Electronic Journal of Plant Breeding, 5(1): 71-76 (Mar 2014)
ISSN 0975-928X

Research Note

Genetic variability for different biometric traits in wheat (*Triticum aestivum* L.) under medium fertility conditions

Y. Kumar*, R.A.S. Lamba And R.P. Saharan[1]
Regional Research Station, CCS Haryana Agricultural University, Bawal-123501, India
[1]Directorate of Research, CCS HAU, Hisar-125004
Email: yogenderkgulia@gmail.com

(Received: 25 Feb 2014; Accepted: 06 Mar 2014)

Abstract

This study was carried out at CCS HAU, Regional Research Station, Bawal (Haryana) during *rabi* 2012-13 with 24 wheat genotypes to assess the genetic variability, correlation and path coefficient analysis under medium fertility conditions. Ten biometric traits *viz*., plant height (cm), spike length (cm), number of tillers per meter row, number of grains per spike, days to heading, days to maturity, 1000-grain weight (g), harvest index (%), biological yield (kg/plot) and grain yield (kg/plot). The higher phenotypic (PCV) and genotypic coefficients of variation (GCV) were exhibited by number of grains per spike, number of tillers per meter row, harvest index, biological yield, 1000-grain weight and grain yield. Moderate to high heritability coupled with high genetic advance as per cent of mean was observed for number of grains per spike, 1000-grain weight, grain yield, biological yield, number of tilers per meter row, harvest index and plant height, indicating the importance of these traits in selection and crop improvement. The genotypic correlation estimates showed significant positive association of grain yield with harvest index, 1000-grain weight, days to heading and maturity. Path coefficient analysis at genotypic level revealed high positive direct effect of harvest index and biological yield and negative direct effect by number of tillers per meter row on grain yield. Hence these are the main contributors to grain yield under medium fertility conditions.

Key words: Wheat, Genetic variability, correlation coefficient, path analysis, biometric traits

Wheat (*Triticum aestivum* L.) is one of the most important cereal crop of India, occupies an area of 29.65 million hectares with the production and productivity of 92.46 million tons and 3119 kg ha^{-1}, respectively. Haryana state on the whole has achieved a productivity level of 4.45 tons ha^{-1} on 2.50 million hectares (Anonymous, 2013). Our country has witnessed spectacular growth in production and productivity, which has made country not only self sufficient but also for exporting surplus wheat. There is need to further increase in production to fulfill requirement of exploding population, maintenance of adequate buffer stock and to meet out demand for processing industries. The attainment of maximum crop yield under stress condition is an important objective in most breeding programs and the major emphasis in wheat breeding is on the development of improved varieties. Yield is a complex quantitative trait entailing several contributing factors which are in turn highly susceptible to environment influence. Selection is one of the important tools in crop improvement. It should not only be restricted to grain yield alone but other components related to grain yield must also be considered. Although, the success of selection depends on the choice of selection criteria for improving grain yield. This requires information about nature and magnitude of variability in base population and association of yield components with grain yield.

Correlation coefficient is an important statistical method which can help wheat breeders in selection for higher yield. Partitioning the correlation coefficient into direct and indirect effects can be done through path analysis technique (Dewey and Lu, 1959). Path coefficients have been used to develop selection criteria for complex traits in several crop species of economic importance. There are many reports on genetic variability and characters association analysis in wheat but comparatively deficient on study under stress conditions. The objectives of this study were to assess genetic variability, find out the interrelationship of yield and yield contributing characters in wheat genotypes and to partition the observed correlations into their direct and indirect effects. The information thus obtained will be used to define the suitable selection criteria for yield improvement under medium fertility/stress conditions.

