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RESEARCH ARTICLE

Genetic variability, heritability and genetic advance in *Triticum aestivum*

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SUMMARY

The present investigation was carried out to study gene action, heterosis, correlations, variance, genetic advance, heritability using diallel mating design at Research farm, Department of Agriculture, Mata Gujri college, Fatehgarh sahib during *rabi,* 2016-17 and 2017-18. The experiment was carried out in Randomized Block Design and observations were recorded on fifteen characters. The best heterotic cross for grain yield per plant was Kalyan Sona × WH-1080 followed by PDW-215 × CPAN-1796, Kalyan Sona× CPAN-1796, DBW-90 × PDW-215, DBW-90 ×WH-1080 and Kalyan Sona × DBW-90. Results revealed that grains per plant showed highly significant and positive genotypic correlations with days to booting, days to heading, spike length, plant height, harvest index and peduncle length. The experimental materials for the present investigation consisted of five lines *viz.,* Kalyan sona , WH-1080, PDW-215, DBW-90 and CPAN-1796 and one check *viz.,* PBW-725.

Key Words : Diallel, Heterosis, Harvest index, Variance

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Wheat (*Triticum aestivum* L.) is the most widely cultivated crop among the cereals and is the principal food crop in most areas of the world.

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Triticum aestivum (bread wheat) belongs to the family Poaceae. It is an autogamous allo-hexaploid species (2n = 6x = 42) and three genomes, designated as A, B and D (AABBDD), were involved in its evolution. It combines the genomes of three diploid ancestrals, *Triticum urartu* (2n = 14, AA), *Aegilops squarrosa* (2n = 14, DD) and *Aegilops* species (2n = 14, BB). *Durum*, the only tetraploid form of wheat widely used today, and the second most widely cultivated wheat; *monococcum*, a diploid species with wild and cultivated variants; *dicoccum*, a tetraploid species, cultivated in ancient times but no longer has widespread use; *spelta*, another hexaploid species, which is cultivated in limited quantities.

One of the hybrid variety of wheat *i.e* (Emmer wheat) are grown commercially in India, covering 86, 12, and 2 per cent of the total area under wheat, respectively (Ukani *et al.,* 2005). Wheat is one of the most important and widely cultivated crops in the world, used mainly for human consumption and support nearly 35% of the world population (Mohammadi-joo, 2015) and providing 20% of the total food calories.

It has been emphasized that heritability alone is not enough to make sufficient improvement through selection generally in advance generations unless accompanied by substantial amount of genetic advance. The utility of heritability, therefore, increases when it is used to calculate genetic advance, which indicates the degree of gain in a character obtained under a particular selection pressure. Thus, genetic advance is yet another important selection parameter that aids breeder in a selection programme.

Wheat is an important cereal of the world and staple food in india. It plays a remarkable role in meeting the food requirements of the country. A feasible strategy to achieve quantum jump in the yield of wheat is the commercial production of hybrid varieties. The exploration of heterosis in wheat can be accomplished through the vigorous parental line and their subsequent evaluation for combing ability in cross combination to identify hybrid with high heterotic effect. For this purpose, the basic knowledge of genetic architecture of yield and yield components and nature of gene action is require. The area under wheat cultivation in world during 2016-17 was 221.56 million hectare, production 750.4 million metric tons and grain yield 3.39 metric tons per hectare (United States Developmental Agriculture, 2017). In India during 2017-18, wheat is grown on 31.86 million hectares with an average production of 95 million tons and average yield of 3.0 metric ton per hectare (Ministry of Agriculture, FAO, 2018). Ministry of India has second position in both area and production after China (Jaiswal *et al.,* 2017).

Among various genetic techniques, combining ability analysis developed by Kempthorne provide important information for selection of parents's in terms of the performance of their hybrids. Further it is the nature and magnitude of various types of gene action involved in the expretion quantitative characters .The combining ability has been defined that high general combining abilty effects were due to additive type of gene action, were as high specific combining ability indicated non additive effects. There for the present studies conductive to access the relative of magnitude of general combining ability and specific combining ability to select the best combiner for successful wheat hybridation. Hybrid breeding in durum wheat (*Triticum durum* L.) is a promising avenue to appreciably enhance its yield potential and stability.

