

## ESTIMATION OF GENETIC PARAMETERS IN F<sub>2</sub> POPULATION OF WHEAT DERIVED FROM INTER-CULTIVARAL HYBRIDIZATION

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### ABSTRACT

The present study was conducted to determine the heritability of grain yield with various yield components in six F<sub>2</sub> populations of bread wheat originated from ten parental varieties. The experiment was carried out in Randomized Complete Block Design (RCBD) with 3 replications. Parameters viz., environmental variance, phenotypic variance, genetic variance, and broad sense heritability were calculated for different important traits such as plant height (cm), tillers plant<sup>-1</sup>, spike length (cm), spikelets spike<sup>-1</sup> and grains spike<sup>-1</sup>. The results regarding mean squares depicted that the genotypes were highly significant at P < 0.01 level for as plant height (cm), tillers plant<sup>-1</sup>, spikelets spike<sup>-1</sup> and grains spike<sup>-1</sup>. The crosses Qafzah-16 x Mehran showed highest performance in spike length (12.58cm), spikelets spike<sup>-1</sup> (12.5) and grains spike<sup>-1</sup> (74.75). The heritability in broad sense showed that all the crosses had high heritability in all the traits studied. Cross Katila-12 x Khirman showed highest heritability in plant height (86.74%) and spikelets per spike (86.33%) whereas Gamdow x TD-1 showed highest heritability 97.48 and 90.66 in grains spike<sup>-1</sup> and tillers plant<sup>-1</sup>, respectively.

**Key-words:** Bread wheat, yield parameters, F<sub>2</sub> population.

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### INTRODUCTION

The population of Pakistan is increasing day after day which is a challenge to the breeders to evolve better and even better varieties of wheat to fulfill the food requirement. Many efforts have been made to increase per acre grain yield but a great task of further improvement still lies ahead. Yield potential of present wheat varieties is much lower than other wheat growing countries. Therefore, it is important to conduct research on food crops particularly on wheat for evolving new and better varieties. Genetic diversification in wheat provides many opportunities of developing new and favorable genotypes through hybridization and other breeding techniques. Therefore, understanding of genetic factors governing the yield components is very important. The search of new and desirable germ plasm is continuous process and development of new varieties is an unending goal of plant breeders. The heritability is valuable in determining the parameters and predicting the magnitude and genetic gain that can be used for selection of any desirable character (Aycicek and Yildirim. 2006, Memon *et al.* (2007), Laghari *et al.* (2010). Mangi *et al.* (2010) and Abinasa *et al.* (2011) have worked on heritability estimates and have reported high heritability and high genetic advance for yield and yield components. The present investigation is also aimed to investigate the inheritance, for yield, and its components in F<sub>2</sub> generation.

### MATERIALS AND METHOD

The experiment was carried out at Botanical Garden, Department of Plant Breeding and Genetics, Sindh Agriculture University Tandojam. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications, six crosses viz. Gamdow X TD-1, Katila-12 X Khirman, Gamdow X Marvi, Jouhar-78 X Girvil and Qafzah-16 X Mehran and 10 varieties viz Gamdow, TD-1, Katila-12, Khirman, Marvi, Jouhar-78, Girvil, Quimma, Qafzah-16, and Mehran were planted during rabi season 2012-13. The sowing was done by hand dibbling keeping 30 cm apart between rows. First thinning was done after 25 days to maintain 15 cm distance between plants. At maturity 10 plants per population per replication were tagged for recording data for plant height (cm), tillers plant<sup>-1</sup>, spike length (cm), spikelets spike<sup>-1</sup> and grains spike<sup>-1</sup>.

The collected data were analyzed through analysis of variance (ANOVA) as described by Gomez and Gomez (1984), the means were compared using least significant difference at 5%. The genetic parameters were determined as follows:

$$\begin{aligned} \text{Genetic variance} &= \sigma^2_g = \sigma^2_{ph} - \sigma^2_e \\ \text{Phenotypic variance} &= \sigma^2_{ph} = \sigma^2_g + \sigma^2_e \end{aligned}$$

$$\text{Heritability} = \frac{\sigma^2_g}{\sigma^2_{ph}}$$

$\sigma^2_e$  = environmental variance  
 $\sigma^2_g$  = genotype  
 $\sigma^2_{ph}$  = phenotypic variance

## RESULTS

### Analysis of Variance

Analysis of variance and mean performance of six F<sub>2</sub> populations and their parental lines of bread wheat is presented in Table 1 and 2 respectively. Results showed that genotypes / parents were highly significant at 0.01 level for plant height (cm), tillers plant<sup>-1</sup>, spikelets spike<sup>-1</sup>, grain spike<sup>-1</sup>.

