Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5793

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (6):** 686-690 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Genetic Variability and Correlation Studies for Yield, Yield contributing and Quality Traits in Bread Wheat (*Triticum aestivum* L.)

Ankita Singh[*] and Anil Kumar

Department of Genetics and Plant Breeding, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar - 263 145, INDIA

*Corresponding Author E-mail: ankita.gbp@gmail.com

Received: 26.09.2017 | Revised: 30.10.2017 | Accepted: 4.11.2017

ABSTRACT

Genetic variability and correlation studies were carried out using line x tester analysis for grain yield, yield related and quality traits in 15 parental genotypes (12 lines and 3 testers) and 36 F_1 hybrids in a line x tester scheme. This material along with 2 commercial check varieties was evaluated using Randomized Block Design in 3 replications. The purpose of the study was to determine the extent of genetic variability for various characters and estimation of genotypic and phenotypic correlation coefficients between these traits. Analysis of variance revealed highly significant genetic differences among the genotypes for all the characters. Days to heading, protein content and sedimentation value showed negative correlation with grain yield per meter. Number of grains per spike was significantly and positively correlated with grain yield per running meter.

Key words: *Bread wheat, yield, Quality traits, Genetic variation, Correlation coefficient.*

INTRODUCTION

Wheat is the one of the most important staple crop of India with a production of 93.5 million tonnes in 2015-16 [2], second only to rice. Globally, India ranks second after China in production with 13.43% of global wheat production[10].

The much predicted population explosion worldwide and the looming danger of food insecurity, have made it absolutely necessary to increase the food production manifolds. Plant breeders contribute to this by carefully selecting for traits that directly or indirectly affects production in a crop. Also, it is universally approved that higher the genetic variability in the starting material, more is the genetic improvement in the progenies. Studies on genetic variability provide a clearer picture of trait wise variation in the experimental material. Correlation studies enable to identify and determine the proportion of the phenotypic correlation that is associated with genetic causes, to verify whether the selection for a certain trait influences another one, to quantify indirect gains due to selection on correlated traits, and to evaluate the complexity of the traits[9].

Cite this article: Singh, A. and Kumar, A., Genetic Variability and Correlation Studies for Yield, Yield contributing and Quality Traits in Bread Wheat (*Triticum aestivum* L.), *Int. J. Pure App. Biosci.* **5(6):** 686-690 (2017). doi: http://dx.doi.org/10.18782/2320-7051.5793

Keeping the above facts in mind, the main objectives of the study were a) determination of the extent of genetic variability for various characters and b) estimation of genotypic and phenotypic correlation coefficients between yield, yield components and quality traits.

MATERIALS AND METHODS

The present research work was undertaken at the Norman E. Borlaug Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, India. Twelve lines of wheat *viz.* ATTILA*2/STAR, MILAN /3/PAT24 /ALD/DOVE /BUC, SERI.LB// KAUZ/ HEVO/3/ AMAD, VL 858, UP 2672, QLD 33, QLD 39, UP2706, PBW 574, UP 2647, CAL /NH //H567 .71 /3 /SERI /4/CAL /NH/ H567.7/5/… and UP2338*2 /4/ SNZ / TRAP# /3/ KAUZ*2 /TRAP / /KAUZ and three testers *viz.* PBW 550, UP 2584 and K 9107 were crossed in a line x tester mating scheme to produce 36 crosses during *Rabi* 2009-10. These crosses were then evaluated along with the parents and 2 checks, *viz.* UP 2338 and PBW 343, at the same location. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Each plot consisted of two rows of 1 m long with a row to row distance of 23 cm. The plant to plant distance was maintained at 10 cm. The seeds were dibbled manually.

In the present research, twelve morphological characters *viz.* days to 75% heading, days to maturity, flag leaf area, plant height at maturity, number of effective tillers per plant, spike length, number of spikelets per ear, number of grains per spike, 1000 grain weight, grain yield per meter, biological yield and harvest index and three quality traits namely, protein content (%), sedimentation value and hectolitre weight were studied. After recording the observations the variability and correlation coefficients were calculated using standard statistical formulae and procedures. Sixteen characters were analysed using analysis of variance (ANOVA) to test whether treatments were differing significantly among themselves[4].