The experimental material consisted of 24 wheat genotypes *viz*., P 12033, P 13040, P 12392, P 12252, P 12406, P 12289, P 12272, P 12283, P 12394, P 12253, PBW 175, P 12286, WH 1080, P 12401, P 12337, P 12396, P 12333, P 12393, P 12334, C 306, P 12391, P 12332, WH 147 and P 12407 evaluated in randomized block design with three replications at CCS HAU, Regional Research Station, Bawal (Haryana) during *rabi* 2012-13 under medium fertility conditions (100 kg N and 50 kg P/ha with two irrigations at 21 and 85 days after sowing). These genotypes were received from Wheat and Barley Section, Department of Genetics and Plant Breeding, CCS HAU, Hisar. Each genotype was grown in four rows with a plot size of 5 x 1.20 m^2. Recommended agronomic practices were followed to raise a good crop. The observations on ten biometric traits *viz*., plant height (cm), spike length (cm), number of tillers per meter row, number of grains per spike, days to heading, days to maturity, 1000-grain weight (g), harvest index (%), biological yield (kg/plot) 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 (1976).

The mean performance of individual genotypes was employed for statistical analysis. Analysis of variance to test the significance for each character was carried out as per methodology given by Panse and Sukhatme (1967). Genotypic and phenotype coefficients of variation (GCV and PCV) were calculated by formula given by Burton (1952), heritability in broad sense (h^2) by Burton and Vane (1953) and genetic advance given by Johnson *et al.* (1955). Correlation and path coefficients were worked out as per method suggested by Al-Jibouri *et al.* (1958) and Dewey and Lu (1959), respectively.

Significant differences were observed among the genotypes for all the traits, indicating considerable amount of variability among them. The average performance of the genotypes for all the characters under study is presented in Table 1. The genotypes, P 12252 and P 12332 were found superior for spike length. Number of tillers per meter row were found maximum in genotype P 12286 whereas, number of grains per spike were recorded highest in WH 1080. This variety i.e. WH 1080 also performed best for biological yield. Three genotypes namely, WH 147, P 12253 and P12337 were found earliest maturing among the studied genotypes. The short statured genotype, P 12391 showed superiority for grain yield and harvest index. In case of 1000- grain weight, best result was observed in P 13040.

The estimates of genetic variability parameters for all the traits were worked out and are presented in Table 2. The results revealed that in general the material under study had wide range for all the traits. PCV was greater than GCV for all the characters which reflect the influence of environment on the expression of traits. The higher phenotypic (PCV) and genotypic coefficients of variation (GCV) were exhibited by number of grains per spike, number of tillers per meter row, harvest index, biological yield, 1000-grain weight and grain yield, thereby indicating presence of sufficient variability and thus exhibited scope for genetic improvement through selection for all these traits. Similar findings were also reported for tillers per plant, 1000-grain weight, harvest index and grain yield (Dawit *et al.* 2012; Kotal *et al.* 2010); grains per spike (Kumar *et al*. 2009; Oguz *et al.* 2011); and biological yield (Bhushan *et al.*, 2013). However, days to heading, days to maturity and spike length exhibited least genotypic and phenotypic coefficients of variation. Similar results were also reported by Dharmendra and Singh (2010) for days to heading and maturity; and Oguz *et al.* (2011) for spike length.

High heritability for grain yield per plant, number of tilleres per meter row, harvest index, 1000-grain weight, days to heading, number of grains per spike and days to maturity indicated that the characters were less influenced by environment. Other studied traits exhibited low to moderate estimates of heritability. Ali and Shakor (2012) reported low estimates of heritability for spike length, harvest index and biological yield; however Ali *et al.* (2008) observed high heritability for various traits except for tillers per plant. 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, 1000-grain weight, grain yield, plant height and biological yield indicating the importance of these traits in selection and crop improvement. The present findings corroborate the earlier report of Ali and Shakor (2012) except for grains per spike. Ali *et al.* (2008) recorded high heritability for grains per spike, 1000-grain weight and grain yield with high genetic advance in wheat.

