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Research Article

Estimation of combining ability for yield and its components traits in bread wheat (*Triticum aestivum* L.) by using half diallel analysis

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Abstract

Ten genotypes of bread wheat (*Triticum aestivum* L.) were used and their 45 $F_{1's}$ from half diallel cross, and they were planted at the Agricultural Research farm ITM University, Moradabad using randomized block design with three replicates in order to study the combining ability. Significant differences were observed among the treatment (parents and their 45 $F_{1's)}$ revealing that existence of variability for all the traits. The present study revealed that mean squares due to (GCA) and (SCA) were significant for all the traits, indicating the importance of additive and non- additive gene effects in the inheritance o traits. However, the ratio of σ2 gca/ σ2 sca was recorded below unity showed in the traits for days to blooming, plant height and spike length indicating the preponderance of non-additive type of gene actions for all these characters and reaming traits were showed high gca /sca ratio. The parents who were good general combiner for grain yield per plant were also good general combiners for some of its yield contributing traits. HD-2967 for yield, 1000 grain weight and days to maturity, PBW-154, K-9107, SUPER-111, RAJ-3765, UP-2338, K-7903 and PBW-502 were the good general combiners, it was interesting to note that K-7903 exhibited superior performance for grain yield per plan, whereas crosses HD-2967 × DPW-621-50, PBW-343× K-9107, PBW-343× PBW-154, and PBW-343 × PBW-502 were found to be best specific combiners for grain yield per plant and some of the yield contributing traits were considered to be most promising for further exploitation in breeding programs.

Key words: General combining ability, specific combing ability, wheat

1. Introduction

Bread wheat (*Triticum aestivum* L..,2n=6x=42, AABBDD)) is an important grain crop contributing 20% of the caloric intake of the global population, Upadhyay, (2020) and Grote *et al.* (2021). Because of decreases of the frequency and amount o precipitation, drought induced yield losses are projected to increase annually at a rate of 3% for wheat. It is widely cultivated due to its remarkable adaptation to a wide range of environment. Estimation of combining ability effects and the extent of variance components reveal the magnitude of additive and non- additive gene action, (Fasahat *et al.* 2016; Kumar & Bains 2013; Mohammadi *et al.* 2021). In hybrid breeding, additive, dominance and epistatic interaction of non – allelic genes influence maximum heterosis (Whitford *et al.*, 2013). On the other hand, additive gene effects are more important in line breeding with minimal contribution from non-additive gene effects, which are lost during segregation in early generations, Adhikari *et al.* (2020). Plant breeder seek to enhancement production and productivity of wheat crop using many ways, including as cross- pollination between genetically distinct structure to create genetic variety, in order to obtain novel genotypes with high productivity and desirable traits. Due to the fact that wheat plants have two sets of chromosomes, substantial genetic variants can develop through cross breeding, making it possible to select for superior genotypes in isolated generations.

To choose the suitable breeding method in the breeding program, it is essential to identify the genetic bases that control the characteristics for which selection is required, including the components of phenotypic variation and the amount of them inherited in the next generation. This is done by estimating the effects and variance of the general combining ability (GCA) and specific combining ability (SCA). If the GCA is greater than the SCA, this is an indicator of the possibility of selection in the early generation for superior genotypes and this continuation of this in subsequent generation. In an effective breeding program a better understanding of the genetic basis of yield and its contributing characters, general combining ability (GCA), specific combining ability (SCA) and the action of genes in the breeding material is very important. For these purpose, the combining ability analysis is an efficient tool to discriminate good as well as poor combiners for selecting appropriate parental materials for desirable traits in the wheat improvement programme. The combining ability is a powerful tool to discriminate good as well as poor combiners for choosing appropriate parental materials for a particular character in the plant breeding programme. At the same time, it also provides information about the nature of gene action involved in the inheritance of grain yield and its component characters. In a systematic breeding programme, selection of parents with desirable characteristics having good general combining ability effects for grain yield and its components and high estimates of specific combining ability effects are essential. The yield ceiling in the Wheat can be brokenly developing high yielding varieties/ hybrids through hybridization, which reshuffles the genes from suitable diverse parents. Genetic analysis of wheat yield improvement had shown that grain yield is determined by component traits, and is a highly complex character. The analysis showed that genes for yield *per se* performance do not exist (Grafius, 1959). Diallel analysis can aid in partitioning the general combining ability (GCA) and specific combining ability (SCA) effects. It also reveals the magnitude of maternal effects that will be useful in the breeding of wheat. Knowledge about combining ability is important in selecting suitable parents for hybridization, understanding of inheritance of quantitative traits and also in identifying the promising crosses, further use in breeding programmes. The aim of the research is to evaluation the performance of the parents and their F_1 hybrids to determine general and specific combining ability for grain yield and its contributing traits in bread wheat from 10 × 10 using half diallel mating design.

