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Genetic Variability and Association of Characters in Wheat (*Triticum aestivum* L.)

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Abstract: In the present investigation, an attempt has been made to evaluate the genetic variability and correlation of different contributing characters associated with grain yield per plant in wheat. Fourteen genotypes were grown in Randomized Block Design with three replications and evaluated for ten characters. Analysis of variance was done from the mean data obtained in each character and correlation and path coefficient analysis were carried out. Highly significant differences and adequate genetic variability were observed among the genotypes for all the ten selected characters. In this context, it was found that numbers of effective tillers per plant and grain yield per plant were characterized by high GCV, high heritability and high genetic advance and would be effective for selection. Correlation studies and path coefficient analysis revealed the importance of number of effective tillers per plant, number of spiklet per panicle, number of grains per panicle and harvest index for improving grain yield per plant as they had positive direct effects on yield and these traits were also significantly and positively correlated with grain yield per plant. So for increasing grain yield per plant a wheat genotype should have more number of effective tillers per plant, more number of spikelet per panicle, more number of grains per panicle and high harvest index value because these characters were positively associated with grain yield and resemble high estimates of heritability along with high genetic advance. In this regard the importance of large panicle length and more 1000 grain weight could not be under mined for yield improvement.

Key words: Correlation, path analysis, genetic parameters, heritability, characters, yield

INTRODUCTION

Wheat (*Triticum aestivum* L., Graminae) is the world most cultivated food crop known as the king of all cereal crops as its cultivation is easier, ecologically suitable and contain high amount of nutrients. It is rich in protein (7-22%), carbohydrate, calcium, lysine, iron, glutein, vitamin and minerals. Wheat is cultivated over an area of 230.16 million ha with a production of 673.09 million ton in the world (FAOSTAT, 2003). In India it is the second important crop after rice and covers an area over 27.75 million hectares which is about 20% of the total cultivated area under cereal. India has attained a record of 80.58 million tones of wheat production in 2008-2009 and continues to remain as the second largest producer of wheat in the world (USDA, 2009).

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In the context of yield enhancement, in order to have a good choice of character for selection of desirable genotypes under planned breeding programme, the knowledge of nature and magnitude of variation existing in available plant breeding materials, the association of component characters with yield and their exact contribution through direct and indirect effects are very important. Genotypic variation, heritability, genetic advance were calculated for different yield attributing characters in wheat by several workers (Kheiralla *et al*., 1993; Subhani and Khaliq, 1994; Gupta and Verma, 2000; Jedynski, 2001) which revealed that selection was effective for a population with broad genetic variability and character with high heritability. Several workers studied the components of variance, correlation between different yield attributing characters and their direct and indirect effects on yield (Ismail *et al*., 2001; Kumar and Sukla, 2002; Satyavart *et al*., 2002; Tamam *et al*., 2000). So in this background, the objective of the present investigation was to estimate the genetic variability, association of different characters and their direct and indirect effect on grain yield per plant with a view to identify the genotypes with best potentiality for upgrading yield and its component characters.

MATERIALS AND METHODS

Experimental Material and Design

The present investigation was conducted at Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India during the Rabi season of 2004-2005. The farm is situated at 22.93°N latitude and 88.59°E longitudes with an average altitude of 9.75 m above mean sea level with gangetic alluvial sandy loam soil having good drainage facility. Fourteen genotypes (PBW 443, HD 2733, K 0307, C 306, PBW 343, HUW 468, K 9107, UP 262, Raj 4084, PBW 550, PBW 533, Lok 17, HD 2932 and HD 2824) were collected from different parts of India and planted in Randomized Block Design (RBD) with three replications. Observations were recorded from ten plants from the middle rows of the plot excluding the border plants, for ten plant characters viz. Plant height (cm), number of effective tillers per plant, panicle length (cm), number of spikelets per panicle, number of grain per panicle, 1000 grain weight (g), days to flower, days to maturity, harvest index and grain yield per plant.

Statistical Analysis

Analysis of variance was done from the mean data obtained in each character. Estimates of genetic parameters were computed (Johnson *et al*., 1963). Phenotypic and genotypic correlation coefficients for all pairs of ten characters were estimated (Robinson *et al*., 1951). As there is no suitable statistical procedure for testing the significance of genotypic correlation (Nasr *et al*., 1973) only phenotypic correlations were tested. Path coefficient analysis was carried out as described by Dewey and Lu (1959) at phenotypic level only.

