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# Assessment of genetics parameters and characters association in bread wheat (*Triticum aestivum*. em. Thell) for grain yield characters

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**Abstract**
The present experiments was conducted during *Rabi* 2015-2016. The data were recorded on seventeen quantitative characters. Analysis of variance revealed highly significant differences for seventeen quantitative characters except flag leaf width. Number of spike per plant showed relatively high GCV and PCV estimates. High estimates of heritability in broad sense were observed for plant height, number of grains per plant, flag leaf length harvest index, and biological yield. High estimates of genetic advance as % of mean observed for number of grain per plant, harvest index, number of tillers per plant, grain yield per plant, biological yield, peduncle length, flag leaf length, test weight, spike length, spikelet per spike, number of grain per spike, grain filling period and flag leaf width. Correlation studies revealed that seed yield per plant at genotypic and phenotypic level was positively significantly correlated with plant height, flag leaf length, flag leaf width, peduncle length, spikelets per spike, spike length, number of grains per spike, test weight, harvest index and biological yield. These characters can be used as selection indices for bread wheat yield improvement.

**Keywords:** Bread Wheat, Genetics variability, Heritability, Genetic advanced and Correlation coefficient

## 1. Introduction
Wheat (*Triticum aestivum* L. em. Thell.) is a self- pollinated crop of the member of *Poaceae* family and one of the most leading cereal of many countries of the world including India. It a main source of protein and energy. In India, wheat is the second most important food crop after rice both in terms of area and production. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. It is grown in temperate, irrigated to dry and high-rain-fall areas and in warm, humid to dry, cold environments. Wheat is consumed in a variety of ways such as bread, chapatti, porridge, flour; suji etc. Wheat has relatively high content of niacin and thiamin which are principally concerned in providing the special protein called 'Gluten'. Wheat proteins are of special significance because gluten provides the framework of spongy cellular texture of bread and baked products. (Anonymous, 2012) [4].

Wheat production estimated in the recent past 2015-2016 *Rabi* season 93.50 million tons from an estimated area 30.23 million hectares with the yield productivity of 3.1 tons per hectare. In Uttar Pradesh recording to 2015-2016 data, the total area of wheat cultivated was 9.65 million hectares and the total production 26.87 million tons and the yield productivity was 2.8 tons per hectare All India Coordinated Wheat & Barley Improvement Project, (2016).

Therefore, the effort were made to study the extend of variability, heritability and possible amount of genetic gain expected to occur during selection for yield improvement. Similarly an attempt was made to analysis gain yield and its contributing traits of wheat by correlation coefficient.

## 2. Materials and Methods
The experiment was conducted during *Rabi* 2015- 2016 at Sam Higginbottom University of Agriculture, Technology & Science Allahabad, Research farm Department of Genetics and Plant Breeding. The experimental material comprising of 19 diverse wheat genotypes grown under Randomized Block design with three replications. Each genotype was accommodated in a single row of 2m length and spaced at 25 cm between rows with an approximate plant to plant distance of 5 cm. Data were recorded on five randomly selected plants from each treatment and replication for days to 50% heading, days to 50% flowering, plant height, number of tillers per plant, flag leaf length, flag leaf width, peduncle length, grain filling period, spikelets per spike, number of spike per plant, spike length, number of grain per spike, test weight, days to maturity, harvest index, biological yield, grain yield per plant. The assessment of genetic variability, heritability and genetic advance were computed according to method suggested by Johnson *et al.* (1955) [8]. The character association was estimated from variance by Al-Jibouri *et al.* (1958).

## 3. Results and Discussion
Mean sums of square due to genotypes were significant at 5% and 1% level of significance for all the 17 characters except of flag leaf width under the study. These quantitative characters are days to 50% heading, days to 50% flowering, plant height (cm), number of tillers per plant, flag leaf length (cm), flag leaf width (cm), peduncle length (cm), grain filling period, spikelets per spike, number of spikes per plant, spike length, number of grains per spike, test weight (g), days to maturity, harvest index (%), biological yield and grain yield per plant (g). This suggested that the genotypes selected were genetically variable and considerable amount of variability

existed among of them. The presence of large amount of variability might be due to diverse source of material taken as well as environmental influence affecting the phenotypes. Estimates of phenotypic coefficient of variation was found higher than their corresponding genotypic coefficient of variation, indicating that the little influence of environment on the expression of these characters Table 2.