Table 1. Analysis of variance for plant height, number of tillers plant<sup>-1</sup>, spikelets spike<sup>-1</sup> and grains spike<sup>-1</sup>

| Source of variation | D.F | Plant height | No. Tillers Plant <sup>-1</sup> | Spikelets spike <sup>-1</sup> | Grains spike |
|---------------------|-----|--------------|---------------------------------|-------------------------------|--------------|
| Replication         | 2   | 29.95        | 2.99                            | 18.79                         | 53.13        |
| Genotypes           | 15  | 1060.47**    | 57.45**                         | 19.08**                       | 850.32**     |
| Error               | 30  | 9.45         | 1.87                            | 4.66                          | 14.02        |
| Total               | 47  | -            | -                               | -                             | -            |

Table 2. Mean performance of parents and their F<sub>2</sub> populations: plant height, number of tillers plant<sup>-1</sup>, spikelets spike<sup>-1</sup> and grains spike<sup>-1</sup>

| Parents F <sub>2</sub> population | Plant height(cm) | Tillers plant <sup>-1</sup> | Spikelets spike <sup>-1</sup> | Grain spike <sup>-1</sup> |
|-----------------------------------|------------------|-----------------------------|-------------------------------|---------------------------|
| Gamdow X TD-1                     | 68.85 f          | 8.4 e                       | 17.16 def                     | 49.6 ef                   |
| Katila-12 X Khirman               | 68.84 b          | 7.33 e                      | 18.11 cdef                    | 53.8 e                    |
| Gamdow X Marvi                    | 91.92 e          | 7.4 e                       | 17.73 cdef                    | 54.26 de                  |
| Jouhar-78 X Girvil                | 92.10 e          | 7 e                         | 15.93 ef                      | 46 e                      |
| Qafzah-16 X Mehran                | 64.83 f          | 4.66 e                      | 25.5 a                        | 74.75 a                   |
| Quimma X Khirman                  | 53.23 g          | 2.83 f                      | 15.33 f                       | 2.09 g                    |
| Gamdow                            | 101.57 bcd       | 15.36 ab                    | 20.28 bcd                     | 60.31 cd                  |
| TD-1                              | 102.21 bcd       | 16.25 a                     | 21.29 bc                      | 64.04 bc                  |
| Katila-12                         | 106.44 b         | 14.45 abc                   | 19.54 bsd                     | 54.14 de                  |
| Khirman                           | 102.48 bcd       | 13.72 bcd                   | 19.49 bcde                    | 55.08 de                  |
| Marvi                             | 97.84 d          | 16.1 a                      | 21.99 ab                      | 68.37 b                   |
| Jouhar-78                         | 100.89 cd        | 15.5 ab                     | 22.04 ab                      | 64.49 bc                  |
| Girvil                            | 104.59 bc        | 12.67 cd                    | 18.5 bcdef                    | 47.37 f                   |
| Quimma                            | 100.53 cd        | 13.57 bcd                   | 20.4 bcd                      | 51.45 ef                  |
| Qafzah-16                         | 113.35 a         | 11.79 d                     | 18.75 bcdef                   | 52.07 ef                  |
| Mehran                            | 118.25 a         | 14.26 abc                   | 19.44 bcde                    | 77.19 a                   |

Mean followed by similar letters are not significantly different from each other

### Plant height

The perusal of Table 3 showed that cross Gamdow x TD-1 exhibited high heritability (96.95 %) followed by cross Katilla x Khirman (96.74 %). Genetic variance of cross Gamdow x TD-1 was also higher (63.6) showing more genetic contribution of these cross.

### Tillers plant<sup>-1</sup>:

The results pertaining to tillers plant<sup>-1</sup> are given in Table 3 for different cross combinations and their heritability estimates. The data revealed that cross Gamdow x TD-1 indicated highest heritability (90.66 %) followed by cross Gamdow x Marvi (89.20 %) Genetic variance was higher for cross Gamdow x TD1 (10.97) showing more genetic contribution of these crosses for tillering attribute.

**Spikelet's spike<sup>-1</sup>:**

The results regarding spikelets spike<sup>-1</sup> are mentioned in Table 3 for different combination and their heritability estimates, cross Katilla-12 x Khirman and Gamdow x TD-1 proved highest heritability (86.33 and 83.75%) followed by cross Gamdow x Marvi (80.77 %) Genetic variance of crosses Gamdow x TD-1 and Gamdow x Marvi were also higher (17.06 and 14.20 %, respectively) showing more genetic contribution of these crosses for spikelets spike<sup>-1</sup> character.

**Grain spike<sup>-1</sup>:**

The results of heritability estimates for grain spike<sup>-1</sup> are presented in Table 3 for different cross combinations. Highest heritability was exhibited by cross Gamdow x TD-1 (97.48 %) followed by cross Katilla-12 x Khirman (96.83 %). Results for Genetic variance of crosses Gamdow x Marvi and Gamdow x TD -1 were higher (13.11 and 130.82 respectively) thus more genetics contribution of these recombination.