Phenotypic and genotypic correlation components were calculated using following formulae[3].

a) Phenotypic Correlation

$$P_{xy} = \frac{CovP_{xy}}{\sqrt{\sigma^2 P_{xx} X \sigma^2 P_{yy}}}$$

Where,

Cov P_{xy} = Phenotypic covariance between character X and Y

$\sigma^2 P_{xx}$ = Phenotypic variance for character X

$\sigma^2 P_{yy}$ = Phenotypic variance for character Y

b) Genotypic correlation

$$G_{xy} = \frac{CovG_{xy}}{\sqrt{\sigma^2 G_{xx} X \sigma^2 G_{yy}}}$$

Where,

Cov G_{xy} = Genotypic covariance between character X and Y

$\sigma^2 G_{xx}$ = Genotypic variance for character X

$\sigma^2 G_{yy}$ = Genotypic variance for character Y

The significance of correlation coefficient(r) was tested by comparing the calculated value of t with tabulated 't' value at (n-2) d.f.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

RESULTS AND DISCUSSION

The general mean, range of variation, coefficient of variation along with genotypic, phenotypic and environmental coefficients of variation are presented in Table 1. The estimated values of phenotypic coefficient of variation were higher than genotypic coefficient of variation and more than environmental coefficient of variation for all the characters studied. Highest value for phenotypic coefficient of variability was observed for biological yield followed by flag leaf area and grain yield per meter. However, biological yield exhibited highest genotypic coefficient of variability followed by grain yield per meter and sedimentation value. Environmental coefficient of variability was highest for grain yield per meter followed by harvest index and flag leaf area. These results were in general agreement with the findings of Ali *et al.*,[1] and Makwana *et al*[6].

The yield is a complex and highly variable trait and is a result of cumulative effect of its component characters and therefore, direct selection of yield *per se* may not be effective. Improvement of yield by selection of component characters rather than yield *per se* has also been advocated by Grafius *et al* [5]. Since, all these characters are correlated, a change in one of the character bring about a series of changes in other characters. Thus, to bring a change in yield or other characters to a desired level, proper understanding of association among the yield and yield contributing traits is must. The association between two traits that can be directly observed is the phenotypic correlation. The genotypic correlation in the true sense may be interpreted as the correlation of breeding value. The environmental correlation includes both environmental and non-additive genetic deviations. Phenotypic and genotypic correlations for all the sixteen characters among the fifty three genotypes are presented in Table 3 and Table 4, respectively. Phenotypic correlations in general were higher than genotypic correlations. Directions of phenotypic and genotypic correlations were same for most of the character combinations. At phenotypic level, days to 75% heading showed highly significant and positive correlation with days to maturity (0.5328) while yield contributing characters *viz.* number of spikelets per spike (-0.3456), 1000 grain weight (-0.4144) and grain yield per running meter (-0.4564) were found to be negatively and significantly correlated with this trait. Days to maturity was significantly and negatively correlated phenotypically with protein content (-0.2943). However this character was found to have significant and positive association with plant height (0.3847). Flag leaf area exhibited highly significant and positive correlation with plant height(0.4718), 1000 grain weight(0.4351), biological yield(0.4456) and protein content (0.3979), sedimentation value (0.4344) and hectolitre weight (0.4573).

Genotypically, flag leaf area exhibited highly significant positive correlation with plant height (0.4048), spike length (0.6927), biological yield (0.4078), 1000 grain weight (0.3887), protein content (0.3887), sedimentation value (0.3294) and hectolitre weight (0.3978). Plant height possessed positive and highly significant correlation with spike length (0.7648) and number of spikelets per spike (0.3919). It exhibited significant positive correlation with 1000 grain weight (0.3488) and hectolitre weight (0.3313). It was negatively correlated with number of effective tillers per plant, harvest index, phenol colour reaction and grain yield per running meter. At genotypic level, plant height was found to possess significant positive correlations with number of spikelets per spike (0.3181), 1000 grain weight (0.3295) and hectolitre weight (0.2950). The same character had highly significant positive correlations with spike length (0.6718). Spike length exhibited positive and highly significant correlation with number of spikelets per spike (0.5312), biological yield (0.4329), 1000 grain weight (0.3997), protein content (0.3444), sedimentation value (0.4569) and hectolitre weight (0.4679). However, this character possessed highly significant negative correlation with flag leaf area (-0.7939).

With respect to genotypic correlation coefficient, spike length showed significant positive correlations with 1000 grain weight (0.3575) and protein content (0.3163). Highly significant and positive correlation values of this trait were found with number of spikelets per spike (0.4147), sedimentation value (0.4217) and hectolitre weight (0.3898). Number of grains per spike was significantly and positively correlated with grain yield per meter (0.3243). Number of grains per spike was significantly and positively correlated genotypically with grain yield per running meter (0.2899). 1000 grain weight possessed significant and positive correlation with sedimentation value (0.3448) and hectolitre weight (0.2978). Biological yield showed highly significant and positive correlation with sedimentation value (0.3629) while protein content (0.2887) was found to be significantly correlated with this character. Also biological yield was found to be negatively correlated with harvest index (-0.3881). At genotypic level, significant and positive correlation of this trait was observed with protein content (0.2850) and sedimentation value (0.3559). However, the correlation between biological yield and harvest index (-0.3561) was significantly negative. Harvest index was identified to be negatively correlated with protein content (-0.1606) and sedimentation value (-0.1833).