The commercial exploitation of heterosis in wheat has limited applications of practical difficulties in hybrid seed production. The nature and magnitude of heterosis will also helpful in identifying the superior cross combinations that may produce transgressive segregants in advanced generations. The study of heterosis has a direct bearing on the breeding metaodology to be employed for varietal improvement and also provides useful information about usefulness of the parents in breeding programs. Hybrid technology in crop plants, especially cross-pollinated crops is successfully used for enhanced production.

MATERIAL AND METHODS

The present study was conducted at the Agriculture Research Farm, Mata Gujri College, Fatehgarh Sahib (Punjab). This place is situated 13 km away from the Sri Fatehgarh Sahib. It is situated at latitude 30^0 56' N and longitude 76^0 40' E and at a height of 255 meters above mean sea level.

The experiment was conducted during winter 2016-17 and 2017-18 at Experimental Farm of Department of Agriculture Mata Gujri College, (Fatehgarh Sahib).

First year (2016-17) winter season:

– Five elite lines of wheat raised in the field with three replications in RBD and for producing F_1 make with diallel design.

– A total of 10 crosses were made. Individual plant of parents were selfed to maintain pure seed.

– F_1 seeds were collected separately for further evaluation.

Second year (2017-18) winter season:

– F_1s with five parents and one check was raised with three replications in RBD and population size was 10 plants per treatment with standard spacing.

– Data was recorded on yield characteristics.

– Parents, F_1 and F_2 seed was collected separately

Detail of experimental materials			
Sr.No.	Genotype	Description	Source
1.	Kalyan Sona	Timely sown	I.I.W.BKarnal
2.	DBW-90	Late sown,	-do-
3.	WH-1080	Timely sown,	-do-
4.	PDW-215	Timely sown;	-do-
5.	CPAN-1796	Timely sown,	-do-
6.	PBW-725	Check	Market

for further evaluation.

The experiment consisting 10 crosses of wheat along with five their parents and one check varieties were seeds sown in randomized complete block design with three replications in fully irrigated condition on 19 November, 2017. Each genotype was grown in double row, with row to row 22.5 centimeter with appropriate plant to plant distance of 5-6 centimeter in each replication. The recommended packages of practices were adopted for optimum crop growth. The fertilizer was applied at the dose of 120:60:40 kg NPK/ha.

Heterosis:

Heterosis was calculated over superior parent (heterobeltiosis) and over the standard variety, *i.e.*, check (economic heterosis), following the method described by Kempthorne (1957) Heterosis over superior parent

$$= \frac{\overline{F_1} - \overline{SP}}{\overline{F_1}} x100$$

Heterosis over standard variety (check) $= \overline{F_1} - \overline{SV}$

where,

$\overline{F_1}$ = Mean value of the F_1 generation;

$\overline{SP}$ = Mean value of the superior parent;

$\overline{SV}$ = Mean value of the standard variety (check).

Percentage heterosis over the superior parent and over the standard variety was calculated, as given below:

Percentage heterosis over superior parent

$$= \frac{\overline{F_1} - \overline{SP}}{\overline{SP}} x100$$

Percentage heterosis over standard variety

$$= \frac{\overline{F_1} - \overline{SV}}{\overline{SV}} x100$$

Test of significance of heterosis:

The test of significance of heterosis was accomplished by the 't' test, as given below :

$$t = \frac{\overline{F_1} - \overline{SP}}{\text{S.E. of heterosis over superior parent}}$$

where, $\text{S.E. of heterosis over superior parent} = \sqrt{S_1^2 \left(\frac{1}{r} + \frac{1}{r}\right)}$

s_1^2 = Error variance obtained by using F_1s and parents together

r = Number of replications.

The calculated 't' value was compared with table value of 't' at error degrees of freedom at P = 0.05 and P = 0.01. The difference of two estimates was tested against C.D.

C.D. = S.E. difference × t 5% at error d.f.

Here, $\text{S.E. difference will be} = \sqrt{\left(\frac{S_1^2}{r} + \frac{3}{2}\right)}$

where, s_1^2 = Error variance obtained by using F_1s and parents together;

r = Number of replications.

