RESPONSE OF INTRASPECIFIC CROSSES IN F1 AND THEIR DETERIORATION IN F2 GENERATION OF BREAD WHEAT (Triticum aestivum L.)

Soomro Z.A.1, M. Khalid2, T.F. Abro3, G.S. Mangrio4, S.A. Channa5, U.A. Kasi6, P.A. Shar7, M.D. Hassni8, R.A. Shah9

1, 2, 3, 4, 5, 7, 9 Sindh Agriculture University, Tandojam, Pakistan.
6 Balochistan Agriculture College, Quetta, Pakistan.
*Corresponding author

ABSTRACT

The experimental trail was conducted at Wheat and barley Research Institute, Tandojam. The seed of nine parents along with their six F1 and F2 generations were sown in Randomized Complete Block Design (RCBD) with three replications. The varieties used in the experiment were Sassui, Abadgar, Maxipak, Soghat, Marvi, Noori, Moomal, Anmol-91 and Mehran. The mean squares regarding the grains spike-1, grain yield plant-1, and seed index exhibited that parents, crosses, F1 and F2 hybrids were highly significant at 0.01 level of probability. Among the parents, Mehran gave highest value for grain yield plant-1, while F1 hybrid Moomal × Anmol-91 displayed maximum grain yield plant-1. The results for grain yield plant-1, displayed that highest heterosis (87.22%) and heterobeltiosis (86.80%) was exhibited by the cross Maxipak × Soghat. The maximum inbreeding depression (16.23%) for the said trait was shown by the cross Sassui × Abadgar. The cross Maxipak × Soghat could be selected for further evaluation in advanced segregating generations.

1. INTRODUCTION

Wheat is widely cultivated crop among the cereals in the world (Kumar et al., 2013). The wheat crop refers to different species of genus Triticum, including diploid, tetraploid and hexaploid species. Bread wheat (Triticum aestivum), 2n = 6x = 42) is the major species cultivated worldwide, covering more than 85% of wheat area (Kilian et al., 2009). Hybrid cultivars are used for the commercial cultivation because of their ability to capitalize over their parents and it has been a powerful force for evolution of new genotypes (Birchler et al., 2003). Heterosis is the result of allelic or non-allelic interaction of genes under the influence of particular environments as it is common in plant species, but its level of expression is highly variable (Fehr, 1987). Inbreeding, the crossing between two related genotypes, is mandatory in the small, uneven or isolated populations typical of many liable species (Frankham, 2002) and can lead to a major reduction in population suitability (Keller and Waller, 2002). Hybrid vigour has been
observed in a series of crop species which has a key role for increasing productivity of crop plant. It is now well understood that hybrid vigour does occur due to the proper combination of parents in the appearance of heterozygosity articulate increased vigour, size, fertility, insect pest, dieases or climatic extremes may either the high-parent or the mid-parent value (Larik and Hussain, 1990). Utilization of this outstanding achievement through hybrid wheat is more attractive than conventional plant breeding methods as utilization of hybrid vigour mainly depends upon the direction and magnitude of heterosis while estimation of heterosis over the better parent (heterobeltiosis) may be useful in identifying true heterotics cross combinations (Singh et al., 2004). Inbreeding depression occurs in the reduced survival and fertility of offspring of related characters in wild animal and plant populations as well as in humans, indicating that genetic variability in capability traits exists in naturally occurring populations. In the evolution of outcrossing mating systems inbreeding depression is very important because inter crossing inbred strains improves yield of specific crop (Charlesworth and Willis, 2009).

2. MATERIAL AND METHODS

The seed of nine parents along with their six F₁ and F₂ generations were sown in Randomized Complete Block Design (RCBD) with three replications at Wheat and barley Research Institute, Tandojam. The experimental material consist of Parents (Sassui, Abadgar, Maxipak, Soghat, Marvi, Noori, Moomal, Anmol-91 and Mehran), F₁ and F₂ hybrids. (Sassui x Abadgar, Marvi x Noori, Maxipak x Soghat, Moomal x Anmol-91, Marvi x Sassui and Mehran x Sassui). Three rows of three meter length were grown of each genotype by keeping sown through hand drill method. After first irrigation, thinning was done to maintain 15cm plant to plant and 30 cm row to row distance. Ten plants were randomly selected and tagged for recording following traits. number of grains spike⁻¹, grain yield plant⁻¹ and seed index (1000 grain weight, g).

2.1. Statistical Analysis

The collected data was statistically analysed after Gomez and Gomez (1984). Whereas heterosis and heterobeltiosis will be work out after Fehr (1987) and inbreeding depression was calculated after Falconer (1989).