**3.1 Phenotypic coefficient of variation**

A wide range of phenotypic coefficient of variation (PCV) was observed for all the traits ranged from 5.59 (days to maturity) to 52.44 (number of spike per plant). High magnitude of PCV was recorded for 52.44 (number of spikes per plant) followed by 48.26 (number of grain per spike), 40.49 (number of tillers per plant), 34.12 (harvest index), 33.97 (grain yield per plant), 29.86 (plant height), 26.72 (biological yield), 25.20 (test weight), 25.13 (peduncle length), 23.12 (flag leaf length), 21.71 (flag leaf width), 20.58 (spikelet per spike), 18.79 (spike length), 12.87 (grain filling period), 7.05 (days to 50% heading) and 6.43 (days to 50% flowering). Present finding with Arati Yadawad *et al.* (2015) [5].

**3.2 Genotypic coefficient of variation**

A wide range of genotypic coefficient of variation (GCV) was observed for all the traits, ranged from 5.14 (days to maturity) to 46.96 (number of grains per spike). High magnitude of GCV was recorded for number of grains per spike (46.96) followed by 45.16 (number of spikes per plant), 34.22 (number of tiller per plant), 31.46 (harvest index), 30.44 (number of grain per plant), 29.43 (plant height), 24.53 (biological yield), 22.97 (peduncle length), 21.38 (flag leaf length), 21.07 (test weight), 17.67 (spikelet per spike), 17.12 (spike length), 16.18 (leaf length), 11.42 (grain filling period), 6.46 (days to heading) and 5.65 (days to flowering). Present finding with Bharat Bhushan *et al.* (2013) [6].

**3.3 Heritability (broad sense)**

In the present study high estimates of heritability were observed for plant height (97.04), number of grains per spike (94.91), flag leaf length (85.50), harvest index (84.98), days to maturity (84.41), biological yield (84.27), days to 50% heading (83.77), peduncle length (83.49), spike length (83.02), grain yield per plant (80.27, grain filling period (78.75), days to 50% flowering (77.18), number of spikes per plant (74.17), spikelets per spike (73.77), number of tillers per plant (71.45) and test weight had (70.32) had high estimate of heritability.. This suggested that heritability is due to the additive genetic effects and selection could be effective in early segregating generations for these traits and the possibility of improving wheat grain yield through direct selection for grain yield related traits. Present finding with Tripathi *et al.* (2015), Kaddem *et al.* (2014) and Navin Kumar *et al.* (2014)

In present investigation, genotypic correlation coefficients of different characters with seed yield per plant and inter relationship among component characters are presented in Table 3.

**4. Correlation between seed yield and other characters in genotypic level**

Seed yield per plant exhibited positive and significant correlation with plant height (0.740**), flag leaf length (0.466**), flag leaf width (0.395**), peduncle length (0.653**), spikelets per spike (0.514**), spike length (0.464**), number of grains per spike (0.560**), test weight (0.837**), harvest index (0.739**) and biological yield (0.343*). While days to 50% flowering (- 0.329*), number of tillers per plant (-0.528**), number of spikes per plant (-0.486**) and days to maturity (-0.278*) showed negative and significant correlation with grain yield per plant. Present finding with Salahuddin Wahidy *et al.* (2016).

**5. Correlation between seed yield and other characters in phenotypic level**

Seed yield per plant exhibited significant and positive correlation with harvest index (0.625**), test weight (0.620**), peduncle length (0.602**), plant height (0.579**), spikelet per spike (0.476**), number of grain per spike (0.420**), flag leaf length (0.330*) and spike length (0.325**). Grain filling period (0.088), days to maturity (0.087) and biological yield (0.144) exhibited positive and non-significant correlation with seed yield per plant while, days to maturity (- 0.171), days to 50% heading (-0.090), number of tiller per plant (-0.115), flag leaf width (-0.002) and number of spike per plant (-0.125) showed negative and non-significant correlation with seed yield per plant. Present finding with Yakubu Yahaya *et al.* (2014) [12], Dargicho Dutamo *et al.* (2015) [7] and Zahid Akram *et al.* (2008) [2].

