# Genetic Variability, Correlation and Path Coefficient Analysis for Yield and it's Contributing Traits in Wheat [*Triticum aestivum* (L.)]

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**Abstract:** ***A field experiment was undertaken to analyze the genetic variability, correlation and path coefficient analysis of yield and its contributing traits in ten wheat genotypes grown at the farm, of B.N.P.G. College, Rath, Hamirpur, (U.P.), during Rabi season of 2012-13. Analysis of variance revealed highly significant differences among the genotypes for yield and its contributing components. Wide genetic variability was observed among genotypes for days to 50% flowering, plant height (cm.), length of ear (cm), number of spikelets per ear, days to maturity, number of seed per ear, test weight (g) and grain yield per plant. Phenotypic variances were higher than the genotypic variances. High heritability with low genetic advance in percent of mean was observed for days to maturity which indicated the involvement of non-additive gene action for the expression of this character and selection for such trait might not be rewarding. High heritability coupled with high genetic advance in percent of mean was observed for days to 50% flowering, indicating that this traits were under additive gene control and selection for genetic improvement for this traits would be effective. Yield per plant had high positive and significant correlation with number of tillers per plant, number of seed per ear and test weight (g). Path coefficient analysis revealed maximum direct contribution towards yield per plant with length of ear followed by test weight (g). Hence, emphasis should be given to select these traits to increase the production and productivity of wheat.***

**Keywords:** Wheat (*Triticum aestivum* L.), heritability, genetic advance, correlation and path-coefficient

## 1. Introduction

Wheat *(Triticum aestivum* L.) is a crop of global significance, grown in diversified environments. It is the major staple food of country and it occupies a prominent position in the cropping pattern of the country. A great deal of research work has been done in the domain of wheat breeding through genetic manipulation. However, increasing population and the changing circumstances in the country necessitate the breeders for further breakthrough in this food crop. For bringing improvement in heritable characters, estimation of genetic parameters is of prime importance in any breeding programme. Heritability estimates provide the information about index of transmissibility of the quantitative characters of economic importance and are essential for an effective crop breeding strategy. The magnitude of heritability also helps in predicting the behaviour of succeeding generations by devising the appropriate selection criteria and assessing the level of genetic improvement (Hanson *et al*., 1963). Similarly, genetic advance gives clear picture and precise view of segregating generations for possible selection.

Grain yield , being a complex trait, depends upon component variables and their interaction. Degree and direction of relationship between two or more variables lead to estimation of correlation. Correlation studies provide better understanding of yield component which helps the plant breeder during selection (Robinson *et al*., 1951 and Johnson *et al*., 1955). Path coefficient analysis measures the direct and indirect contribution of independent variables on dependent variables and thus helps breeder in determining the yield component and understanding cause of association between two variables (Dewey and Lu, 1959). The information obtains by path coefficient analysis helps in indirect selection for genetic improvement of yield because direct selection is not effective for low heritable trait like yield. Thus, the estimation of heritability and genetic advance is essential for a breeder which helps in understanding the magnitude, nature and interaction of genotype and environmental variation of the trait. With the above reference, the present experiment was conducted to study the extent of genotypic and phenotypic variability among the genotypes and to estimate genetic advance, correlation coefficient among the selected characters, direct and indirect effects of component characters on yield of wheat to screen out the suitable parental groups for future breeding programme, in order to sustain the productivity of wheat.

## 2. Materials and Methods

The experiment was conducted during *Rabi* season of 2012-13 at the agricultural Research Farm of BNPG college, Rath, Hamirpur. The experiment was laid out in CRBD (completely randomized block design) with three replications in individual plot size (3mx1m ). The distance maintained between row to row and plant to plant was 50 cm and 10 cm, respectively. Recommended agronomic package and practices were applied to raise a healthy crop. Data were recorded on various parameters, *viz*., days to 50% flowering, day to maturity, plant height (cm), number of tillers per plant, number of ears per plant, length of ear, number of spikelets per ear, number of seed per ear, test weight (g), yield per plant (g). The data recorded on each character on different genotypes was statistically analyzed. Mean, range and coefficient of variation were also estimated. Genotypic and phenotypic coefficients of variation were estimated according to (Burton and de Vane, 1953); heritability in broad sense (Hanson *et al*., 1956); genetic advance (Johnson *et al*., 1955); genotypic and phenotypic correlations (Robinson *et al.* 1951) and path-coefficient analysis (Dewey and Lu, 1959) was applied to carry out selection based on characters which would be more effective to meet higher seed yield.