The estimates of genotypic correlation coefficients among ten traits are depicted in Table 3. The grain yield was significant and positively correlated with harvest index, 1000-grain weight, days to heading and maturity. These results showed close resemblance with the report of Ali and Shakor (2012) for harvest index and 1000-grain weight; and days to heading and maturity of Minhas (2012). Similarly, positive and significant correlation was found for spike length with harvest index; days to heading with days to maturity and harvest index; days to maturity with harvest index; number of tillers per meter row with number of grains per spike and biological yield; number of grains per spike with biological yield; 1000-grain weight with harvest index, thereby indicating that these traits may be improved simultaneously. Some researchers reported positive correlation between grain yield and plant height, spike length, tillers per plant, grains per spike, biological yield (Gelalcha and Hanchinal, 2013; Khan and Dar, 2010) in wheat. The significant positive association were also reported for days to heading with maturity (Kotal *et al.* 2010), harvest index

Electronic Journal of Plant Breeding, 5(1): 71-76 (Mar 2014)
ISSN 0975-928X

(Bhushan *et al.* 2013); number of tillers per plant with biological yield and grains per spike (Gelalcha and Hanchinal, 2013); biological yield with grains per spike (Ahmadi *et al.* 2012); and 1000-grain weight with harvest index (Ali and Shakor, 2012).

The significant negative association observed for plant height with days to heading, days to maturity, number of tillers per meter row and number of grains per spike; days to maturity with number of grains per spike and 1000-grain weight; number of tillers per meter row with harvest index; and harvest index with biological yield. Similar findings were also reported for plant height with days to heading and maturity (Mohammadi *et al.* 2012), tillers per plant and grains per spike (Khan *et al.*, 2010); days to maturity with 1000-grain weight (Dharmendra and Singh, 2010); harvest index with biological yield (Tripathi *et al.* 2011) . Tripathi *et al.* (2011) further reported negative correlation between tillers per plant and harvest index. Similar to our finding, days to maturity showed negative association with grains per spike (Khan *et al.* 2013) and positive with harvest index as reported by Bhushan *et al*. (2013) and Tripathi *et al.* (2011).

A critical perusal of path analysis at genotypic level (Table 4) revealed that harvest index (0.807) and biological yield (0.719) had high positive direct effect on grain yield which support the findings of Dharmendra and Singh (2010) and Gelalcha and Hanchinal (2013). The high negative direct effect on grain yield was recorded for number of tillers per meter row (- 0.343). The highest indirect effect on grain yield was observed via harvest index by many traits. The highest direct contribution of biological yield and harvest index towards grain yield in wheat was also reported by Ali and Shakor (2012). The unexplained variation in genotypic path was only 0.023 and indicated that most of the grain yield contributing traits were included in this study.

Therefore, it can be concluded from variability parameters, correlation and path coefficient analysis that harvest index, biological yield and number of tillers per meter row are the most important yield contributing traits and due emphasis should be given to these traits for genetic improvement of grain yield in wheat under medium fertility conditions.

References

Ahmadi, M., Farshadfar, E. and Veisi, S. 2012. Evaluation of genetic diversity in land races of bread wheat under irrigated and rainfed conditions. *Intl. J. Agri. Crop Sci.*, **4** (21): 1627-1636.

Ali, I. H. and Shakor, E. F. 2012. Heritability, variability, genetic correlation and path analysis for quantitative traits in durum and bread wheat under dry farming conditions. *Mesoptamia J. Agri.,* **40** (4): 27 - 39.

Ali, Y., Atta, B.M., Akhter, J., Monneveux, P. and Lateef, Z. 2008. Genetic variability, association and diversity studies in wheat (*Triticum aestivum* L.) germplasm. *Pak. J. Bot.,* **40** (5): 2087-2097.

Al-Jibouri, H.A., Miller, A.R. and Robinson, H.F. 1958. Genotypic and environmental variances and covariances in upland cotton crosses of interspecific origin. *Agron. J.,* **50**: 633-637.