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences for all the fifteen traits studied. Variance due to genotype was highly significant for all the fifteen traits indicating the presence of sufficient variability in the genotypes selected for this study. High magnitude of variability has been reported in bread wheat and varieties for various characters by many workers for grain yield per plant and biological yield per plant. The reason for high magnitude of variability in the present study may be due to the fact that the genotypes selected were developed in different breeding programmes representing different agro-climatic conditions of the country. It was evident

Table 1: Promising hybrid combinations based on *per se* performance, heterobeltosis, economic heterosis

Sr. No.	Three top ranking bread wheat hybrids combination on the basis of *per se* performance	*Per se* performance	Heterobeltiosis (%)	Economic heterosis (Standard check)
1.	Kalyan sona×WH-1080	32.34	65.65	47.69
2.	WH-1080×CPAN-1796	37.20	62.88	69.87
3.	Kalyan sona×CPAN-1796	33.42	56.85	63.59

from the result that the phenotypic variance is greater than genotypic variance indicating the influence of environment on the expression of the trait (Ismail, 2015 ; Thomas, 2017 and Rajput and Kandalkar, 2018).

Among the yield attributes maximum PCV and GCV was depicted by grain yield per plant (26.27 and 23.81) followed by number of grains per plant (23.88 and 21.99), number of productive tiller per plant (22.57 and 20.64), harvest index (21.21 and 18.92), spike length (14.12 and 10.68), plant height (12.08 and 11.42), biological yield per plant (12.01 and 11.56), peduncle length (10.80 and 9.33), test weight (10.05 and 8.42), number of grains per spike (9.46 and 9.27), number of spikelets per spike (7.63 and 5.07), days to maturity (6.30 and 5.99), days to anthesis (4.43 and 3.73), days to heading (4.38 and 3.59) and days to booting (4.30 and 3.24), respectively. The high values of PCV and GCV indicating that selection may be effective on these traits. The lowest value for PCV and GCV was indicating less scope of selection as they are under less influence of environment. Wide difference between PCV and GCV was observed for grain yield per plant and harvest index which may indicate the high contribution of environmental variance to the phenotypic variance.

The highest heritability was recorded on number of grains per spike (0.96%) with genetic advance and expected genetic advance over percentage of mean (12.10% and 18.71%), followed by biological yield per plant (0.93%) with genetic advance and an expected genetic advance over percentage of mean (13.22% and 22.93%) followed by days to maturity (0.90%) with genetic and an expected genetic advance over percentage of mean (14.67% and 11.47%), plant height (0.89%) with genetic advance and an expected genetic advance over percentage of mean (19.54% and 22.24%), number of grains per plant (0.85%) with genetic advance and an expected genetic advance over percentage of mean (267.13% and 41.72%), number of productive tillers per plant (0.84%) with genetic advance and an expected genetic advance over percentage of mean (3.88% and 38.89%), grain yield per plant (0.82%) with genetic advance and an expected genetic advance over percentage of mean of (12.11% and 44.44%), harvest index (0.80%) with genetic advance and an expected genetic advance over percentage of mean (15.48% and 34.78%), peduncle length (0.75%) with genetic advance and an expected genetic advance over percentage of mean (5.14 and 16.61%), days to anthesis (0.71%) with genetic advance and an expected genetic advance over percentage of mean (0.6.47% and 6.48%), test weight (0.70%) with genetic advance and an expected genetic advance over percentage of mean (6.20% and 14.52%), days to heading (0.67%) with genetic advance and an expected genetic advance over percentage of mean (5.61% and 6.05%), days to booting and plant height (0.57%) and with genetic advance and an expected genetic advance over percentage of mean (5.14% and 16.61%, 4.39% and 5.03%) and number of spikelets per spike (0.44) with genetic advance and an expected genetic advance over percentage of mean (1.39% and 6.93%), respectively.