RESULTS AND DISCUSSION

Highly significant differences were obtained among the genotypes for all the ten selected characters (Table 1); this indicated adequate variability among the genotypes considered in this study. The genotype K 9107 produced the highest value regarding panicle length, no. of spiklet per panicle and no. of grains per panicle. In case of 1000 grain weight best result was found in UP 262. Genotype K 9107 with lowest plant height resembled the highest harvest index value. Regarding grain yield per plant HD 2824 showed the best result than other.

Table 1: Mean of ten characters of fourteen genotypes of wheat (*Triticum aestivum* L.)

Genotypes	Plant height (cm)	No. of effective tiller/plant	Panicle length (cm)	No. of spikelet/ panicle	No. of grains/ panicle	1000 grain weight (g)	Days to flower	Days to maturity	Harvest index	Grain yield/ plant (g)
PBW 443	79.33	15.13	9.60	16.73	46.46	28.23	67.46	108.00	31.93	6.66
HD 2733	78.73	8.93	10.63	19.53	55.66	43.66	60.46	110.10	33.76	7.33
KO 307	82.06	9.60	10.76	16.93	50.73	55.33	71.40	105.40	32.30	9.03
C 306	103.33	10.13	8.86	16.40	47.66	45.33	53.40	90.33	32.21	7.66
PBW 343	84.66	9.86	9.73	17.66	51.53	48.16	71.40	110.76	26.85	6.23
HUW 468	61.03	14.00	9.73	16.20	45.20	27.33	70.06	109.16	43.08	6.33
K 9107	84.51	9.40	11.46	20.53	57.46	55.66	83.20	119.10	31.40	7.66
UP 262	82.66	9.86	9.53	21.00	54.46	56.66	69.93	109.10	33.99	9.00
RAJ 4084	90.30	10.66	11.63	18.70	52.13	47.00	80.33	118.66	32.50	6.66
PBW 550	66.76	8.73	9.50	19.93	56.20	30.00	68.00	102.80	36.43	6.66
PBW 533	76.06	8.46	10.43	19.66	56.66	32.00	76.13	111.50	34.81	7.93
LOK 17	82.86	8.60	11.40	19.46	55.46	52.00	83.86	110.60	29.76	6.66
HD 2932	67.80	12.56	9.23	19.66	55.73	47.33	52.53	90.16	32.77	10.0
HD 2824	77.80	15.73	10.80	20.13	53.01	36.33	59.53	94.43	42.70	13.76
CD at 5%	13.02	2.21	1.02	1.61	4.96	12.05	7.45	8.53	6.59	2.61

Table 2: Mean, range and other genetic parameters in wheat (*Triticum aestivum* L.)

Characters	Mean	Range	Coefficient of variation (CV)	Coefficient of variation GCV	PCV	ECV	Standard error (SE±m)	Heritability (h^2%)	Genetic advance as % over mean
Plant height (cm)	79.78	61.03-103.33	27.64	11.80	15.29	03.49	4.82	59.50	18.77
No. of effective tiller/plant	10.83	8.46-15.73	39.67	21.80	24.97	03.17	4.62	76.00	26.11
Panicle length (cm)	10.23	8.86-11.63	15.16	8.04	10.01	01.97	4.20	64.00	14.33
No. of spikelet/panicle	18.75	16.20-21.00	15.13	8.22	9.69	01.47	1.14	71.00	39.21
No. of grains/panicle	53.01	45.20-57.46	13.45	7.06	9.00	01.94	0.41	61.00	13.31
1000 grain weight (g)	43.21	27.33-56.66	42.25	22.42	27.91	5.49	0.75	64.00	14.37
Days to flower	69.12	52.53-8386	25.01	13.95	15.36	01.41	1.90	82.00	11.42
Days to maturity	106.46	90.16-119.10	14.79	8.08	9.39	01.31	4.88	74.00	37.00
Harvest index	33.89	26.85-43.08	39.61	11.20	16.12	04.92	2.04	58.25	26.02
Grain yield/plant (g)	7.97	6.23-13.76	42.85	22.67	29.91	7.24	0.93	57.00	35.42