Anonymous, 2013. Progress report of All India Coordinated Wheat and Barley Improvement Project 2012-13, Project Director's Report, Directorate of Wheat Research, Karnal (ICAR), p. 1-2.

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

Burton, G.W. 1952. Quantitative inheritance of grasses. In: *Proc. 6th Intl. Grassland Cong.* **1**: 277-283.

Burton, G.W. and Vane de, E.H. 1953. Estimating heritability in tall fescue (*Festuca arundinacea* L.) from replicated clonal material. *Agron. J.,* **45**: 478-481.

Dawit, T., Tadesse, D., Yigzaw, D. and Getnet, S. 2012. Genetic variability, correlation and path analysis in durum wheat germplasm (*Triticum durum* Desf.). *Agri. Res. Rev*., **1**: 107- 112.

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

Dharmendra, S. and Singh, K. N. 2010. Variability analysis for yield and yield attributes of bread wheat under salt affected condition. *Wheat Information Service,* **110:** 35-39.

Donald, C.M. and Humblin, J. 1976. The biological yield and harvest index of cereals as agronomic and plant breeding criteria. *Adv. Agron.,* **28**: 361-405.

Gelalcha, S. and Hanchinal, R.R. 2013. Correlation and path analysis in yield and yield components in spring bread wheat (*Triticum aestivum* L.) genotypes under irrigated conditions in Southern India. *African J. Agri. Res.,* **8**(24): 3186-3192.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soyabean. *Agron. J.,* **47**: 314-318.

Khan, A.A., Alam, M.A., Alam, M.K., Alam, M.J. and Sarker, Z.I. 2013. Genotypic and phenotypic correlation and path analysis in durum wheat (*Triticum turgidum* L. var. *durum*). *Bangladesh J. Agri. Res.,* **38** (2): 219-225.

Khan, A.J., Azam, F. and Ali. A. 2010. Relationship of morphological traits and grain yield in recombinants inbred wheat lines grown under drought conditions. *Pak. J. Bot*. **42** (1): 259-267.

Khan, M.H. and Dar, A.N. 2010. Correlation and path coefficient analysis of some quantitative traits in wheat. *African Crop Sci. J.,* **18** (1): 9-14.

Kotal, B. D., Das, A. and Choudhary, B.K. 2010. Genetic variability and association of characters in wheat (*Triticum aestivum* L.). *Asian J. Crop Sci.,* **2** (3): 155-160.

Kumar, B., Lal, G.M., Ruchi and Upadhyay, A. 2009. Genetic variability, diversity and association of qualitative traits with grain yield in bread wheat (*Triticum aestivum* L.). *Asian J. Agri. Sci.,* **1**(1): 4-6.

Minhas, N.M. 2012. Genetic analysis for grain, quality and biochemical traits in wheat. Ph.D. Thesis submitted to PMAS, Arid Agriculture University, Rawalpindi, Pakistan.

Mohammadi, M., Sharifi, P., Karimizadeh, R. and Shafazadeh, M.K. 2012. Relationship between grain yield and yield components in bread wheat under different water availability. *Notulae Botanicae Horti Agrobotanici*, **40** (1): 195-200.

Oguz, B., Kayihan, Z., K., Ismet, B., Orhan, D., Irfan, O., Turhan, K and Balkan, A. 2011. Genetic variation and inter-relationship of some morpho-physiological traits in durum wheat (*Triticum durum* L.). *Pak. J. Bot*., **43**: 253-260.

Panse, V.G. and Sukhatme, P.V. 1967. *Statistical Methods of Agricultural Workers*. 2nd Edn., ICAR Publication, New Delhi, India, pp: 381.

Tripathi, S.N., Marker, S., Pandey, P., Jaiswal, K.K. and Tiwari, D.K. 2011. Relationship between some morphological and physiological traits with grain yield in bread wheat (*Triticum aestivum* L.). *Trends Applied Sci. Res.*, **6** (9): 1037-1045.

.