## 3. Results and Discussion

The analysis of variance revealed significant differences among treatments for all the characters are presented in (Table 1). The genotypic and phenotypic coefficient of variability, heritability (%) in broad sense and genetic advance are presented in (Table 2). The Phenotypic coefficient of variation were slightly higher than genotypic coefficient of variation for all selection parameters indicating presence of environmental influence on the expression of characters. Estimates of genetic variability revealed that the GCV and PCV were comparatively higher for days to 50% flowering, followed by number of spikelets per ear, days to maturity and number of seed per ear; these results are similar to those of Sharma and Garg (2002) and Kumar *et al.* (2002). High estimates heritability associated with high estimates of genetic advance was observed for days to 50 % flowering, plant height, which in fact demonstrate the presence of additive genes effect indicating effectiveness of selection for the improvement of these trait. Such a results showed similarity with findings of Atta *et al.* (2008) and Bhoite *et al.* (2008). Broad sense heritability was highest for days to 50 % flowering, followed by number of spikelets per ear, plant height, days to maturity, similar results were published by Atta *et al.* (2008). The higher estimate of genetic advance was noticed for days to 50 % flowering and plant height. The genotypic and phenotypic correlation coefficient between yield and yield components are presented in table 3. Seed yield was significantly and positively correlated with test weight (g) (0.353), number of seed per ear (0.426), number of tillers per plant (0.579). It indicated that increase in one trait will cause increase in the other. Such positive association of seed yield/plant with this trait was also observed by Khan *et al.* (2010) and Khokhar *et al.* (2010). Among the yield attributes, The number of tillers per plant showed highly significant positive correlation at genotypic level with number of ears per plant (0.925) and number of spikelets per plant showed highly significant positive correlation at genotypic level with number of seed per ear (0.868). In the present study genotypic correlation coefficient is higher than phenotypic correlation coefficient, which revealed that there was strong association between these two characters genetically but the phenotypic value is lessened by the significant interaction of environment. The genotypic correlation coefficients of seed yield with other yield traits was further partitioned into direct and indirect effects are presented in table 4. Path coefficient analysis revealed that length of ear followed by test weight (g), number of seed per ear, number of ears per plant and number of tillers per plant had positive direct effect on yield whereas, days to 50 % flowering, number of spikelets per plant, days to maturity had negative direct effect on yield. Thus, path analysis suggest that test weight, length of ear, number of seed per ear, number of tillers per plant, may serve as effective selection attributes during breeding program for yield improvement in wheat, these findings are in accordance with Satish Kumar *et al.* (2004) and Mondal, A.B. (1997). Correlation and direct and indirect estimates vary for different traits with variation in genetic material based on seed yield/plant. Hence, correlation and direct and indirect effect estimation would provide useful information for planning a successful breeding programme. Germplasm, which is prerequisite for any breeding programme, serves as a valuable source material as it provides scope for building of genetic variability. Study of variability, heritability and genetic advance in the germplasm will help to ascertain the real potential value of the genotype. Further, efficiency of selection in any breeding programme mainly depends upon the knowledge of association of the characters. Hence, to break yield barrier and to attend yield plateau, the proper investigation on variability, heritability, genetic advance, correlation, direct and indirect effects suggested those characters which would be taken into consideration for formulating selection breeding programme in order to bring out improvement in the studied population of Wheat (*Triticum aestivum* L.) genotypes.

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**Table 1:** Analysis of variance (ANOVA) for yield and its contributing components in wheat

| *Source of variation* | *Degree of freedo-m* | *Days to 50 % flowering* | *Plant height (cm.)* | *No. of tillers per plant* | *No. of ears per plant* | *Length of ear* | *No. of spikelet s per ear* | *Days to maturity* | *No. of seed per ear* | *Test weight (g)* | *Yield per plant (g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Replication | 2 | 1.2031 | 0.4218 | 1.071 | 0.1962 | 2.315 | 1.241 | 0.5000 | 3.7031 | 2.0355 | 0.464 |
| Treatment | 9 | 486.399 | 234.880 | 1.212 | 1.5094 | 3.852 | 26.774 | 51.847 | 9.6643 | 0.1450 | 4.532 |
| Error | 18 | 0.9788 | 1.7905 | 0.765 | 0.2980 | 0.5959 | 0.320 | 3.399 | 1.8848 | 84.793 | 1.668 |

**Table 2:** Genotypic and phenotypic coefficient of variability, heritability (% in broad sense) and genetic advance for yield and it's contributing components in wheat.

| Genetic parameters | *PCV (phenotypic coefficient of variability)* | *GCV (genotypic coefficient of variability)* | *$h^2$ (broad sense) heritability (%)* | *Genetic advance* |
|---|---|---|---|---|
| Day to 50 % flowering | 12.760 | 12.713 | 99.4 | 26.12 |
| Plant height (cm.) | 8.917 | 0.805 | 97.7 | 17.96 |
| No. of tillers per plant | 0.956 | 0.386 | 16.3 | 0.32 |
| No.of ears/ plant | 0.837 | 0.6345 | 57.4 | 0.99 |
| Length of ear | 1.296 | 1.042 | 64.6 | 1.72 |
| No of spikeletes /ear | 3.023 | 2.969 | 96.5 | 6.01 |
| Days to maturity | 4.420 | 1.017 | 82.6 | 7.52 |
| No. of seed per ear | 1.224 | 1.605 | 57.9 | 2.52 |
| Test weight (g) | 0.232 | 0.123 | 84.3 | 0.40 |
| Yield per plant | 1.619 | 0.976 | 36.4 | 4.45 |