From the results obtained from present experimentation, it is concluded that wheat genotypes showed significant genetic variability. High heritability (>60) along with moderate to low genetic advance as % of mean were related for number of tillers per plant, flag leaf length, flag leaf width, peduncle length, grain filling period, spikelets per spike, number of spikes per plant, spike length, number of grains per spike, test weight, harvest index, biological yield and grain yield per plant, which indicates that additive gene action was responsible for their expression. Hence, selection can be exercised upon these characters. Correlation coefficient analysis showed strong positive and significant association with test weight, plant height, and harvest index suggesting that these characters could be used as selection indices for yield improvement in wheat.

**Table 1:** Analysis of variance for different quantitative in Wheat

| Characters | Mean sum of squares | | |
|---|---|---|---|
| | Replications | Treatments | Error |
| | df = 2 | df = 18 | df = 36 |
| Days to 50% heading | 6.807 | 25.910** | 4.714 |
| Days to 50% flowering | 15.842 | 22.526** | 6.064 |
| plant height | 139.562 | 370.735** | 59.035 |

| | | | |
|---|---|---|---|
| Number of tillers/ plant | 3.259 | 6.271** | 2.212 |
| Flag leaf length | 10.493 | 25.577** | 4.106 |
| Flag leaf width | 0.084 | 0.102 | 0.054 |
| Peduncle length | 11.848 | 61.416** | 11.395 |
| Grain Filling Period | 6.684 | 13.532** | 3.351 |
| Spikelets /spike | 1.620 | 10.005** | 3.180 |
| Number of spikes/plant | 6.703 | 128.93** | 2.087 |
| Spike length | 1.693 | 2.827* | 0.541 |
| Number of grains /spike | 6.595 | 128.934** | 2.359 |
| Test weight | 34.211 | 57.02** | 21.104 |
| Days to Maturity | 3.21 | 34.51** | 6.00 |
| Harvest index | 24.26 | 67.98** | 11.34 |
| Biological yield | 1.710 | 15.88** | 2.79 |
| Grain yield/ plant | 0.533 | 1.456** | 0.330 |

*and ** significant at 5% and 1% level of significant

**Table 2:** Estimates of components of variance and genetic parameters for 17 quantitative characters in wheat

| Characters | Genotypic variance | Phenotypic variance | Genotypic coefficient of variation | Phenotypic coefficient of variation | Heritability | Genetic advance | GA AS % |
|---|---|---|---|---|---|---|---|
| Days to 50% heading | 24.34 | 29.05 | 6.46 | 7.05 | 83.77 | 9.30 | 12.17 |
| Days to 50% flowering | 20.50 | 26.57 | 5.65 | 6.43 | 77.18 | 8.19 | 10.22 |
| plant height | 79.13 | 81.54 | 29.43 | 29.86 | 97.04 | 18.02 | 19.88 |
| Number of tillers per plant | 5.53 | 7.75 | 34.22 | 40.49 | 71.45 | 4.10 | 59.59 |
| Flag leaf length | 24.21 | 28.31 | 21.38 | 23.12 | 85.50 | 9.37 | 40.72 |
| Flag leaf width | 0.08 | 0.14 | 16.18 | 20.71 | 61.08 | 0.47 | 26.05 |
| Peduncle length | 57.62 | 69.01 | 22.97 | 25.13 | 83.49 | 14.29 | 43.23 |
| Grain Filling Period | 12.42 | 15.77 | 11.42 | 12.87 | 78.75 | 6.44 | 20.88 |
| Spikelet /spikes | 8.94 | 12.13 | 17.67 | 20.58 | 73.77 | 5.29 | 31.27 |
| Number of spikes/plant | 5.99 | 8.08 | 45.16 | 52.44 | 74.17 | 4.34 | 80.12 |
| Spike length | 2.65 | 3.19 | 17.12 | 18.79 | 83.02 | 3.05 | 32.14 |
| Number of Grains /spike | 42.19 | 44.54 | 46.96 | 48.26 | 94.91 | 12.91 | 31.12 |
| Test weight | 49.99 | 71.10 | 21.07 | 25.20 | 70.32 | 12.21 | 36.40 |
| Days to Maturity | 32.52 | 38.52 | 5.14 | 5.59 | 84.41 | 10.79 | 9.72 |
| Harvest index | 64.20 | 75.55 | 31.46 | 34.12 | 84.98 | 15.22 | 59.74 |
| Biological yield | 14.96 | 17.75 | 24.53 | 26.72 | 84.27 | 7.31 | 46.39 |
| Grain yield/plant | 1.35 | 1.68 | 30.44 | 33.97 | 80.28 | 2.14 | 56.18 |