3. RESULTS

The mean squares regarding the number of grains spike⁻¹, grain yield plant⁻¹, and seed index are presented in Table 1, which further exhibited that parents, crosses, F₁ and F₂ hybrids are highly significant at 0.01 level of probability for the trait studied. The previous works like Sharma and Sain (2004) worked on different parental line and their generation for durum wheat. They reported that variation in the traits due to non-fixable genes effects were higher than that of fixable ones.

| Source of variation | D.F. | Grains spike⁻¹ | Grain yield plant⁻¹ | Seed index |
|---------------------|------|----------------|---------------------|------------|
| Replications        | 2    | 11.223**       | 3.939*              | 1.068**    |
| Genotypes           | 20   | 367.596**      | 49.156**            | 32.127**   |
| Parents             | 8    | 121.266**      | 23.254**            | 49.718**   |
| Crosses             | 11   | 404.446**      | 30.081**            | 21.978**   |
| F₁ hybrids          | 5    | 213.590**      | 30.857**            | 19.614**   |
| F₂ hybrids          | 5    | 119.327**      | 29.798**            | 25.281**   |
| Error               | 40   | 8.608          | 0.703               | 1.095      |
| Total               | 62   |                |                     |            |

** = Highly significant at 0.01 level of probability.

Table 2 revealed that maximum number of grain spike⁻¹ (79.267) produced by F₁ hybrid (Marvi × Noor) followed by F₁ hybrid (Maxipak × Soghat), whereas minimum number of grain spike⁻¹ (42.833) displayed by F₂ hybrid (Marvi × Sassui). Maximum grain yield plant⁻¹ (21.633 g) produced by F₁ hybrid Moomal × Anmol-91 followed by F₁ hybrid (Maxipak × Soghat) whereas the lowest grain yield plant⁻¹ (9.82 g) produced by parent
Marvi. Higher seed index (47.89) displayed by parent Sassui followed by F₂ hybrid (47.18 g) (Maxipak × Soghat) whereas minimum seed index (34.72 g) recorded by parent Maxipak. The workers like Morojele and Labuschagne (2013) reported variation in parents and their hybrids whereas Noorka et al. (2012) reported that genotypes perform different as when this environment changed.

Table 2. Mean performance of parents, F₁, and F₂ hybrids for quantitative traits of wheat genotypes.

| Genotypes       | Grain spike¹ | Grain yield plant¹ | Seed index (1000-grain weight, g) |
|-----------------|--------------|--------------------|-----------------------------------|
| Parents         |              |                    |                                   |
| Abadgar         | 55.2         | 11.787             | 46.66                             |
| Anmol-91        | 67.367       | 14                 | 46.787                            |
| Marvi           | 54.633       | 9.82               | 40.827                            |
| Maxipak         | 63.8         | 11.107             | 34.72                             |
| Mehran          | 54.767       | 18.04              | 44.387                            |
| Moomal          | 48.867       | 9.163              | 39.933                            |
| Noori           | 49.9         | 9.613              | 42.667                            |
| Soghat          | 49.667       | 11.09              | 42.313                            |
| Sassui          | 57.333       | 13.17              | 47.89                             |
| F₁ hybrids      |              |                    |                                   |
| Sassui × Abadgar| 65.5         | 17.467             | 44.993                            |
| Marvi × Noori   | 79.267       | 16.16              | 44.873                            |
| Maxipak × Soghat| 77.567       | 20.807             | 47.88                             |
| Moomal × Anmol-91| 75.467     | 21.637             | 43.64                             |
| Marvi × Sassui  | 57.267       | 13.447             | 41.773                            |
| Mehran × Sassui | 73.633       | 20.58              | 40.713                            |
| F₂ hybrids      |              |                    |                                   |
| Sassui × Abadgar| 55.467       | 15.033             | 44.287                            |
| Marvi × Noori   | 56.735       | 15.003             | 42.427                            |
| Maxipak × Soghat| 62.1         | 18.563             | 47.18                             |
| Moomal × Anmol-91| 54.7        | 19.15              | 41.807                            |
| Marvi × Sassui  | 42.833       | 11.833             | 41.233                            |
| Mehran × Sassui | 53.333       | 20.003             | 38.827                            |
| LSD at 5%       | 4.841        | 1.384              | 1.727                             |

All crosses showed positive heterosis and heterobeltiosis. The highest heterosis (51.66%) and heterobeltiosis (45.08%) shown by the cross Marvi × Noori followed by the cross Maxipak × Soghat, whereas the lowest heterosis (4.18%) and heterobeltiosis (3.04%) shown by the cross Marvi × Sassui. Singh et al. (2013) and Kalhoro et al. (2015) reported that maximum heterotic effect noted in all character including grain spike¹ and grain yield plant¹.