The commercial exploitation of heterosis in bread wheat would help in determination of the parents which produce the best cross combinations having the maximum heterosis. Both positive and negative heterosis is useful depending on the breeding objectives. Generally, positive heterosis is desired in the selection for yield and its components, where as negative heterosis is desired for early cycling and low plant height. Additive and non-additive effects have been reported for grain yield and its associated components in bread wheat in studies throughout the world. In any crop improvement programme the foremost objective is to develop commercially successful high yielding varieties over existing extent or local types. It can be manifested by certain specific gene combinations and how rapidly these gene combinations can be obtained in single cross variety, much depends on the system into which the genes are available for improvement, coupled with introgression and selection of favorable plant type, limited to utilization of fixable gene effect only Moreover, modifications in the genetic make-up of crops may be quite rewarding in the future as well (Shrief *et al.,* 2017 and Lal *et al.,* 2013). It is beneficial in young plants as with ageing , all the contents decreases. primary metabolites ofcommercial importance and result in great interest in plant pharmaceuticals and its decrease with ageing after 18 months interval and effect of biochemical factors in loss of viability can be seen through TTC test (Singh and Sharma, 2016) .

The major objectives of any crop improvement programme is to develop a variety which has high yield potential, resistant against prevalent pest and diseases, of desired duration and having good grain quality. Yield is the ultimate result of interaction between genetic and environmental factors and is polygenic in nature.

Conclusion:

On the basis of *per se* performance and estimates of heterosis, the crosses Kalyan Sona × WH-1080 was found most promising followed by WH-1080 × CPAN-1796 and Kalyan Sona × CPAN-1796 for grain yield per plant, hence, could be evaluated further to exploit the heterosis or utilized in future breeding programme to obtain desirable segregants for the development of superior genotypes.

High heritability estimates in broad sense along with high genetic advance as percent of mean was observed for number of grains per spike, biological yield per plant, days to maturity, plant height, number of grains per plant, number of productive tillers per plant, grain yield per plant, harvest index, peduncle length, days to anthesis, test weight, days to heading, days to booting and number of spikelets per spike. Hence, these traits were found under the control of additive genetic variance and direct selection would be beneficial.

REFERENCES

Ismail, K.A.S. (2015). Heterosis and combining ability analysis for yield and its components in bread wheat (*Triticum aestivum* L.). *International Journal of Curring Microbiology & Applied Sciences*, **4**(8):1-9.

Jaiswal, B., Prasad, S., Dwivedi, R., Singh, S., Rani, R., Shrivastava, S., Kumar, A. and Yadav, R.K. (2017). Study of yield and yield components of wheat (*Triticum aestivum* L.) genotypes at grain filling stage under heat regimes. *International Journal of Pure Applied Biosciences* , **5** (4) : 331- 340.

Lal, C., Kumar, V. and Maloo, S.R. (2013). Heterosis and inbreeding depression for some quantitative and heat tolerance characters in bread wheat (*Triticum aestivum* L.). *Journal of Wheat Research*, **5**(2): 52-55.

Mohammadi-joo, S., Mirasi, A., Saeidi-aboeshaghi, R. and Amiri, M. (2015). Evaluation of bread wheat (*Triticum aestivum* L.) genotypes based on resistance indices under field conditions. *International Journal of Biological Sciences* , **6** (2) : 331-337.

Rajput, R.S. and Kandalkar, V.S. (2018). Combining ability and heterosis for grain yield and its attributing traits in bread wheat (*Triticum aestivum* L.). *Journal of Pharmacognosy & Phytochemistry,* **7** (2): 113-119.

Shrief, A.E., Kandil, A.A. and Gomaa, H.S.M. (2017). Estimation of general and specific combining ability in bread wheat (*Triticum aestivum* L.). *International Journal of Agronomy & Agricultural Research,* **12** : 37-44.

Singh, Geetika and Sharma, Richa M.L. (2016). Effect of prolonged storage on the biochemical constituents of primary metabolites in three species of bamboo seeds, *Int. J. Pharm. Sci. Rev. Res.,* **39**(1) : 248-250.

Thomas, N., Marker, S., Lal, G.M. and Dayal, A. (2017). Study of heterosis for grain yield and its components in wheat (*Triticum aestivum*) over normal and heat stress condition. *Journal of Pharmacognosy and Phytochemistry,* **6** (4): 824- 830.

Ukani, J.D., Patel, J.B., Dabhi, K.H. and Ribadia, K.H. (2005). Development of identification keys on the basis of plant morphological character in wheat. *AGRES-An International e-Journal,* **l4** (3): 290- 300.

WEBLIOGRAPHY

United States Developmental Agriculture (2017). *https://www.usda.gov.*

Ministry of Agriculture, FAO (2018). *http://faostat.fao.org.*