Table 1. Average performance of wheat genotypes for different biometric traits

Genotypes	Plant height (cm)	Spike length (cm)	Days to heading	Days to maturity	No. of tillers per meter row	No. of grains per spike	1000-grain wt. (g)	Harvest index (%)	Biological yield (kg/plot)	Grain yield (kg/plot)
P 12033	102.94	9.39	97.33	135.33	86.00	35.73	25.03	29.39	4.67	1.33
P 13040	108.67	9.72	91.00	132.33	126.33	43.27	40.67	31.11	4.83	1.49
P 12392	112.61	9.53	91.33	132.67	101.33	35.83	32.50	27.54	4.77	1.31
P 12252	106.97	10.33	92.33	133.00	106.00	41.07	30.97	32.45	4.40	1.42
P 12406	104.78	9.17	95.00	133.67	122.67	34.13	32.63	24.75	5.48	1.32
P 12289	104.78	10.27	99.33	137.67	128.00	42.27	30.13	33.76	4.93	1.66
P 12272	104.22	9.78	91.00	133.00	108.00	36.00	29.30	33.97	4.20	1.42
P 12283	113.94	9.70	95.33	136.67	90.33	37.73	35.37	34.25	4.17	1.43
P 12394	100.83	8.87	97.00	138.33	88.67	32.53	30.40	29.58	4.72	1.39
P 12253	112.83	10.17	90.33	131.67	99.33	38.73	30.77	30.05	4.92	1.48
PBW 175	111.31	9.81	93.67	134.00	109.00	24.53	33.60	29.91	4.80	1.44
P 12286	107.83	9.73	94.00	134.67	129.33	21.73	29.80	26.81	4.85	1.30
WH 1080	102.33	9.14	91.33	132.33	125.00	55.67	31.60	24.59	5.78	1.40
P 12401	99.06	9.17	96.67	136.00	129.00	41.73	29.00	28.78	4.67	1.34
P 12337	102.03	9.33	91.33	131.67	101.00	40.67	29.47	25.72	4.57	1.16
P 12396	96.67	9.03	97.00	137.33	107.00	36.77	27.57	30.72	4.37	1.35
P 12333	106.42	8.61	94.33	132.33	98.00	40.30	34.47	33.89	4.20	1.42
P 12393	103.19	9.06	94.33	133.00	125.00	38.87	28.30	26.89	4.37	1.18
P 12334	106.14	9.19	98.00	135.00	113.33	38.30	31.57	34.35	4.88	1.67
C 306	131.00	8.13	92.33	132.33	95.67	32.17	32.70	33.49	4.52	1.49
P 12391	93.55	9.00	97.33	135.00	108.67	37.07	40.17	37.64	4.47	1.68
P 12332	104.11	10.33	97.33	135.00	106.67	43.80	35.77	35.03	4.68	1.62
WH 147	106.86	9.36	89.33	132.00	119.33	44.10	32.70	29.39	4.65	1.37
P 12407	102.03	9.69	98.33	136.33	112.67	35.13	27.67	27.41	4.57	1.26
Mean	**106.05**	**9.44**	**94.39**	**134.22**	**109.85**	**37.84**	**31.76**	**30.48**	**4.69**	**1.41**

Table 2. Estimates of genetic variability parameters for different characters in wheat