2. Materials and Methods

The genetic materials for present investigation comprised of ten bread wheat varieties viz. HD – 2967, PBW – 343, DPW -621-50, PBW -154, K -9107, SUPER 111, RAJ -3765, UP -2338, K -7903, PBW -502 and 45 hybrids generated by crossing the above varieties in all possible combination excluding reciprocals were evaluated in Randomized Block Design with three replications and the experiment was conducted in 2018-19 to 2019-20 at the agriculture research farm, School of Agricultural Sciences and Engineering, IFTM University, Lodhipur Rajput, Moradabad (U.P.). Each parent and their $F_{1's}$ was grown in single row of 5 m length with row to row and plant to plant distance of 22.5×10 cm respectively. Recommended cultural practices were adopted in order to raise a healthy crop. Observation were recorded on ten randomly selected competitive plants of each parent and 20 plants their $F_{1's}$ in every replication for following traits *viz.,* Days to earhead emergence, Days to blooming, Days to maturity, Plant height (cm), Number of effective tillers per plant, Spike length (cm), Number of spikelet's per spike, Number of grains per spike, Grain yield per plant, 1000 grain weight (gm), Days to 50% Heading and yield (q/ha). The mean of each plot used for statistical analysis. The data were first subjected to the design for individual environments suggested by Panse and Sukhantme, (1985). The combining ability analysis was done following method II model I of Griffing, (1956).

3. Results and Discussion

3.1. Analysis of variance for combing ability

Study of combining ability analysis provides useful information about the nature and magnitude of gene action and selection of suitable parents and specific cross combinations to prepare an effective breeding programme and to utilize them in further breeding programme for the improvement of yield potential of a crop. Combining ability give the information about genetic value of parental line to produce superior hybrid. The general combining ability give the information about additive and additive x additive gene action, whereas specific combining ability about the non-allelic interaction and dominance gene action.

Significant differences were observed among the treatments (parents and their F_1s) revealing that existence of variability for all the traits. Analysis of variance for combining ability effects were presented in (Table 1) revealed that mean squares due to GCA as well as SCA were significant for all the traits, indicating the importance of both additive and non-additive gene effects in the inheritance of characters. However, the ratio of σ2 gca/σ2 sca was recorded below unity showed in the traits for days to blooming, plant height and spike length indicating the preponderance of non-additive type of gene actions for all these characters and reaming traits were showed high gca /sca ratio. Similar results were earlier reported by Kumar *et al.* (2011) and Singh *et al.* (2010). However the mean square for (GCA) was significant, the non- additive component may be predominant for all the characters. Both GCA (σ2g) and SCA (σ2s) variance data analysis revealed many important ideas about additive as well as non- additive about various characters under study. The (GCA) variance appears if there is difference in (GCA) effects of parents whereas in case of (SCA) variance arises from differences in (SCA) effects of crosses. Here, the value of (GCA) variance represents the variance of the breeding value which means additive genetic variance (σ2a). But non-additive genetic variance (σ2d) is due to (SCA) variance which is mainly dominance variance. The relative importance of additive or non0n additive genetic variance is assist by information give by variance of (GCA) and (SCA). Both additive and non-additive genetic variance is of equal importance value is equal to unity. Here, both genetic variances play important role in an expression of gen. The results were also similar by Kumar *et al.*, (2015), Arya *et al.,* (2017), Kohli (2019) and Khan (2019).