**Table 3:** Genotypic correlation coefficient of different yield characters with grain yield per plant

| Characters | Days to 50% Flowering | plant height (cm) | Number of tillers per plant | Flag leaf length (cm) | Flag leaf width | Peduncle length (cm) | Grain Filling Period | Spikelet /spike | Number of spikes/ plant | Spike length (cm) | Number of Grains /spike | Test weight (g) | Days to Maturity | Harvest index | Biological yield (g) | Grain yield/plan t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50% heading | 0.330* | 0.192 | 0.365** | -0.016 | 0.620** | -0.386** | 0.127 | 0.542** | 0.370** | 0.255 | -0.703** | 0.189 | 0.878** | 0.228 | -0.423** | -0.182 |
| Days to 50% flowering | 1.00 | 0.038 | 0.444** | -0.126 | 0.795** | -0.511** | 0.159 | 0.329* | 0.458** | 0.131 | -0.941** | 0.134 | 0.814** | 0.185 | -0.390** | -0.329* |
| plant height (cm) | | 1.00 | -0.533** | 0.247 | 0.765** | 0.656** | -0.127 | 0.733** | -0.433** | 0.769** | 0.187 | 0.653** | -0.088 | 0.613** | 0.218 | 0.740** |
| Number of tillers/ plant | | | 1.00 | -0.307* | -0.094 | -0.634** | 0.511** | -0.779** | 0.990** | -0.594** | -0.134 | -0.449** | 0.588** | -0.682** | 0.349* | -0.528** |
| Flag leaf length (cm) | | | | 1.00 | 0.112 | 0.393** | 0.152 | 0.478** | -0.102 | 0.465** | -0.142 | 0.451** | -0.071 | 0.223 | 0.154 | 0.466** |
| Flag leaf width | | | | | 1.00 | 0.546** | 0.466** | 0.972** | 0.044 | 0.184 | 0.406** | 0.309* | 0.834** | 0.600** | -0.441** | 0.395** |
| Peduncle length (cm) | | | | | | 1.00 | -0.045 | 0.306* | -0.530** | 0.323* | 0.723** | 0.320* | -0.491** | 0.399** | 0.350* | 0.653** |
| Grain | | | | | | | 1.00 | - | 0.490** | -0.209 | 0.272* | -0.285* | 0.737** | -0.163 | 0.282* | 0.126 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Filling Period | | | | | | | | 0.578** | | | | | | | | |
| Spikelet /Ear | | | | | | | | 1.00 | -0.674** | 0.896** | -0.396** | 0.922** | -0.184 | 0.752** | -0.221 | 0.514** |
| Number of spikes/plant | | | | | | | | | 1.00 | -0.517** | -0.142 | -0.439** | 0.592** | -0.710** | 0.427** | -0.486** |
| Spike length (cm) | | | | | | | | | | 1.00 | -0.032 | 0.649** | -0.086 | 0.554** | -0.188 | 0.464** |
| Number of Grains /spike | | | | | | | | | | | 1.00 | 0.143 | -0.646** | 0.237 | 0.583** | 0.560** |
| Test weight (g) | | | | | | | | | | | | 1.00 | -0.035 | 0.790** | -0.122 | 0.837** |
| Days to Maturity | | | | | | | | | | | | | 1.00 | 0.038 | -0.094 | -0.278* |
| Harvest index | | | | | | | | | | | | | | 1.00 | -0.525** | 0.739** |
| Biological yield (g) | | | | | | | | | | | | | | | 1.00 | 0.343* |