Characters	Mean ± SE (d)	Range	Coefficients of Phenotypic (PCV)	Coefficients of Genotypic (GCV)	Heritability (bs) (%)	Genetic advance (% mean)
Plant height (cm)	106.05 ±4.08	93.55-131.00	7.84	6.27	63.85	10.32
Spike length (cm)	9.44 ± 0.43	8.13-10.33	7.39	4.83	42.61	6.49
Days to heading	94.39 ± 0.64	89.33-99.33	3.21	3.10	93.21	6.16
Days to maturity	134.22 ± 0.81	131.67-138.33	1.63	1.45	79.26	2.66
No. of tillers per meter row	109.85 ± 10.83	86.00-129.33	15.67	10.00	40.67	13.13
No. of grains per spike	37.84 ± 1.62	21.73-55.67	18.07	17.29	91.62	34.10
1000-grain weight (g)	31.76 ± 0.77	25.03-40.67	11.87	11.50	93.82	22.94
Harvest index (%)	30.48 ± 3.01	24.59-37.64	15.28	9.33	37.32	11.75
Biological yield (kg/plot)	4.69 ± 0.43	4.17-5.78	12.13	8.97	54.55	13.89
Grain yield (kg/plot)	1.41 ± 0.08	1.16-1.68	11.39	9.17	64.76	15.20

Electronic Journal of Plant Breeding, 5(1): 71-76 (Mar 2014)
ISSN 0975-928X

Table 3. Estimates of genotypic correlation coefficients among 10 characters in wheat

Characters	Plant height (cm)	Spike length (cm)	Days to heading	Days to maturity	No. of tillers per meter row	No. of grains per spike	1000-grain wt. (g)	Harvest index (%)	Biological yield (kg/plot)	Grain yield (kg/plot)
Plant height (cm)	**1.000**									
Spike length (cm)	-0.102	**1.000**								
Days to heading	-0.473**	-0.055	**1.000**							
Days to maturity	-0.451**	0.051	0.871**	**1.000**						
No. of tillers per meter row	-0.342**	0.139	-0.046	-0.136	**1.000**					
No. of grains per spike	-0.275*	0.099	-0.159	-0.243*	0.249*	**1.000**				
1000-grain wt. (g)	0.179	0.008	-0.179	-0.243*	0.062	0.146	**1.000**			
Harvest index (%)	0.178	0.249*	0.367**	0.300*	-0.452**	-0.011	0.575**	**1.000**		
Biological yield (kg/plot)	-0.075	-0.103	-0.129	-0.182	0.909**	0.474**	0.037	-0.268*	**1.000**	
Grain yield (kg/plot)	0.126	0.229	0.341**	0.261*	0.018	0.181	0.583**	0.926**	0.123	**1.000**

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

Table 4. Genotypic path analysis showing direct (diagonal) and indirect effects of different characters on grain yield (kg/plot) in wheat

Characters	Plant height (cm)	Spike length (cm)	Days to heading	Days to maturity	No. of tillers per meter row	No. of grains per spike	1000-grain wt. (g)	Harvest index (%)	Biological yield (kg/plot)	Genotypic correlation with Grain yield (kg/plot)
Plant height (cm)	**-0.080**	-0.017	-0.088	0.043	0.117	0.033	0.028	0.143	-0.054	0.126
Spike length (cm)	0.008	**0.168**	-0.010	-0.005	-0.047	-0.012	0.001	0.201	-0.074	0.229
Days to heading	0.038	-0.009	**0.185**	-0.082	0.016	0.019	-0.028	0.296	-0.093	0.341**
Days to maturity	0.036	0.009	0.161	**-0.095**	0.047	0.029	-0.038	0.242	-0.131	0.261*
No. of tillers per meter row	0.027	0.023	-0.009	0.013	**-0.343**	-0.030	0.010	-0.364	0.654	0.018
No. of grains per spike	0.022	0.017	-0.029	0.023	-0.085	**-0.120**	0.023	-0.009	0.341	0.181
1000-grain wt. (g)	-0.014	0.001	-0.033	0.023	-0.021	-0.018	**0.155**	0.464	0.027	0.583**
Harvest index (%)	-0.014	0.042	0.068	-0.028	0.155	0.001	0.089	**0.807**	-0.192	0.926**
Biological yield (kg/plot)	0.006	-0.017	-0.024	0.017	-0.312	-0.057	0.006	-0.216	**0.719**	0.123

Residual effect: 0.023; rg: genotypic correlation; *, ** Significant at 0.05 and 0.01 level, respectively.