International Journal of Sustainable Agricultural Research
2019 Vol. 6, No. 4, pp. 198-202
ISSN(e): 2312-6477
ISSN(p): 2313-0393
DOI: 10.18488/journal.70.2019.64.198.202

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

Soomro Z.A.[1+]
M. Khalid[2]
T.F. Abro[3]
G.S. Mangrio[4]
S.A. Channa[5]
U.A. Kasi[6]
P.A. Shar[7]
M.D. Hassni[8]
R.A. Shah[9]

[1,2,3,4,5,7,9]*Sindh Agriculture University, Tandojam, Pakistan.*
[1]*Email: zasoomro_cap@hotmail.com*
[6]*Balochistan Agriculture College, Quetta, Pakistan.*
[8]*Agriculture Extension, Balochistan, Pakistan.*

(+ Corresponding author)

Article History
Received: 30 July 2019
Revised: 2 September 2019
Accepted: 4 October 2019
Published: 12 November 2019

Keywords
Bread wheat
Heterosis
Heterobeltiosis
Inbreeding depression
Segregating population
Agronomic traits.

ABSTRACT

The experimental trail was conducted at Wheat and barley Research Institute, Tandojam. The seed of nine parents along with their six F_1 and F_2 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, F_1 and F_2 hybrids were highly significant at 0.01 level of probability. Among the parents, Mehran gave highest value for grain yield plant^{-1}, while F_1 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.

Contribution/ Originality: This study contributes in the existing literature regarding the plant breeding especially in the field of hybrid vigour in bread wheat. The material selected observed for performance in F1 and its percentage of deterioration in F2 generation.

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, dieasesor 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 F_1 and F_2 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), F_1 and F_2 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 maintain15cm plant to plant and 30cm 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, F_1 and F_2 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 duram wheat. They reported that variation in the traits due to non-fixable genes effects were higher than that of fixable ones.

Table-1. Mean squares from analysis of variance for yield and its component in bread wheat (*Triticum aestivum* L).

Source of variation	D.F.	Grains spike^{-1}	Grain yield plant^{-1}	Seed index
Replications	2	11.223	3.939	1.068
Genotypes	20	307.996**	49.156**	32.127**
Parents	8	121.266**	23.254**	49.718**
Crosses	11	404.446**	30.081**	21.978**
F_1 hybrids	5	213.590**	30.857**	19.614**
F_2 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 F_I hybrid (Marvi × Noor) followed by F_1 hybrid (Maxipak × Soghat), whereas minimum number of grain spike^{-1} (42.833) displayed by F_2 hybrid (Marvi × Sassui). Maximum grain yield plant^{-1} (21.633 g) produced by F_I hybrid Moomal × Anmol-91 followed by F_1 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 F_2 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, F_1 and F_2 hybrids for quantitative traits of wheat genotypes.

Genotypes	Grain spike^{-1}	Grain yield plant^{-1}	Seed index (1000-grain weight, g)
Parents			
Abadgar	55.2	11.787	46.06
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	53.467	15.033	44.287
Marvi × Noori	56.733	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	38.627
LSD at 5%	4.841	1.384	1.727

M.Sc thesis submitted to deptt. PBG, SAU Tandojam.

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 heteriotic effect noted in all character including grain spike^{-1} and grain yield plant^{-1}.

The highest heterosis (87.22%) and heterobeltiosis (86.80%) exhibited by the cross Maxipak × Soghat followed by cross Moomal × Anmol-91 of heterois (86.87%), whereas heterobeltiosis (64.89%) fallowed 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 heteriotic effects in hybrid show the higher yield plant^{-1}. 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 heteriotic effect in F_1 hybrid.

All crosses showed inbreeding depression for the character number of grains spike^{-1}. 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 crosss Sassui×Abadgar Table 3. Rad *et al.* (2012) and Bertan *et al.* (2009) reported that number of grain spike^{-1} contributing to the expression of distinct heterosis level and inbreeding depression level.

Table-3. Inbreeding depression effect in F_2 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	42.42	4.40
Marvi × Sassui	61.19	33.69	16.60	13.69	43.15	2.54
Mehran × Sassui	63.36	38.40	15.94	2.9	40.87	5.23

M.Sc thesis submitted to deptt. PBG, SAU Tandojam.

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, F_1 and F_2 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.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Acknowledgement: All authors contributed equally to the conception and design of the study.

REFERENCES

Beche, E., C.L. da Silva, E.S. Pagliosa, M.A. Capelin, J. Franke, G. Matei and G. Benin, 2013. Hybrid performance and heterosis in early segregant populations of Brazilian spring wheat. Australian Journal of Crop Science, 7(1): 51-57.

Bertan, I., F. de Carvalho, A. de Oliveira, J. da Silva, G. Benin, I. Hartwig, D. Schmidt, I. Valério, D. da Fonseca and G.d. Silveira, 2009. Effects of heterosis and endogamy on agronomic important traits in wheat. Ceres Magazine, 56(6): 753-763.

Birchler, J.A., D.L. Auger and N.C. Riddle, 2003. In search of the molecular basis of heterosis. The Plant Cell, 15(10): 2236-2239.Available at: https://doi.org/10.1105/tpc.151030.