*and ** significant at 5% an d 1% level of significance

**Table 4:** Phenotypic correlation coefficient of different yield component with grain yield per plant

| **Characters** | **Days to 50% flowering** | **Plant height(cm)** | **Number of tillers per plant** | **Flag leaf length (cm)** | **Flag leaf width (cm)** | **Peduncle length (cm)** | **Grain filling period** | **Spikelets per spike** | **Number of spikes per plant** | **Spike length (cm)** | **Number of grain per spike** | **Test weight (g)** | **Days to maturity** | **Harvest index (%)** | **Biological yield (g)** | **Grain yield per plant** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50% heading | 0.905** | 0.115 | -0.079 | -0.019 | 0.304* | -0.369* | -0.313* | 0.167 | -0.066 | 0.001 | -0.358* | 0.123 | 0.512** | 0.097 | -0.262* | -0.171 |
| Days to 50% flowering | 1.00 | 0.251 | -0.083 | 0.120 | 0.241 | -0.211 | -0.215 | 0.260 | -0.068 | 0.067 | -0.129 | 0.053 | 0.679** | 0.136 | -0.356* | -0.090 |
| Plant height (cm) | | 1.00 | -0.308* | 0.440** | 0.182 | 0.665** | 0.003 | 0.699** | -0.286* | 0.687** | 0.469** | 0.508** | 0.256 | 0.507** | -0.075 | 0.579** |
| Number of tillers per plant | | | 1.00 | -0.157 | 0.020 | -0.185 | 0.414** | -0.196 | 0.962** | -0.115 | -0.096 | -0.240 | 0.270* | -0.305* | 0.302* | -0.116 |
| Flag leaf length (cm) | | | | 1.00 | 0.274* | 0.543** | 0.125 | 0.581** | -0.075 | 0.496** | 0.342* | 0.335* | 0.260 | 0.238 | -0.117 | 0.330* |
| Flag leaf width (cm) | | | | | 1.00 | 0.050 | 0.049 | 0.130 | 0.053 | 0.190 | 0.034 | 0.124 | 0.187 | 0.083 | -0.037 | -0.002 |
| Peduncle length (cm) | | | | | | 1.00 | 0.134 | 0.535** | -0.149 | 0.489** | 0.755** | 0.253 | 0.006 | 0.388** | 0.058 | 0.602** |
| Grain filling period | | | | | | | 1.00 | -0.114 | 0.437** | 0.092 | 0.213 | -0.160 | 0.516** | 0.028 | 0.088 | 0.086 |
| Spikelets per spike | | | | | | | | 1.00 | -0.195 | 0.787** | 0.303* | 0.586** | 0.237 | 0.561** | -0.328* | 0.476** |
| Number of spike per plant | | | | | | | | | 1.00 | -0.098 | -0.128 | -0.251 | 0.273* | -0.320* | 0.334* | -0.125 |
| Spike length (cm) | | | | | | | | | | 1.00 | 0.255 | 0.529** | 0.171 | 0.520** | -0.224 | 0.325* |
| Number of grain per spike | | | | | | | | | | | 1.00 | 0.082 | 0.142 | 0.299* | 0.042 | 0.420** |
| Test weight (g) | | | | | | | | | | | | 1.00 | -0.025 | 0.678** | -0.107 | 0.620** |
| Days to maturity | | | | | | | | | | | | | 1.00 | 0.169 | -0.263* | 0.087 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harvest index | | | | | | | | | | | | | | 1.00 | -0.474** | 0.625** |
| Biological yield | | | | | | | | | | | | | | | 1.00 | 0.144 |

*and ** significant at 5% an d 1% level of significance

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