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Studies on Genetic Variability, Correlation and Path Coefficient for Yield and Its Component Traits in Wheat (*Triticum aestivum* L. em. Thell.)

Anurag Kumar*, Lokendra Singh, Kanhaiya Lal, Ashvani Kumar and Kuladeep Yadav

Department of Genetics and Plant Breeding, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur - 208002 (U.P.), India

*Corresponding Author E-mail: barwaranurag351@gmail.com

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ABSTRACT

The present investigation was carried out taking collection of fifty wheat genotype from different eco-geographic origin. Data on eight quantitative characters viz; Plant height, reproductive tillers/plant, length of spike, spikelets/spike, days to maturity, grains/spike, test weight and grain yield/plant were recorded. Analysis of variance (ANOVA) revealed significant differences among all the genotypes for almost all the traits under study. The genotypes showed moderate to high level of genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV). The magnitudes of phenotypic coefficient of variance (PCV) for all the characters were slightly higher than their corresponding genotypic coefficient of variance (GCV), indicated very less environmental influence on the expression of the characters. Higher estimate of GCV (15.55) was recorded for Length of spike followed by grain yield per plant (14.91). Analysis of correlation revealed that in general, the magnitude of genotypic correlation coefficients was higher than the phenotypic correlation coefficients, suggesting the existence of inherent association among the traits studied. Plant height, reproductive tillers per plant, spikelets per spike, grains per spike and test weight had high positive correlation with grain yield per plant and also having maximum direct positive effect on it. The studies suggest that the selection pressure should be exercised simultaneously on plant height, reproductive tillers per plant, spikelets per spike, grains per spike and test weight to obtain maximum yield.

Key words: *Wheat (Triticum aestivum L.), Spikelets, Variability, Correlation and Path coefficient analysis.*

INTRODUCTION

Wheat (*Triticum aestivum* L. em. Thell.; 2n=42), a member of graminae (Poaceae) family belongs to the genus Triticum, is the main cereal crop. It has unique place among the cereals. Bread wheat is an allohexaploid species with 2n=42 chromosome having genome AABBDD. Wheat is the most important food crop of the world. Globally the area under wheat is 220.41 million hectares with a production of 729.01 million tonnes and productivity of 3307.4 kg/ha[6].

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Wheat has versatile nature because it has high yield potential and can be grown easily in different agro-ecological conditions but almost all the wheat varieties are low in protein content as well as in essential amino acids such as lysine and tryptophan. Having such a yielding ability and nutritional value there is an imperative need to improve the quality of grains as a sizeable protein as well as quantity of wheat grains to cater the ever increasing demand of the population. Yield being a complex character is a function of several component characters and their interaction with environment. Proving of structure of yields involves assessment of mutual relationship among various characters contributing to the yield. In this regard genotypic and phenotypic correlation reveals the degree of association between different characters and thus aid in selection to improve the yield and its contributing characters simultaneously. Further path coefficient analysis help in partitioning of correlation coefficients into direct and indirect effects and in the assessment of relative contribution of each components character to the yield. Keeping all these problems in the consideration the present investigation was done to assess the extent of genetic variability, correlation and path coefficient for yield and different yield contributing traits.

MATERIAL AND METHODS

The present investigation was carried out during Rabi 2016-17 at crop research farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) using Randomized Complete Block Design with three replications to work out the status of genetic variability, association of different seed yield traits and direct & indirect effects of these traits on seed yield in fifty genotypes/lines of wheat. These lines were taken from the germplasm maintained, in the Genetics and Plant breeding department of the university. Each genotype was sown in two lines of 5.0 m long with 23 cm wide plot and 5 cm plant to plant distance. The observations were recorded on five randomly taken plants for eight quantitative characters *viz*., Plant height (cm), Number of reproductive tillers per plant, Length of spike (cm), Number of spikelets per spike, Days to maturity, Number of grains per spike, Test weight (g), Grain yield per plant (g). Crop research farm is situated between 26.4607^0N latitude, 80.3334^0 E longitude and at a altitude of 126 m above the mean sea level, near company bag, Kanpur. Kanpur district has humid sub tropical climate and low temperature in winter season and high temperature in summer season. The experimental data collected in respect of eight characters on 50 wheat genotypes were compiled by taking the mean values of selected plants in each plot and subjected for Analysis of variance, Estimation of correlation coefficients[14] and Path coefficient analysis[5].