It was evident from the (Table 2) result that the magnitude of Phenotypic Coefficient of Variation (PCV) was higher than the Genotypic Coefficient of Variation (GCV) for all the characters studied. This indicates that the apparent variation was not only due to genotypes but also due to influence of environment. The characters like grain yield per plant, thousand grain weight, plant height, number of effective tillers per plant and harvest index showed larger difference between phenotypic and genotypic coefficient of variation indicating the greater influence of environment on these characters. However, in rest of the characters minimum difference between phenotypic and genotypic coefficients of variation was observed indicating less environmental influence and scope of selection for these traits. The heritability showed highest value for days to flower, followed by number of effective tillers per plant and days to maturity. This result showed close resemblance with the report of Fida *et al.* (2001) where these characters also exhibited high heritability. However, the genetic advance as percent over mean was found high in number of spikelet per panicle, days to maturity, grain yield per plant, harvest index and number of effective tillers per plant. GCV alone is not sufficient for determination of the extent of variation that perpetuate from one generation to the next. GCV together with heritability estimates would give a better picture of the extent of genetic advance that can be made through selection (Johnson *et al.*, 1963) for estimating genetic gain under selection. In this context, number of effective tillers per plant and grain yield per plant was characterized by high GCV, high heritability and high genetic advance and might be considered to be governed by additive genes and was less

influenced by environmental effect. So selection for these traits would be effective. Similar findings were also observed by Ghimiray and Sarkar (2000) and Kumar and Sukla (2002) where number of tillers per plants and grain yield showed high heritability associated with high genetic advance. Mean square for GCA effects of these two characters was also highly significant (Kashif and Ihsan, 2003) which resemble additive genetic effects and supported the present finding. On the other hand, characters like, panicle length, plant height, number of grains per panicle, thousand grain weight, days to flower having high heritability values, had low estimates of genetic advance. Therefore, these characters are expected to be controlled by non-additive genes. The high heritability was being exhibited due to favorable influence of environmental effects rather than genotype and selection for such traits would not be rewarding.

Correlation coefficient at genotypic levels was, in general higher than phenotypic level in all the characters (Table 3). Genotypic correlation was found more significant than phenotypic correlation indicating that, there was prevalence of environmental interaction. The high positive significant genotypic correlation were found between number of spikelet per panicle and number of grains per panicle, days to flower and days to maturity, panicle length and days to flower and panicle length and days to maturity than phenotypic correlation which indicated that there was a strong association between characters genetically and there was some scope for selection of better yielding types. Number of effective tillers per plant, number of spikelet per panicle, number of grains per panicle and harvest index gave significantly positive correlation with the grain yield per plant both at genotypic and phenotypic levels. So these characters exhibited correlated response with the grain yield and therefore might be considered for selection of better yield. Similar findings were observed by several previous workers (Fida *et al*., 2001; Tamam *et al*., 2000; Korkut *et al*., 2001). They reported positive significant correlation between days to heading and plant heights, Number of effective tillers per plant with grain yield per plant and harvest index and between panicle length and number of grains per panicle. Sultana *et al*. (2002) reported that No. of effective tillers per plant, spikelet per spike, florets per spike,

Table 3: Genotypic and phenotypic correlations among the ten characters of wheat (*Triticum aestivum* L.)