The highest heterosis (87.22%) and heterobeltiosis (86.80%) exhibited by the cross Maxipak × Soghat followed by cross Moomal × Anmol-91 of heterosis (86.87%), whereas heterobeltiosis (64.89%) followed by the cross Marvi × Noori. Minimum heterosis (17.10%) and heterobeltiosis (2.12%) by the cross Marvi × Sassui among all the crosses. Whereas Beche et al. (2013) and Singh et al. (2013) reported the same result that due to heterotic effects in hybrid show the higher yield plant¹. For the character of seed index (1000 grain weight, g), three crosses showed negative heterosis while four crosses displayed negative heterobeltiosis. The highest heterosis (23.79%) and heterobeltiosis (12.69%) showed by the crosses Maxipak × Soghat, whereas the minimum negative heterosis (−4.21%) and heterobeltiosis (−6.03%) shown by the cross Sassui × Abadgar. Singh et al. (2008) and Shehzad et al. (2004) reported the result is higher heterosis and heterobeltosis due to heterotic effect in F₁ hybrid.

All crosses showed inbreeding depression for the character number of grains spike¹. The maximum inbreeding depression (39.71%) shown by the cross Marvi × Noori followed by the cross Mehran × Sassui (38.40%). Whereas minimum observed inbreeding depression (22.52%) were showed by the cross Sassui × Abadgar Table 3. Rad et al. (2012) and Bertan et al. (2009) reported that number of grain spike¹ contributing to the expression of distinct heterosis level and inbreeding depression level.
Table 3. Inbreeding depression effect in F₂ generation for the traits grains/spike, grain yield/plant and seed index.

| F₂ hybrids                  | Grains/spike |                     | Grain yield/plant |                     | Seed index |                     |
|-----------------------------|--------------|---------------------|-------------------|---------------------|------------|---------------------|
|                             | Expected ID  | Observed ID         | Expected ID       | Observed ID         | Expected ID| Observed ID         |
| Sassui × Abadgar            | 60.57        | 22.52               | 14.98             | 16.23               | 45.98      | 1.60                |
| Marvi × Noori               | 72.85        | 39.71               | 15.95             | 7.73                | 45.38      | 5.77                |
| Maxipak × Soghat            | 72.25        | 24.89               | 16.90             | 12.12               | 45.25      | 1.05                |
| Moomal × Anmol-91           | 73.07        | 37.95               | 18.81             | 13.00               | 45.38      | 4.40                |
| Marvi × Sassui              | 61.19        | 33.69               | 16.60             | 13.69               | 45.15      | 2.54                |
| Mehran × Sassui             | 63.36        | 38.40               | 15.94             | 2.9                 | 40.87      | 5.23                |

Inbreeding depression for the character grain yield plant⁻¹ shown in the Table 3. Maximum inbreeding depression (16.23%) shown by the cross Sassui × Abadgar followed by cross Marvi × Sassui. Whereas minimum observed inbreeding depression (2.9%) displayed by the cross Mehran × Sassui. Beche et al. (2013) reported negative co relation between heterobeltiosis and grain yield plant⁻¹ inbreeding depression indicating the presence of additive × additive epistatic interaction. Table 3 revealed the inbreeding depression for the trait seed index (1000 grain weight, g). The maximum inbreeding depression (5.77%) shown by the cross Marvi × Noori followed by the cross Mehran × Sassui. Whereas minimum observed inbreeding depression (1.05%) displayed by the cross Maxipak × Soghat. Gaur et al. (2014) reported positive expected and negative observed significantly inbreeding depression in many crosses.

4. CONCLUSION

It is concluded that parents, crosses, F₁ and F₂ hybrids are highly significant at 0.01 levels for grains/spike, grain yield/plant and seed index. Among the varities the parent Mehran perform highest value for grain yield plant⁻¹. Cross Maxipak × Soghat showed highest heterosis and heterobeltiosis for grain yield plant⁻¹ and 1000 grain weight. Mehran × Sassui showed that minimum inbreeding depression for grain yield plant⁻¹. Therefore variety Mehran and Anmol-91 could be used in the breeding program whereas cross Maxipak × Soghat could be used in the hybrid seed production.

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Table 4. Percentage increase (+) or decrease (-) over mid parent and better parent of F1 hybrids for the traits grains/spike, grain yield/plant and seed index (1000 seed weight).

| F1 hybrids       | Grains/spike | Seed index |
|------------------|--------------|------------|
|                  | MP   | BP   | MP   | BP   |
| Sassui × Abadgar | 17.74 | 17.25 | 39.98 | 32.64 | -4.21 | -6.03 |
| Marvi × Noori    | 51.66 | 45.08 | 66.51 | 64.89 | 7.67  | 5.18  |
| Maxipak × Soghat | 36.72 | 21.58 | 87.22 | 86.80 | 7.47  | 12.69 |
| Moomal × Anmol-91| 29.77 | 12.02 | 86.87 | 54.57 | 0.65  | -6.71 |
| Marvi × Sassui   | 4.18  | 3.64  | 17.10 | 2.12  | -4.00 | -11.69|
| Mehran × Sassui  | 33.12 | 31.81 | 33.64 | 15.22 | -11.90 | -15.12|

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