**Table 3:** Genotypic and phenotypic correlation coefficients for yield and its contributing components in wheat.

| Character | | Days to 50 % flowering | Plant height (cm) | No. of tillers per plant | No. of ears per plant | Length ears per plant | No. of spikelet per ear | Days to maturity | No. of seed per ear | Test weight (g) | Yield per plant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50 % flowering | G | | -0.254 | -0.001 | -0.344* | 0.353* | 0.054 | 0.196 | -0.185 | -0.469* | -0.358* |
| | P | | -0.249 | 0.027 | -0.252 | 0.274 | 0.055 | 0.182 | -0.154 | -0.426* | 0.208 |
| Plant height (cm) | G | | | -0.501* | -0.372* | 0.237 | -0.350* | 0.176 | 0.449* | -0.336 | -0.449* |
| | P | | | 0.175 | -0.296 | 0.202 | -0.330 | 0.147 | 0.341* | -0.316 | -0.274 |
| No. of tillers per plant | G | | | | 0.925** | 0.072 | 0.408* | 0.041 | -0.303 | 0.0354 | 0.579* |
| | P | | | | 0.343* | 0.055 | 0.154 | 0.204 | -0.343* | -0.080 | -0.006 |
| No. of ears per plant | G | | | | | -0.631* | 0.226 | -0.267 | -0.234 | 0.752* | 0.151 |
| | P | | | | | -0.303 | 0.143 | -0.119 | -0.276 | 0.476 | -0.078 |
| Length of ear | G | | | | | | 0.533* | 0.622* | -0.256 | -0.567* | -0.620* |
| | P | | | | | | 0.434* | 0.483* | -0.106 | -0.485* | -0.385* |
| No. of spikelets per plant | G | | | | | | | 0.043 | -0.868** | -0.054 | -0.307 |
| | P | | | | | | | 0.026 | -0.626* | -0.037 | -0.185 |
| Days to maturity | G | | | | | | | | 0.372* | 0.114 | -0.191 |
| | P | | | | | | | | 0.212 | 0.078 | -0.174 |
| No. of seed per ear | G | | | | | | | | | 0.304 | 0.426* |
| | P | | | | | | | | | 0.175 | 0.228 |
| 100 seed weight | G | | | | | | | | | | 0.353* |
| | P | | | | | | | | | | 0.248 |

*, ** Significant at 5% and 1% probability levels, respectively.

**Table 4:** Direct and indirect effects for different characters on seed yield in wheat.

| Characters | Days to 50 % flowering | Plant height | No. of tillers per plant | No. of ears per plant | Length ear per plant | No. of spikelets per ear | Days to maturity | No. of seed per ear | Test weight (g) | Correlation coefficient with grain yield per plant |
|---|---|---|---|---|---|---|---|---|---|---|
| **Days to 50 % flowering** | **-0.493** | 0.319 | 0.000 | -0.153 | 1.139 | -0.103 | -0.410 | -0.136 | -0.513 | -0.350* |
| **Plant height** | 0.125 | **-1.255** | -0.175 | -0.165 | 0.765 | 0.662 | -0.367 | 0.329 | -0.368 | -0.449* |
| **No. of tillers per plant** | 0.001 | 0.629 | **0.348** | 0.411 | 0.231 | -0.771 | -0.086 | -0.222 | 0.038 | 0.579* |
| **No. of ears per plant** | 0.170 | 0.467 | 0.322 | **0.445** | -2.033 | -0.428 | 0.558 | -0.171 | 0.823 | 0.153 |
| **Length of ear** | -0.174 | -0.298 | 0.025 | -0.281 | **3.222** | -1.007 | -1.298 | -0.188 | -0.621 | -0.620* |
| **No. of spikelets per plant** | -0.257 | 0.439 | 0.142 | 0.101 | 1.716 | **-1.891** | -0.090 | -0.638 | -0.059 | -0.537 |
| **Days to maturity** | -0.097 | -0.221 | 0.014 | -0.119 | 2.002 | -0.081 | **-2.088** | 0.273 | 0.125 | -0.190 |
| **No. of seed per ear** | 0.091 | -0.533 | -0.106 | -0.104 | -0.826 | 0.642 | -0.776 | **0.734** | 0.333 | 0.426* |
| **Test weight (g)** | 0.231 | 0.422 | 0.12 | 0.334 | -1.827 | 0.102 | -0.239 | 0.224 | **1.094** | 0.461* |

Underlines figure indicate direct effect.