	9.04	10.53	73.71	7.02	15.99
Harvest index	22.63	45.43	38.19	21.45	23.07	86.40	15.68	41.07
Yield /plant	3.51	11.58	8.55	32.19	34.82	85.47	5.24	61.30

Table 3: Phenotypic coefficient of correlation for different quantitative characters in bread wheat genotypes.

	Days to flowering 50%	Flag leaf length	Flag leaf width	Days to maturity	Plant height	Number of Tillers/plant	Spike length	Number of grains/spike	Biological yield /plant	Test weight (1000 grain)	Harvest index	Yield /plant
Days to (50%) flowering	1.00	0.197	0.151	0.627**	0.198	0.209*	0.373**	0.196	0.156	0.111	-0.090	0.255*
Flag leaf length		1.00	0.224*	0.318**	0.348*	0.001	0.530**	0.117	0.052	0.096	-0.108	0.060
Flag leaf width			1.00	0.180	0.086	0.154	0.282**	0.002	0.051	0.115	-0.077	0.028
Days to maturity				1.00	0.257*	0.259*	0.402**	0.022	0.087	0.114	-0.148	0.099
Plant height					1.00	-0.106	0.411**	0.001	0.080	0.120	-0.595**	-0.263*
Number of tillers/plant						1.00	0.055	-0.097	0.106	0.085	0.026	0.164
Spike length							1.00	0.057	0.126	0.351**	-0.399**	0.057
Number of grains / spike								1.00	0.386**	-0.307**	0.286**	0.415**
Biological yield/plant									1.00	0.099	0.191	0.757**
Test weight (1000 grain)										1.00	-0.230*	-0.023
Harvest index											1.00	0.523**
Yield /plant												1.00

*** significant at 5% and 1% level of significance

Table 4: Path coefficient analysis of genotypic level for twelve characters of seed Yield Components in wheat

Characters	Days to Flowering 50 %	Flag leaf length	Flag leaf width	Days to maturity	Plant height	Number of tillers/ plant	Spike length	Number of grains/spike	Biological yield/plant	Test weight (1000 grain)	Harvest index
Days to (50%) flowering	-3.230	0.844	0.362	3.897	-1.753	0.381	-3.523	-1.669	0.335	0.324	1.434
Flag leaf length	-0.439	6.218	2.144	2.078	-4.075	-0.092	-10.548	-1.369	0.277	0.958	3.268
Flag leaf width	-0.760	8.663	1.539	3.459	-3.891	1.252	-17.404	-3.195	2.301	1.965	5.160
Days to maturity	-2.569	2.637	1.086	4.901	-1.908	0.502	-6.535	0.670	0.128	0.729	2.343
Plant height	-0.767	3.431	0.811	1.266	-7.387	-0.157	-6.698	0.625	0.117	0.360	7.303
Number of tillers/plant	-0.857	-0.400	1.343	1.715	0.807	1.434	-0.754	1.972	0.068	0.424	-0.376
Spike length	-0.819	4.721	1.928	2.306	-3.562	0.078	-13.891	0.987	0.181	1.402	6.107
Number of grains / spike	-0.813	1.284	0.742	-0.495	0.697	-0.427	2.069	-6.628	0.590	-1.482	-4.721
Biological yield/plant	-0.722	1.152	2.365	0.419	-0.576	0.065	-1.684	-2.613	1.497	0.027	-2.880
Test weight (1000 grain)	-0.573	3.261	1.655	1.956	-1.457	0.333	-10.662	5.377	0.022	1.827	3.283
Harvest index	0.471	-2.068	-0.808	-1.169	5.490	0.055	8.633	-3.184	0.439	-0.610	-9.826

Residual are 1.36797

Table 5: Path Coefficient Analysis of Phenotypic level for 12 seed Yield Components in wheat

Characters	Days to Flowering 50 %	Flag leaf length	Flag leaf width	Days to maturity	Plant height	Number of tillers/plant	Spike length	Number of grains/spike	Biological yield /plant	Test weight (1000 grain)	Harvest index (%)
Days to (50%) flowering	0.629	0.005	-0.005	-0.157	-0.034	0.016	0.015	0.001	0.101	-0.001	-0.029
Flag leaf length	0.124	0.024	-0.007	-0.079	-0.060	0.000	0.021	0.000	0.034	-0.001	-0.035
Flag leaf width	0.095	0.005	-0.030	-0.045	-0.015	0.012	0.011	0.000	0.033	-0.001	-0.025
Days to maturity	0.395	0.008	-0.005	-0.250	-0.044	0.020	0.016	0.000	0.057	-0.001	-0.048
Plant height	0.124	0.008	-0.003	-0.064	-0.173	-0.008	0.016	0.000	0.052	-0.001	-0.194
Number of tillers/plant	0.131	0.000	-0.005	-0.065	0.018	0.077	0.002	0.000	0.069	-0.001	0.008
Spike length	0.235	0.013	-0.008	-0.100	-0.071	0.004	0.039	0.000	0.082	-0.003	-0.130
Number of grains / spike	0.123	0.003	0.000	-0.006	0.000	-0.007	0.002	0.004	0.250	0.003	0.093
Biological yield/plant	0.098	0.001	-0.002	-0.022	-0.014	0.008	0.005	0.002	0.647	-0.001	0.062
Test weight (1000 grain)	0.070	0.002	-0.003	-0.028	-0.021	0.007	0.014	-0.001	0.064	-0.009	-0.075
Harvest index (%)	-0.057	-0.003	0.002	0.037	0.103	0.002	-0.016	0.001	0.123	0.002	0.326

Residual are 0.14483

References

- Ahmed B, Iftikhar RH Khalil, Muhammad Iqbal and Hidayat-Ur-Rahman. Genotypic and phenotypic correlation among yield components in bread wheat under normal and late plantings. *Sarhad Journal of Agriculture*. 2010; 26(2):259-265.
- Al-Jibouri HA, Miller PA, Robinson HP. Genotypic and phenotypic co-variances in an upland cotton cross of inter-specific origin. *Agronomy Journal*. 1958; 50:633-636.
- Dewey DR, Lu KH. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agronomy Journal*. 1959; 51(9):515-518.
- Fisher RA. *Statistical methods for research workers*, Oliver and Boyd. Ltd. London, 1954.
- Monpara BA. Grain filling period as a measure of yield improvement in bread wheat. *Crop Improvement*. 2011; 38(1):1-5
- Monpara BA, Kalariya RP. Changes in certain yield traits as influenced by differences in maturity time in bread wheat (*T. aestivum* L.) *Plant Achieves*. 2009; 9(1):335-339.
- Sakhare SB, Ghawat NP. Correlation and path analysis in durum wheat. *PKV. Research Journal*. 2011; 35(1):23-25.
- Sharma V, Pawar IS, Munjal R. Variability parameters, correlation and path coefficients for yield, its components and quality traits in bread wheat. *National Journal of Plant Improvement*. 2006; 8(2):153-155.
- Singh AK, Singh SB, Singh AP, Sharma AK. Genetic variability, character association and path analysis for seed yield and its component characters in wheat (*Triticum aestivum* L.) under rainfed environment. *Indian Journal of Agricultural Research*. 2012; 46(1):48-53.
- Singh BN, Vishwakarma SR, Singh VK. Character association and path analysis in elite lines of wheat (*T. aestivum* L.) *Plant Achieves*. 2010; 10(2):845-847.
- Tsegaya D, Dessalegn T, Dessalegn Y, Share G. Genetic variability, correlation and path analysis in durum wheat germplasm (*Triticum durum* Desf.). *Agricultural Research and Review*. 2012; 1(4):107-112.