Characters		Plant height (cm)	No. of effective tiller/plant	Panicle length (cm)	No. of spikelet/ panicle	No. of grains/ panicle	1000 grain weight (g)	Days to flower	Days to maturity	Harvest index	Grain yield/ plant (g)
Plant height	GC	1.000	-0.276	0.149	-0.164	-0.144	0.659**	0.078	0.053	-0.636**	-0.070
(cm)	PC	1.000	-0.290	0.131	-0.107	-0.067	0.337	0.023	0.006	-0.400	-0.055
No. of effective	GC		1.000	-0.217	-0.303	-0.450	-0.593**	-0.433	-0.413	0.655**	0.501*
tiller/plant	PC		1.000	-0.203	-0.298	-0.374	-0.301	-0.337	-0.272	0.402	0.550
Panicle length	GC			1.000	0.367	0.493*	0.364	0.744**	0.715**	-0.106	0.043
(cm)	PC			1.000	0.270	0.314	0.268	0.646**	0.530*	-0.403	0.402
No. of spikelet/	GC				1.000	0.970**	0.363	0.174	0.164	-0.109	0.515*
panicle	PC				1.000	0.871**	0.196	0.187	0.118	0.088	0.528*
No. of grains/	GC					1.000	0.351	0.179	0.110	-0.146	0.522*
panicle	PC					1.000	0.250	0.143	0.042	0.003	0.554*
1000 grain	GC						1.000	0.217	0.134	-0.653**	0.143
weight (g)	PC						1.000	0.230	0.179	-0.512*	0.056
Days to flower	GC							1.000	0.884**	-0.298	-0.514*
	PC							1.000	0.853**	-0.235	-0.348
Days to	GC								1.000	-0.274	-0.639**
maturity	PC								1.000	-0.239	-0.431
Harvest index	GC									1.000	0.580*
	PC									1.000	0.517
Grain yield/	GC										1.000
plant (g)	PC										1.000

**Significant at 1% level, * Significant at 5% level

Table 4: Direct and indirect effects of different characters on grain yield/plant of wheat (*Triticum aestivum* L.)

Genotypes	Plant height (cm)	No. of effective tiller/ plant	Panicle length (cm)	No. of spikelet/ panicle	No. of grains/ panicle	1000 grain weight (g)	Days to flower	Days to maturity	Harvest index	Correlation with grain yield/ plant (g)
Plant height (cm)	0.073	-0.099	0.078	-0.057	0.005	0.198	-0.004	-0.044	-0.209	-0.055
No. of effective tiller/ plant	0.020	0.360	-0.115	-0.106	-0.016	-0.178	0.023	0.348	0.204	0.550
Panicle length (cm)	0.010	-0.078	0.529	0.128	0.017	0.109	-0.040	-0.602	-0.032	0.042
No. of spikelet/ panicle	-0.012	-0.109	0.194	0.350	0.035	0.109	-0.009	-0.137	-0.005	0.528
No. of grains/ panicle	-0.010	0.261	0.339	0.039	0.360	0.105	-0.092	-0.162	-0.044	0.354
1000 grain weight (g)	0.048	-0.213	0.193	0.127	0.012	-0.300	-0.011	-0.112	-0.200	0.056
Days to flower	0.005	-0.156	0.394	0.060	0.006	0.065	-0.053	-0.745	-0.091	0.348
Days to maturity	0.003	0.149	0.379	0.057	0.003	0.040	0.050	-0.842	0.084	0.431
Harvest index	0.049	0.239	0.056	0.006	0.005	0.196	0.016	0.231	0.307	0.517

Residual effect = 0.3412

grains per spike were significantly positively associated with grain yield per plant which was similar with the present finding but they also reported that these characters exhibited negative correlation with total tillers per plant. However, Randhawa *et al.* (1975) observed positive and genotypically significant negative Correlation between numbers of tillers per plant with 1000 grain weight.

In order to obtain a clear picture of the inter-relationship between different characters, the direct and indirect effects of the different characters on grain yield per plant were worked out (Table 4). All the direct effects towards grain yield per plant were positive except days to flower and days to maturity. In general, the indirect effects were either positive or negative and lower in magnitude with low residual effect (0.3412). Considering the relationship of all the traits with grain yield per plant the present investigation showed the importance of number of effective tillers per plant, number of spiklet per panicle, number of grains per panicle and harvest index for improving grain yield per plant as they had positive direct effects on yield and these traits were also significantly and positively correlated with grain yield per plant. So, direct selection for these characters would be effective for yield improvement in wheat. Direct effect of panicle length and 1000 grain weight on grain yield was also high although these two traits showed insignificant but positive correlation with grain yield at both the levels. Positive direct effect of panicle length and 1000 grain weight on yield was also reported by Dokuyucu and Akkaya (1999).

CONCLUSION

So for increasing grain yield per plant a wheat genotype should have more number of effective tillers per plant, more number of spikelet per panicle, more number of grains per panicle and high harvest index value because these characters were positively associated with grain yield and resemble high estimates of heritability along with high genetic advance. In this regard the importance of large panicle length and more 1000 grain weight could not be under mined. However, in case of selection for yield improvement the genotype should have short plant height with less time required for days to flowering and grain filling.