Charlesworth, D. and J. Willis, 2009. The genetics of inbreeding depression. Nature Reviews Genetics, 10(11): 783-796.

Falconer, D.S., 1989. Introduction to quantitative genetics. 3rd Edn., New York, U.S.A: Longman Scientific and Technical. pp:187-192.

Fehr, W.R., 1987. Principles of cultivar development: Theory and techniques. New York: Mac Million Publishing Co. Inc. pp: 115-119.

Frankham, R., 2002. Resolving the genetic paradox in invasive species. Heredity, 94(4): 385-390.

Gaur, S., S. Singh, L. Tiwari and L. Gaur, 2014. Heterosis and inbreeding depression in the inheritance of grain yield and its components in wheat Triticum aestivum. Current Advances in Agricultural Sciences, 6(2): 186-189.Available at: https://doi.org/10.5958/2394-4471.2014.00017.3.

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for agricultural research. 2nd Edn., New York, U.S.A: John Wiley and Sons Inc.

Kalhoro, F.A., A.A. Rajpar, S.A. Kalhoro, A. Mahar, A. Ali, S.A. Otho, R.N. Soomro, F. Ali and Z.A. Baloch, 2015. Heterosis and combing ability in F1 population of hexaploid wheat triticum aestivum L. American Journal of Plant Sciences, 6: 1011-1026.Available at: https://doi.org/10.4236/ajps.2015.67107.

Keller, L.F. and D.M. Waller, 2002. Inbreeding effects in wild populations. Trends in Ecology & Evolution, 17(5): 230-241.Available at: https://doi.org/10.1016/s0169-5347(02)02489-8.

Kilian, B., H. Ozkan, C. Pozziand and F. Salamini, 2009. Domestication of the Triticeae in the Fertile Crescent. In: C. Feuillet and J. Meuhlbauer Genetics and genomics of the Triticeae. Plant genetics and genomics: Crops and models 7. New York: Springer. pp: 81-119.

Kumar, A., V.K. Mishra, R.P. Vyas and V. Singh, 2013. Heterosis and combining ability analysis in bread wheat Triticum aestivum L. Journal Plant Breed Crop Science, 3(10): 209-217.

Larik, A.S. and M. Hussain, 1990. Hetersis in Indian mustard Brassica Juncea L. Pakistan Journal of Botany, 22(2): 168-167.

Morojele, M.E. and M.T. Labuschagne, 2013. Heterotic performance of quality characteristics of bread wheat cultivars. African Journal of Crop Science, 21(4): 223-228.

Noorka, I., M. El-Bramawy, S. Tabasum and S. Ahmad-ur-Rahman, 2012. Consumptive use of water and genetical assessment of wheat genotypes to defy worrisome prevalence of water stress. Sarhad Journal of Agriculture, 28(4): 559-564.

Rad, M.R.N., M.A. Kadir, M.R. Yusop, H.Z. Jaafar and M. Danaee, 2012. Combining ability and inbreeding depression of physiological parameters in F. Journal of Food, Agriculture & Environment, 10(3&4): 875-878.

Sharma, S. and R. Sain, 2004. Genetics of grains per spike in durum wheat under normal and late planting conditions. Euphytica, 139(1): 1-7.Available at: https://doi.org/10.1007/s10681-004-2651-z.

Shehzad, T., I.H. Khalil, M.S. Swati and S.M.A. Shah, 2004. Heterosis for yield and related traits in spring wheat. AGRIS, 20(4): 537-542.

Singh, H., S. Sharma and R. Sain, 2004. Heterosis studies for yield and its components in bread wheat over environments. Hereditas, 141(2): 106-114.Available at: https://doi.org/10.1111/j.1601-5223.2004.01728.x.

Singh, L., P. Singh, D. Ram, B. Singh and J. Kumar, 2008. Heterosis and inbreeding depression for yield components and quality parameters in wheat Triticum aestivum L. Journal Progressive Research, 3(2): 157-159.Available at: https://doi.org/10.2478/s11535-007-0050-x.

Singh, M., P. Sharma, B. Tyagi and G. Singh, 2013. Heterosis for yield component traits and protein content in bread wheat under normal and heat-stress environment. Cereal Research Communications, 42(1): 151-162.Available at: https://doi.org/10.1556/crc.2013.0036.

Table-4. Percentage increase (+) or decrease (-) over mid parent and better parent of F_1 hybrids for the traits grains/spike, grain yield/plant and seed index (1000 seed weight).

F1 hybrids	Grains/spike		Grain yield/plant		Seed index	
	MP	BP	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	7.57	5.18
Maxipak × Soghat	36.72	21.58	87.22	86.80	23.79	12.69
Moomal × Anmol-91	29.77	12.02	86.87	54.57	0.65	-6.71
Marvi × Sassui	4.18	3.04	17.10	2.12	-4.60	-11.69
Mehran × Sassui	33.12	31.81	33.64	15.22	-11.90	-15.12

M.Sc thesis submitted to deptt. PBG, SAU Tandojam.