3.2. General combining ability (GCA) effect

The information regarding general combining ability effects of the parents is of prime importance because it helps in successful prediction of genetic potentiality which would give desirable individuals in subsequent segregating population. The magnitude and direction of combining ability effects provides the guidelines for the utilization of parents in any breeding programme. Based on significant (GCA) effects in desirable direction, we selected a number of good general combiners out of 10 parents for a single character (Table 2).

The estimates of (GCA) effects for grain yield per plant parameters and other contributing traits are presented in (Table 2). The parent classified as good, average and poor combiners on the basis of estimates of combining ability effects for various characters. It was observed that none of the parents was good general combiner for all the characters. In general it is evident from the (Table 2) that the parents who were good general combiner for grain yield per plant were also good general combiners for some of its yield contributing traits. HD-2967 for yield, 1000 grain weight and days to maturity, PBW-154, K-9107, SUPER-111, RAJ-3765, UP-2338, K-7903 and PBW-502 were also good general combiners for grain yield per plant in future breeding program would be more useful for augmenting genes for high grain yield in bread wheat, as they are found to be good general combiners for grain yield per plant and some of the important yield components. It was interesting to note that K-7903 exhibited superior performance for grain yield per plant. Best parent having desirable (GCA) effects for grain yield per plant are presented in table 2. It was revealed that the (GCA) effects and *per se* performance were positively correlated in most of the best parent. Though, such pattern was not prevailed in all the cases. Perusal of table 12 revealed that the parents, who showed desirable, (GCA) effects for grain yield per plant, also exhibited desirable (GCA) effects for one or more yield attributing traits. The parents HD-2967 for yield, 1000 grain weight and days to maturity, PBW-154, K-9107, SUPER-111, raj-3765, up-2338, k-7903 AND PBW-502 emerged as good general combiners for grain yield and some associated traits. Earlier reported by, Gothwal (2006), Kumar *et al.,* (2011), Rajora (1999), Kumar *et al.*, (2015), Kumar *et al.*, (2019a, 2019b) and Singh and Chaudhary (2008) provided similar information on combining ability in wheat. In all such cases where (GCA) effects was more pronounced for particular gene action, so these genotypes should be involved in crosses to improve the specific traits in future breeding program. The data on (GCA) effects of different

Table 1: Analysis of variance of combining ability parents and their F_1 generation of Wheat

Source of Variation	df	Mean sum of square											
		DEE	DB	DM	PH	NETP	SL	SPS	NGPS	GYPP	TGW	DFH	YD
GCA	9	62.19**	73.39**	1,676.02**	196.26**	840.52**	3.12**	28.19**	2,022.04**	116,078.65**	137,320.52**	2,485.88**	2,535.36**
SCA	45	23.12**	118.56**	279.57**	267.90**	335.02**	3.64**	2.92**	218.07**	33,722.16**	37,567.62**	497.047**	476.38**
Error	108	38.06	44.62	37.75	86.64	48.57	1.23	2.16	52.03	995.69	930.95	46.609	63.54
gca/sca ratio		2.69	0.62	5.99	0.73	2.51	0.86	9.65	9.27	3.44	3.66	5.00	5.32

* and ** significant at 5% and 1% level, respectively.

Table 2: Estimates of GCA effects for grain yield per plant and other contributing traits in Wheat.