REFERENCES

Dewey, D.R. and K.H. Lu, 1959. A correlation and path coefficient analysis of component of crested wheatgrass seed production. Agron. J., 51: 515-518.

Dokuyucu, T. and A. Akkaya, 1999. Path coefficient analysis and correlation of grain yield and yield components of wheat (*Triticum aestivum* L.) genotypes. Rachis, 18: 17-20.

FAOSTAT, 2003. Statistics Database. Food and Agriculture Organization, USA.

Fida, M., H. Daniel, K. Shahzad and H. Khan, 2001. Heritability estimates for yield and its components in wheat. Sarhad J. Agric., 17: 227-234.

Ghimiray, T.S. and K.K. Sarkar, 2000. Estimation of genetic parameters for some quantitative traits in wheat (*Triticum aestivum* L.) grown in terai soils of West Bengal. Environ. Ecol., 18: 338-340.

Gupta, S.K. and S.R. Verma, 2000. Variability, heritability and genetic advance under rain fed conditions in durum wheat (*Triticum aestivum* Desf.). Indian J. Agric. Res., 34: 122-125.

Ismail, A.A., M.A. Khalifa and K.A. Hamam, 2001. Genetic studies on some yield traits of durum wheat. Asian J. Agric. Sci., 32: 103-120.

Jedynski, S., 2001. Heritability and path-coefficient analysis of yield components in spring wheat. Proceeding of Symposium on Grupy Problemowej Hoodowli Pszenicy, (SGPHP'01), Zakopane, Poland, pp: 203-209.

Johnson, V.A., J.W. Schmidt, P.J. Mattern and A. Haunold, 1963. Agronomy and quality characteristics of high protein F2-derived families from a soft red hard red winter wheat cross. Crop Sci., 6: 7-10.

Kashif, M. and K. Ihsan, 2003. Determination of general and specific combining ability effects in a diallel cross of spring wheat. Pak. J. Biol. Sci., 6: 1616-1620.

Kheiralla, K.Z., I. Baser and O. Bilgin, 1993. Selection response for grain yield and its components in a segregation population of spring wheat. Assist. J. Agric. Sci., 24: 87-93.

Korkut, K., I. Baser and O. Bilgin, 2001. Genotypic and phenotypic variability, heritability and phenotypic correlation for yield and yield components in bread wheat varieties. Acta Agron. Hung., 43: 237-242.

Kumar, P. and R.S. Shukla, 2002. Genetic analysis for yield and its attributed traits in bread wheat under various situation. JNKVV Res. J., 36: 95-97.

Nasr, H.G., H.L. Shands and R.A. Forsberg, 1973. Correlations between kernel plumpness, lodging and other agronomical characteristics in six rowed barley crosses. Crop Sci., 13: 399-402.

Randhawa, A.S., A.S. Minhas and S. Singh, 1975. Genetic variability correlation studies in bread wheat (*Triticum aestivum* L.). J. Res. Punjab Agric. Univ., 72: 213-217.

Robinson, H.F., R.E. Comstock and P.H. Harvery, 1951. Genotypic and phenotypic correlations in corn and their implication in selection. Agron. J., 43: 282-287.

Satyavart, H., R.K. Yadava and G.R. Singh, 2002. Variability and heritability estimates in bread wheat. Environ. Ecol., 20: 548-550.

Subhani, G.M. and I. Khaliq, 1994. Path coefficient analysis in wheat. Pak. J. Sci Ind. Res., 37: 474-476.

Sultana, S., M.A. Islam, M.R. Islam and M.M. Morshed, 2002. Correlation and regression analysis for heading date, yield and yield contributing characters in wheat under water and phosphorus stress. Pak. J. Biol. Sci., 5: 149-151.

Tamam, A.M., S.A.M. Ali and E.A.M. Sayed, 2000. Phenotypic genotypic correlations and path coefficient analysis in some bread wheat crosses. Asian J. Agric. Sci., 31: 73-85.

USDA, 2009. Foreign agricultural service. Circular Report, WAP 08-09. http://www.fas.usda.gov.