Table 1: ANOVA for eight characters in wheat – (mean sum of squares)

Source of variation	Degree of freedom	Plant height (cm)	Reproductive tillers/plant (cm)	Length of spike (cm)	Spikelets/spike	Days to maturity	Grains /spike	Test weight(g)	Grain yield/plant (g)
Replication	2	2.51	0.000	0.111	0.380	0.607	0.541	0.0450	0.128
Treatment	49	194.52**	2.24**	6.64**	5.55**	25.54**	37.03**	17.40**	9.76**
Error	98	2.45	0.073	0.203	0.241	2.04	1.04	0.048	0.334

*Significant at 5 % level of significance
**Significant at 1% level of significance

Table 2: Mean, range, standard deviation and coefficient of variation (%) for 8 characters in wheat:

S. No.	Characters	Range		Grand mean	Standard deviation	Coefficient of variation
		Minimum	Maximum			
1	Plant height(cm)	61.54	99.60	78.00	1.57	2.01
2	Productive tillers/plant	5.80	9.60	7.92	0.27	3.40
3	Length of spike (cm)	6.47	13.60	9.42	0.45	4.79
4	Spikelets/spike	13.60	20.33	17.86	0.49	2.75
5	Days to maturity	113.00	125.00	119.31	1.42	1.19
6	Grains/spike	34.40	48.27	41.60	1.02	2.45
7	Test weight(gm)	31.60	40.60	36.76	0.22	0.60
8	Grain yield/Plant	8.33	15.47	11.90	0.58	4.86

Table 3: Phenotypic and genotypic coefficients of variation for 8 characters in wheat:

S. No.	Characters	PCV	GCV
1	Plant height(cm)	10.45	10.26
2	Productive tillers/plant	11.27	10.74
3	Length of spike	16.28	15.55
4	Spikelets/spike	7.95	7.46
5	Days to maturity	2.63	2.35
6	Grains/spike	8.68	8.33
7	Test weight	6.57	6.54
8	Grain yield/ plant	15.68	14.91

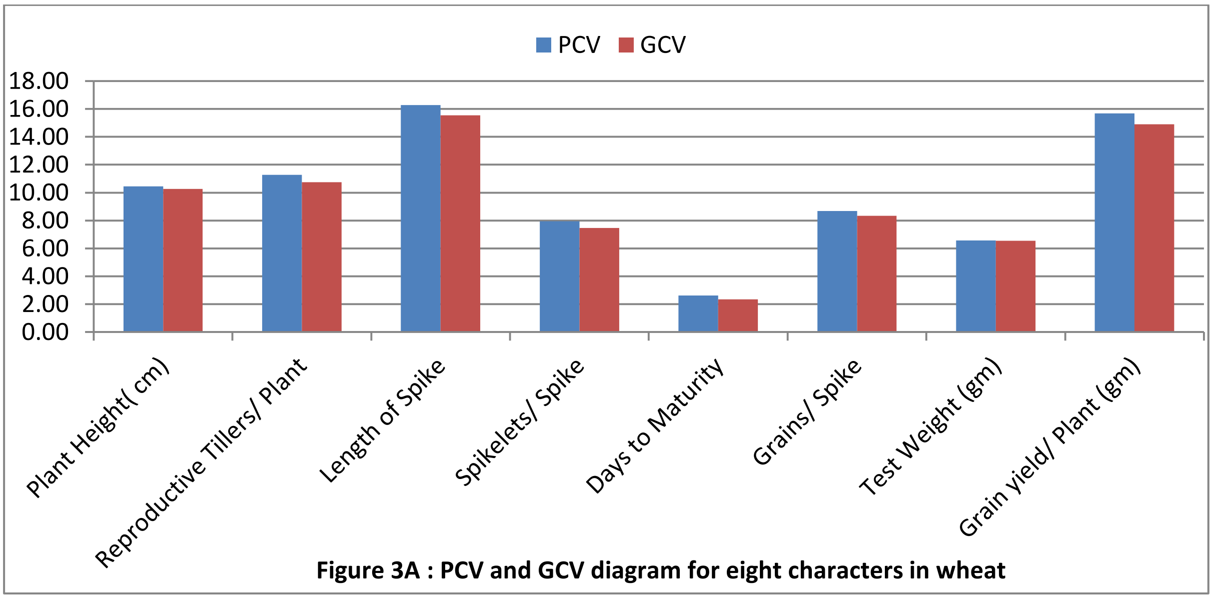

Figure 3A : PCV and GCV diagram for eight characters in wheat

Table 4: Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients in wheat:

Characters	Plant height (cm)	Reproductive tillers/plant (cm)	Length of spike (cm)	Spikelets/spike	Days to maturity	Grains /spike	Test weight	Grain yield/plant
Plant height(cm)	Rp rg	0.280**	0.095	0.212**	-0.035	0.041	0.230**	0.233**
Reproductive tillers/plant(cm)	0.302	rp rg	0.179*	0.354**	0.028	0.023	0.132	0.595**
Length of spike (cm)	0.095	0.191	rp rg	0.321**	-0.157	0.125	-0.043	0.112
Spikelets/spike	0.236	0.402	0.356	rp rg	0.092	-0.021	0.127	0.249**
Days to maturity	-0.051	0.039	-0.187	0.110	rp rg	-0.070	0.117	-0.063
Grains/ spike	0.040	0.011	0.142	-0.012	-0.058	rp rg	-0.096	0.225**
Test Weight	0.236	0.140	-0.043	0.137	0.137	-0.137	rp rg	0.346**
Grain yield/plant	0.252	0.672	0.121	0.286	-0.094	0.241	0.364	rp rg

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

Table 5: Phenotypic direct and indirect effects of various traits on grain yield / Plant in wheat

S.No.	Characters	Plant height (cm)	Reproductive tillers/plant	Length of spike	Spikelets/spike	Days to maturity	Grains / spike	Test weight
1	Plant height(cm)	**-0.001**	-0.003	-0.000	-0.002	0.000	-0.000	-0.002
2	Reproductive tillers/plant	0.153	**0.545**	0.097	0.193	0.015	0.012	0.072
3	Length of Spike	-0.003	-0.006	**-0.329**	-0.011	0.005	-0.004	0.001
4	Spikelets/spike	0.010	0.016	0.015	**0.046**	0.004	-0.001	0.006
5	Days to maturity	0.004	-0.003	0.017	-0.010	**-0.106**	0.007	-0.012
6	Grains / spike	0.010	0.005	0.030	-0.005	-0.017	**0.239**	-0.023
7	Test weight	0.070	0.040	-0.013	0.039	0.036	-0.029	**0.304**
	Correlation with yield	0.233**	0.595**	0.112	0.250**	-0.063	0.225**	0.346**

Table 6: Genotypic direct and indirect effects of various traits on grain yield / plant in wheat

S.No.	Characters	Plant height (cm)	Reproductive tillers/plant	Length of spike	Spikelets/spike	Days to maturity	Grains / spike	Test weight
1	Plant height(cm)	**-0.040**	-0.012	-0.004	-0.009	0.002	-0.001	-0.009
2	Reproductive tillers/plant	0.193	**0.639**	0.122	0.257	0.025	0.007	0.090
3	Length of Spike	-0.006	-0.013	**-0.67**	-0.024	0.012	-0.009	0.003
4	Spikelets/Spike	0.009	0.016	0.014	**0.039**	0.004	-0.000	0.005
5	Days to Maturity	0.008	-0.007	0.031	-0.018	**-0.167**	0.010	-0.023
6	Grains / spike	0.011	0.003	0.038	-0.003	-0.016	**0.269**	-0.027
7	Test weight	0.077	0.046	-0.014	0.045	0.045	-0.032	**0.325**
	Correlation with yield	0.253	0.672	0.121	0.286	-0.094	0.242	0.364

RESULT AND DISCUSSION

Analysis of variance was done for different traits and it is given in Table 1. Mean, range, SD and coefficient of variance is given in Table 2. GCV and PCV is given in Table 3. Bar graph for GCV and PCV is given in Figure 3A.

Magnitude and nature of variability present in a population is a pre- requisite for any crop improvement programme. Variation in population is a result of its genotype, environment and genotype x environment interactions. Only heritable component of variation is of prime importance from breeding point of view. So it is necessary to divide the total variability into its heritable and non-heritable component of variation.

Analysis of variance (ANOVA) revealed significant differences among all the genotypes for almost all the traits under study. Similar results were also reported by Ali *et al.*[2], Kallim Ullah *et al.*[7] and Lal *et al.*[10]. The magnitudes of phenotypic coefficient of variance (PCV) for all the characters were slightly higher than their corresponding genotypic coefficient of variance (GCV), indicated very less environmental influence on the expression of the characters. Same results were also reported by Kumar *et al.*[8] and Singh and Sharma[13].