Genotypes	DEE	DB	DM	PH	NETP	SL	SPS	NGPS	GYPP	TGW	DFH	YD
HD – 2967	-3.29	3.829**	-19.297**	0.594	13.692**	0.35**	-2.11**	-19.574**	-152.884**	166.053**	-22.158**	22.425**
PBW – 343	-0.856	-0.181	1.048	-6.02	-0.407	-0.426**	-0.86	-4.485**	-13.604**	18.22**	-1.929	1.697*
DPW-621-50	0.015	-0.951	1.437	-0.637	-1.936**	-0.31	-0.236	-1.67*	-20.723**	20.634**	-2.689	2.881**
PBW -154	0.393	0.285	3.465	2.761*	-1.199	0.433**	0.889**	4.643*	28.192**	-29.963**	0.255	-1.63
K -9107	0.571	-0.2	1.937	0.851	-1.555**	0.143	0.598**	4.743**	26.994**	-29.118**	3.931**	-3.432**
SUPER 111	-0.007	-0.929	2.632*	1.748	-1.758**	-0.129	0.364**	4.012**	27.644**	-29.099**	4.313**	-2.745**
RAJ -3765	0.425	-0.99	1.132	0.394	-1.567**	0.182	0.496**	3.558**	26.511**	-29.179**	5.237**	-3.649**
UP -2338	1.627	0.157	2.632*	0.092	-1.947**	-0.328**	0.207	3.603**	26.496**	-29.193**	5.246**	-3.895**
K -7903	0.371	-0.833	2.41	0.591	-1.817**	-0.04	0.227	2.193**	28.725**	-28.95**	4.154**	-4.985**
PBW -502	0.75	-0.187	2.604*	-0.375	-1.506	0.126	0.423**	2.977**	22.649**	-29.406**	3.641**	-6.669**
SE GCA	3.28	1.57	1.45	2.194	1.64	0.26	0.35	1.70	7.44	7.19	1.609	1.89
SE SCA	1.15	3.55	3.27	4.950	3.71	0.59	0.78	3.84	16.78	16.24	3.631	4.24
CD5%	6.00	2.87	2.65	4.02	3.00	0.48	0.64	3.11	13.62	13.16	2.94	3.46
σ^2gca	2.12	2.48	2.10	4.81	2.70	0.07	0.12	2.89	55.32	51.72	2.59	3.53
σ^2sca	10.76	12.62	10.68	24.51	13.74	0.35	0.61	14.72	281.61	263.30	13.18	17.97

Table 3: Estimates of SCA effects for grain yield per plant and other contributing traits in Wheat.