Protein content was found to possess highly significant and positive correlation with sedimentation value (0.8694). Protein content (-0.0689) along with sedimentation value (-0.0718), was found to possess negative correlation with grain yield per meter. Highly significant and positive genotypic correlation was found between protein content and sedimentation value (0.8528). In general, it was found that most of the yield contributing traits were negatively correlated with protein content. The above findings were in conformation with Mukherjee *et al.*,[7] and Saini *et al*[8].

Table 1: Analysis of all the genotypes with respect to different characters

S. No.	Characters	gm	cv	CD at 1%	CD at 5%	SEm±	Range of variation	gcv	pcv	ecv
1.	Days to heading	94.28	0.97	1.97	1.49	0.53	93-97	0.79	1.26	0.97
2.	Days to maturity	131.41	1.16	3.29	2.48	0.89	129-134.5	1.01	1.54	1.16
3.	Flag leaf area	41.95	6.28	5.65	4.26	1.52	30.27-60.56	14.48	15.79	6.28
4.	Plant height	96.91	2.39	4.96	3.75	1.34	79.96 -109.67	0.75	0.78	0.24
5.	Tillers per plant	19.84	5.18	2.20	1.66	0.59	15.53-29	11.75	12.85	5.17
6.	Spike length	12.66	3.49	0.95	0.72	0.25	10.91-15.61	8.65	9.33	3.49
7.	No. of spikelets per spike	20.26	3.81	1.65	1.25	0.45	16.73-21.8	5.29	6.53	3.82
8.	No. of grains per spike	64.28	2.50	3.45	2.60	0.93	45.53-74.8	9.92	10.23	2.50
9.	1000 grain weight	45.77	3.11	3.05	2.30	0.82	30.74-54.05	11.24	11.66	3.11
10.	Grain yield per meter	212.12	8.19	37.26	28.15	10.03	62.16-286.66	16.43	18.36	8.19
11.	Biological yield	114.16	2.64	6.47	4.89	1.74	57.88-172.42	22.77	22.92	2.64
12.	Harvest index	43.78	6.77	6.36	4.81	1.71	25.78-63.68	12.63	14.33	6.78
13.	Protein content	12.59	0.93	0.25	0.19	0.067	11.2-14.9	6.21	6.27	0.93
14.	Sedimentation value	40.06	1.84	1.58	1.19	0.43	29.46-49.06	14.79	14.91	1.84
15.	Hectolitre weight	78.62	1.02	1.72	1.30	0.46	72.92-82.08	2.25	2.46	1.02

Table 2: Inter character association (phenotypic) between different character pairs

Characters	Days to maturity	Flag leaf area	Plant height	Tillers per plant	Spike length	Spikelets per spike	Grains per spike	1000 grain weight	Biological yield	Grain yield per m	Harvest index	Protein content	Sedimentation value	Hectolitre weight
Days to heading	0.5328**	-0.1600	0.1008	-0.0890	0.2296	0.3456*	-0.2406	-0.4144**	-0.1965	-0.4564**	-0.2101	-0.0692	-0.1658	0.0279
Days to maturity	1.000	-0.1523	0.3847**	0.0025	0.2186	0.2431	-0.1184	-0.2180	-0.0033	-0.1309	-0.2267	-0.2943*	-0.1478	-0.0498
Flag leaf area		1.000	0.4718**	0.0819	0.7939**	0.2665	0.1012	0.4351**	0.4456**	-0.0689	0.0024	0.3979**	0.4344*	0.4573**
Plant height			1.000	-0.1387	0.7648**	0.3919**	0.2645	0.3488*	0.2483	-0.1052	-0.1399	0.0793	0.2680	0.3313*
Tillers per plant				1.000	-0.0038	-0.0707	-0.1605	-0.0659	0.0829	0.0611	-0.1280	0.0998	0.1350	-0.2012
Spike length					1.000	0.5312**	0.1022	0.3997**	0.4329**	0.0648	-0.1581	0.3444*	0.4569**	0.4679**
Spikelets per spike						1.000	0.2349	0.0328	0.1886	0.0937	0.0153	0.0831	0.1120	0.1690
Grains per spike							1.000	-0.0790	0.1426	0.3243*	0.0858	-0.0578	-0.0352	0.0696
1000 grain weight								1.000	0.1534	0.2498	0.2128	0.1928	0.3448*	0.2978*
Biological yield									1.000	0.1890	-0.3881*	0.2877*	0.3629**	0.2556
Grain yield per meter										1.000	0.1858	-0.0689	-0.0718	0.0816
Harvest index											1.000	-0.1606	-0.1833	0.1265
Protein content												1.000	0.8694**	0.1278
Sedimentation value													1.000	0.0816
Hectolitre weight														1.00

*, ** significant at 5% and 1% probability level, respectively.