Present study revealed that maximum phenotypic and genotypic coefficient of variation was observed for length of spike (16.28) and (15.55), respectively. It indicated that simple selection for length of spike may be more advantageous as compared to other yield contributing characters under study. However, magnitude of others *viz.*, grain yield per plant exhibited phenotypic coefficient of variation (15.68) and genotypic coefficient of variation (14.91), productive tillers per plant phenotypic coefficient of variation (11.27) and genotypic coefficient of variation (10.74), plant height phenotypic coefficient of variation (10.45) and genotypic coefficient of variation (10.26), grains per spikes phenotypic coefficient of variation (8.68) and genotypic coefficient of variation (8.33), spikelets per spike showed phenotypic coefficient of variation(7.95) and genotypic coefficient of variation (7.46), test weight phenotypic coefficient of variation (6.57) and genotypic coefficient of variation (6.54), days to maturity phenotypic coefficient of variation (2.63) and genotypic coefficient of variation (2.35) were found in diversity order respectively. High degree of phenotypic coefficient of variation providing sufficient scope for improvement of those characters. Genotypic coefficient of variation is more important than that of phenotypic coefficient of variation because higher amount of genotypic variation helps in formulation of effective breeding program for crop improvement.

The characters, length of spike, grain yield/plant, productive tillers/plant, plant height, grains/spike, spikelets/spike, test weight, days to maturity exhibited low environmental influence on the expression of the traits. This indicated availability of more chances of improvement through selection breeding programme. This result is in agreement of findings of Dutamo *et al.*[4].

The efficiency of selection determines the success of any breeding programme. It is necessary to study the nature of association of the characters in relation to other relevant traits. The knowledge of correlation among yield and its contributing traits may help the plant breeder to determine the degree of association between them which help in improving the efficiency of selection under the force of favorable combinations.

In the present study correlation coefficient on genotypic and phenotypic levels between yield and its component characters have been worked out and the results obtained are presented in Table 4. It revealed that there is a strong inherent association between the various characters. The plant height, reproductive tillers/plant, spikelets/spike, grains/spike and test weight significantly and positively correlated to yield. The results suggest that the number of spikes per plant, grains per spike and harvest index must be given preference in selection along with optimum plant height and days to flowering to select the superior wheat genotypes. Subhani[15], Bergale *et al.*[3], Lad *et al.*[9], Muhammad and Ehsan[11] and Abdul *et al*.[1] also reported similar results.

Phenotypic correlation coefficients:

Plant height had positive significant correlation with reproductive tillers/plant, spikelets/spike, test weight and grain yield. Reproductive tillers/plant had positive significant correlation with plant height, length of spike, spikelets/spike, and grain yield. Length of spike had positive significant correlation with reproductive tillers/plant, spikelets/spike. Spikelets/spike had positive significant correlation with plant height, reproductive tillers/plant, length of spike and grain yield. Grains/spike had positive significant correlation with grain yield. Test weight had positive significant correlation with plant height and grain yield. Grain yield had positive and significant correlation with plant height, reproductive tillers/plant, spikelets/spike, grains/spike, test weight. The positive associations of these characters were show significant value with yield.

Genotypic correlation coefficient:

Plant height had positive high correlation value with reproductive tillers/plant, spikelets/spike, grain yield/plant and test weight. Reproductive tillers/plant has positive high correlation value with plant height, spikelets/spike and grain yield. Length of spikelet positive high correlation value with reproductive tillers/plant and spikelets/spike Spikelets/spike had positive high correlation value with plant height, reproductive tillers/plant, length of spike and grain yield. Days to maturity had positive and low correlation value with reproductive tillers/plant, spikelets/spike and test weight. Grains/spike has positive high correlation value with grain yield. Test weight had positive high correlation value with plant height and grain yield. Grain yield had positive high value correlation with plant height, reproductive tillers/plant, spikelets/spike, grains/spike and test weight. These characters showed positive significance with yield. These characters showed that if these characters are increased then yield will also increase.

Path coefficient analysis:

Coefficient of correlation measures the degree and association between two characters. However, this may not give true picture under complex situation. Under such conditions, path coefficient analysis provides a means of measuring the direct as well as indirect effect via other variables on the end product by partitioning correlation coefficients. The direct and indirect effects on grain yield were estimated for all characters under study, which provided a better index for selection rather than correlation coefficient.

The result obtained presented in table 5 and Table 6 which indicated that at both phenotype and genotype levels reproductive tillers/plant, spikelets/spikes, grains/spike and test weight had high positive direct effect on grain yield. Similar findings were also reported earlier by Lad *et al*.[9], Saktipada *et al.*[12].

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