Hybrids	Characters											
	DEE	DB	DM	PH	NETP	SL	SPS	NGPS	GYPP	TGW	DFH	YD
HD – 2967 X PBW – 343	2.38	1.13	-6.87	13.66**	-1.77	2.10*	7.76**	3.08**	14.16**	5.49**	7.72**	15.25**
HD – 2967 X DPW -621-50	5.48*	2.60**	15.81**	18.43**	4.08**	4.83**	7.86**	7.10**	32.59**	7.64**	5.77**	35.12**
HD – 2967 X PBW -154	3.42*	-1.62	9.87**	-15.26**	-2.55*	-3.02**	5.14**	-4.43**	-20.34**	-7.89**	-6.09**	21.92**
HD – 2967 X K -9107	2.48	-1.17	7.15**	-13.81**	-1.85	-2.19*	-3.08**	-3.21**	-14.75**	-5.72**	-8.04**	-15.89**
HD – 2967 X SUPER 111	-1.89	-0.90	-5.45	-12.91**	-1.41	-1.67	-6.16**	-2.45	-11.24**	-4.36**	6.13**	-12.11**
HD – 2967 X RAJ -3765	-3.86	-1.83	-11.13**	-15.94**	-2.87*	-3.41**	7.58**	5.00**	22.96**	8.91**	6.52**	24.74**
HD – 2967 X UP -2338	1.68	-0.80	4.85	-12.58**	-1.25	-1.48	-5.47**	-2.18	-9.99**	-3.88*	-5.45**	-10.77**
HD – 2967 X K -7903	12.48*	-1.17	-7.15**	23.81**	-1.85	-2.19*	3.08**	-3.21**	-14.75**	-5.72**	-8.04**	-15.89**
HD – 2967 X PBW -502	2.59	-1.23	-7.47**	13.98**	-1.93	2.28*	4.44**	-3.36*	15.40**	5.98**	-8.40**	-16.60**
PBW – 343 X DPW -621-50	3.75	-1.78	10.82**	-25.77**	2.79**	3.31**	-2.22**	4.86**	22.30**	8.65**	-12.16**	-24.03**
PBW – 343 X PBW -154	-9.48**	-4.49**	17.35**	14.58**	-7.06**	8.36**	4.89**	-2.28	56.38**	-2.87	7.75**	60.76**
PBW – 343 X K -9107	12.25**	5.80**	15.34**	18.84**	9.12**	10.81**	3.92**	5.87**	72.86**	8.26**	9.73**	78.51**
PBW – 343 X SUPER 111	2.50	-1.18	-7.21	-13.85**	-1.86	-2.21*	8.15**	3.24**	-14.87**	-5.77**	-8.11**	-16.02**
PBW – 343 X RAJ -3765	-1.48	-0.70	-4.27	-12.28**	-1.10	-1.31	-4.82**	-1.92	8.80*	-3.41*	-4.80**	-9.49
PBW – 343 X UP -2338	-1.09	-0.52	-3.14	-11.68**	-0.81	-0.96	-3.55**	-1.41	-6.48	-2.51	-3.54*	-6.99
PBW – 343 X K -7903	-2.68	-1.27	7.73**	24.12**	-2.00	-2.36*	5.73**	-3.47**	-15.94**	-6.18**	8.69**	17.18**
PBW – 343 X PBW -502	-8.26**	-3.91**	23.83**	12.71**	-6.15**	-7.29**	6.91**	-1.70	49.13**	-9.06**	-6.79**	52.94**
DPW -621-50 X PBW -154	3.59	-1.70	-10.36**	-15.52**	2.67*	3.17**	-1.70	4.65**	-21.35**	-8.28**	-3.64*	-23.01**
DPW -621-50 X K -9107	-24.49**	-2.13**	12.95**	16.91**	3.34*	3.96**	4.63**	5.82**	26.70**	10.36**	14.56**	28.78**
DPW -621-50 X SUPER 111	-2.65	-1.26	-7.64**	-14.08**	-1.97	2.34*	-5.63**	-3.43**	-15.76**	-6.11**	-8.59**	-16.98**
DPW -621-50 X RAJ -3765	-2.40	-1.14	-6.92**	-23.69**	-1.79	-2.12*	6.82**	3.11**	-14.27**	-5.54**	-7.78**	-15.38**
DPW -621-50 X UP -2338	1.48	-0.70	4.27**	-12.28**	-1.10	-1.31	4.82**	-1.92	8.80*	-3.41*	-4.80**	-9.49