Table 3. Heritability estimates of different F<sub>2</sub> populations for different yield traits.

| S. No.                        | Crosses             | Phenotypic variance | Genotypic variance | Enviromental variance | Heritabiliy (%) |
|-------------------------------|---------------------|---------------------|--------------------|-----------------------|-----------------|
| Plant height                  |                     |                     |                    |                       |                 |
| 1                             | Gamdow X TD-1       | 63.6                | 61.66              | 1.94                  | 96.95           |
| 2                             | Katila-12 X Khirman | 61.37               | 59.37              | 2.0                   | 96.74           |
| 3                             | Qafzah-16 X Mehran  | 18.66               | 15.25              | 3.41                  | 81.72           |
| 4                             | Gamdow X marvi      | 64.66               | 55.23              | 9.43                  | 85.41           |
| 5                             | Jouhar-78 X Girvil  | 36.61               | 34.53              | 2.08                  | 94.31           |
| 6                             | Quimma X Khirman    | 36.51               | 35.02              | 1.49                  | 95.91           |
| Tillers plant <sup>-1</sup>   |                     |                     |                    |                       |                 |
| 1                             | Gamdow X TD-1       | 12.01               | 10.97              | 1.04                  | 90.66           |
| 2                             | Katila-12 X Khirman | 10.34               | 8.09               | 2.25                  | 78.24           |
| 3                             | Qafzah-16 X Mehran  | 10.34               | 8.78               | 1.56                  | 84.91           |
| 4                             | Gamdow X Marvi      | 9.26                | 8.26               | 1.00                  | 89.20           |
| 5                             | Jouhar-78 X Girvil  | 6.66                | 3.55               | 3.11                  | 53.30           |
| 6                             | Quimma X Khirman    | 19.10               | 9.97               | 9.13                  | 52.19           |
| Spikelets spike <sup>-1</sup> |                     |                     |                    |                       |                 |
| 1                             | Gamdow X TD-1       | 20.37               | 17.06              | 3.31                  | 83.75           |
| 2                             | Katila-12 X Khirman | 13.76               | 11.88              | 1.88                  | 86.33           |
| 3                             | Qafzah-16 X Mehran  | 2.46                | 1.00               | 1.46                  | 40.65           |
| 4                             | Gamdow X Marvi      | 17.58               | 14.20              | 3.38                  | 80.77           |
| 5                             | Jouhar-78 X Girvil  | 2.97                | 1.96               | 1.01                  | 65.99           |
| 6                             | Quimma X Khirman    | 9.16                | 7.35               | 1.81                  | 80.24           |
| Grains spike <sup>-1</sup>    |                     |                     |                    |                       |                 |
| 1                             | Gamdow X TD-1       | 134.2               | 130.82             | 3.38                  | 97.48           |
| 2                             | Katila-12 X Khirman | 125.27              | 121.31             | 3.96                  | 96.83           |
| 3                             | Qafzah-16 X Mehran  | 41.96               | 25.49              | 16.47                 | 60.74           |
| 4                             | Gamdow X Marvi      | 135.91              | 131.11             | 4.8                   | 96.46           |
| 5                             | Jouhar-78 X Girvil  | 21.9                | 16.17              | 5.73                  | 73.83           |
| 6                             | Quimma X Khirman    | 69.89               | 66                 | 3.89                  | 94.43           |

## DISCUSSION

Heritability is a convenient expression of phenotypic value. For improvement of a desirable character, heritability estimate is very essential to assess the relative effect of genotype and environment in order to document the extent of possible improvement. The heritability estimates of 60% and above are considered as high below 60% up to 40% as medium and less than 40% as low (Soomro, 2000).

Heritability estimates revealed that all the crosses had moderate range of genotypic and phenotypic variances for the character plant height. Among them, the cross Gamdow x TD1 showed the highest heritability (96.95%). High heritability suggests the simpler the process of selection, which helps in identifying better genotypes in early generation. Larik *et al.* (1997) reported that high heritability was due to the presence of additive and additive x additive gene effects. Further our results match with the results of previous researchers like Aycicek and Yildirim. (2006), Aydin *et al.* (2010), Karim and Jahan (2013) who got the similar results from their research. Heritability estimates revealed that all the crosses showed moderate range of genotypic and phenotypic variances for the character tillers plant<sup>-1</sup>. Among them, the cross Gamdow x TD1 showed the highest heritability (90.66%). High heritability estimates helps in identifying the parents for better cross combination in early generation. Further more our results are in confirmation with the results of previous researchers like Rafi Ullah *et al.* (2007), Abinasa *et al.* (2011), Sial *et al.* (2013)

For the character spikelets spike<sup>-1</sup> all the crosses showed moderate and high range of genotypic and phenotypic variances. Katilla x Khirman shows the highest heritability (86.33%). Larik *et al.* (1997) reported that high heritability was due to the presence of additive and additive x additive gene effects. Further our results are in agreement with the results of previous researchers like Memon *et al.* (2007), Khan and Naqvi (2011), and Ilker *et al.* (2013). Heritability estimates revealed that all the crosses showed high range of genotypic and phenotypic variances for the character grains spike<sup>-1</sup>. The cross Gamdow x TD1 showed the highest heritability (97.48%). Higher the heritability simpler the selection process and more response of the genotypes in early generation. Further our results are in confirmation with the results of previous researchers like Yagd *et al.* (2007), Khalid *et al.* (2011).

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(Accepted for publication November 2016)