Table 3: Inter character association (genotypic) between different character pairs

Characters	Days to maturity	Flag leaf area	Plant height	Tillers per plant	Spike length	Spikelets per spike	Grains per spike	1000grain weight	Grain yield per m	Biological yield	Harvest index	Protein content	Sedimentation value	Hectolitre weight
Days to heading	0.2179	-0.0184	-0.0425	-0.0096	0.1065	0.1924	-0.1332	-0.2478	-0.2575	-0.1215	-0.1063	-0.0500	-0.1091	0.0349
Days to maturity	1.000	-0.0542	0.2241	-0.0533	0.0716	0.1062	-0.0532	-0.1262	-0.1006	0.0039	-0.1296	-0.1889	-0.0897	-0.0496
Flag leaf area		1.000	0.4048**	0.0695	0.6927**	0.1889	0.0840	0.3887**	0.1817	0.4078**	0.0104	0.3693**	0.3850**	0.3978**
Plant height			1.000	-0.1254	0.6718**	0.3181*	0.2307	0.3295*	-0.1063	0.2348	-0.1129	0.0800	0.2560	0.2950*
Tillers per plant				1.000	-0.0090	-0.0240	-0.1435	-0.0550	0.0468	0.0713	-0.1164	0.0908	0.1229	-0.1305
Spike length					1.000	0.4147**	0.0900	0.3575*	0.0498	0.3936*	-0.1140	0.3163*	0.4217**	0.3898**
Spikelets per spike						1.000	0.1762	0.0197	0.0871	0.1540	-0.0149	0.0567	0.0931	0.1133
Grains per spike							1.000	-0.0782	0.2899*	0.1324	0.0752	-0.0495	-0.0351	0.0726
1000 grain weight								1.000	0.2184	0.1517	0.1635	0.1879	0.3294*	0.2551
Grain yield per meter									1.000	0.1773	0.1408	-0.0534	-0.0703	0.1114
Biological yield										1.000	-0.3561*	0.2850*	0.3559*	0.2360
Harvest index											1.000	-0.1354	-0.1598	0.0744
Protein content												1.000	0.8525**	0.1252
Sedimentation value													1.000	0.0729
Hectolitre weight														1.000

*, ** significant at 5% and 1% probability level, respectively.

CONCLUSION

The results revealed that the differences among genotypes were highly significant for all the characters. The high extent of variability is suitable for generation of transgressive seggregants in a hybridization programme. Since, biological yield, grain yield per meter, flag leaf area, harvest index, sedimentation value and phenol colour reaction possessed a high genotypic coefficient of variation, therefore, these may be considered as main selection criteria.

Correlation studies exhibited that quality traits and yield were negatively correlated suggesting a need for different programmes for quality and agronomic improvement of wheat.

REFERENCES

1. Ali, Y., Atta, B. M., Akhtar, J., Monneveux, P. and Zahid, L. Genetic variability, association and diversity studies in wheat (*Triticum aestivum* L.) germplasm, *Pakistan Journal of Botany.*, **40(5):** 2087-2097 (2008).
2. Directorate of Economics and Statistics, 2016. http://eands.dacnet.nic.in/
3. Fisher, R. A., The correlation among relatives on the supposition of Mendelian inheritance. 52, Trans Royal Soc. Of Edinburgh, Edinburgh, 1918, 399 – 433.
4. Fisher, R. A. and Yates, F., Statistical Tables for Biological, Agricultural and Medical Research, 5 Aufl. Oliver and Boyd. Edinburgh, 1936, 143-156.
5. Grafius, J.S., Heterosis in Barley. *Agron J.,* **51:** 551-554 (1959).
6. Makwana, S. M., Dobariyal, K. L. and Mehta, D.R., Triple test cross analysis for grain yield and its component characters in bread wheat (*Triticum aestivum* L.), *National Journal of Plant Improvement.*, **10(2):** 138-143 (2008).
7. Mukherjee, S., Gupta, D., Maji, A., Gupta, S. and Bhowmik, N. Character association and path coefficient analysis of wheat (*Triticum aestivum* L.) genotypes under late sown condition, *Environment and Ecology.*, **26(4C):** 2218-2220 (2007).
8. Saini, D. P., Ved Prakash and Chaudhary, S. P. S., Combining ability and heterosis for seed yield and its components in durum wheat *(Triticum durum Desf.)* under late sown conditions, *Research on Crops.*, **7(1):** 159-164 (2006).
9. Tiwari, J.K. and Upadhyay, D., Correlation and path-coefficient studies in tomato (*Lycopersicon esculentum* Mill.), *Research Journal of Agricultural Sciences*, **2:** 63-68 (2011).
10. Grain: World Markets and Trade, May 2012, www.fas.usda.gov/psdonline, 10 pp.