DPW -621-50 X K -7903	0.98	-0.46	-2.83	-11.51**	-0.73	-0.86	-3.19**	-1.27	-5.83	-2.26	-3.18*	-6.28
DPW -621-50 X PBW -502	5.38*	2.55**	15.52**	8.28**	-4.00**	4.75**	7.53**	6.97**	32.00**	-2.41	-7.45**	34.48**
PBW -154 X K -9107	2.58	1.22**	7.44**	-23.97**	-1.92	-2.28*	8.41**	-3.34**	15.34**	5.95**	8.37**	-16.54**
PBW -154 X SUPER 111	11.25**	-0.59	-3.61	-1.92	-0.93	-1.10	-4.07**	-1.62	-7.43*	-2.88	-4.05**	-8.01
PBW -154 X RAJ -3765	-1.73	-0.82	-4.99	-2.66	1.29	-1.53	-5.64**	-2.24	-10.29**	-3.99	-5.61**	-11.09**
PBW -154 X UP -2338	5.58*	2.64**	16.10**	8.58**	4.15**	4.92**	8.18**	7.23**	33.19**	5.87**	8.10**	35.76**
PBW -154 X K -7903	-3.48*	-1.65	10.04**	15.35**	2.59*	3.07**	6.34**	4.51**	20.70**	8.03**	11.29**	22.30**
PBW -154 X PBW -502	2.58	-1.22	-7.44**	13.97**	-1.92	-2.28*	8.41**	3.34**	15.34**	5.95**	8.37**	16.54**
K -9107 X SUPER 111	-5.50*	2.61**	15.87**	8.46**	4.09**	4.85**	7.92**	7.12**	32.71**	12.69**	7.84**	35.25**
K -9107 X RAJ -3765	-1.69	-0.80	-4.88	-12.60**	-1.26	-1.49	-5.51**	-2.19	-10.05**	-3.90*	-5.48**	-10.83*
K -9107 X UP -2338	12.89**	-1.37	-8.34**	14.45**	-2.15	-2.55*	-3.42**	-3.74**	-17.19**	-6.67**	-9.37**	-18.52**
K -9107 X K -7903	11.98**	-0.94	-5.71	-13.05**	-1.47	-1.75	6.45**	-2.56	-11.78**	-4.57**	-6.42**	12.69**
K -9107 X PBW -502	6.15*	2.91**	17.74**	19.46**	4.58**	5.43**	3.04**	7.97**	36.58**	4.19**	9.95**	39.41**
SUPER 111 X RAJ -3765	-4.26*	2.02**	-12.29**	16.55**	3.17*	3.76**	3.88**	-5.52**	-25.34**	9.83**	-3.82*	-27.30**
SUPER 111 X UP -2338	5.23*	2.48**	15.09**	18.04**	3.89**	4.61**	7.04**	6.77**	31.11**	5.07**	6.96**	33.52**
SUPER 111 X K -7903	-13.86**	-1.83	11.13**	-15.94**	-2.87*	-3.41**	-2.58*	-5.00**	-22.96**	-8.91**	-2.52	24.74**
SUPER 111 X PBW -502	-10.86**	-0.88	-5.37	-12.86**	-1.38	-1.64	6.06**	-2.41	-11.06**	-4.29**	-6.03**	-11.92**
RAJ -3765 X UP -2338	2.79	1.32	8.05**	14.29**	2.08*	2.46*	9.09**	3.61**	-16.59**	-6.44**	9.05**	-17.88**
RAJ -3765 X K -7903	5.64	2.67**	16.27**	18.68**	4.20**	4.98**	8.38**	7.31**	33.54**	-4.01**	-8.29**	-36.15**
RAJ -3765 X PBW -502	-7.21**	-3.42**	20.80**	-11.09**	5.37**	6.36**	-3.49*	9.34**	42.88**	6.64**	7.38**	46.21**
UP -2338 X K -7903	-2.35	-1.11	6.78**	13.61**	-1.75	-2.07*	7.66**	-3.04**	-13.98**	-5.42**	-7.62**	-15.06**
UP -2338 X PBW -502	1.59	-0.75	-4.59	-22.45**	-1.18	-1.40	-5.18**	-2.06	9.46**	3.67*	-5.16**	-10.19*
K -7903X PBW -502	14.45**	-2.11	12.84**	16.84**	3.31**	3.93**	14.50**	5.76**	26.47**	10.27**	14.43**	28.52**

DEE: Days to ear head emergence; DB: Days to blooming, DM: Days to maturity, PH: Plant height (cm), NETP: Number of effective tillers per plant, SL: Spike Length (cm), SPS: Number of spikelet's/spike, NGPS: Number of grains per spike; GYPP: Grain yield per plant (gm), TGW: 1000 grain weight (gm), DFH: Days to 50% heading, YD: Yield (q/ha) parents indicated that the effects varied significantly for different characters. Based on estimates of (GCA) effects for various characters these parents were found to be good general combiners had fixable component of variance like additive and additive × additive epitasis component. Therefore, these parents offer the best possibilities of exploitation for development of improved high yielding lines in wheat. It was further noted that involvement of these parents had resulted into hybrids expressing useful heterosis for various traits. The result in accordance with the result of Sharma *et al.,* (2019); Kumar *et al.,* (2019); Roy *et al.,* 2021: Kumar *et al.*, (2015) and Kumar *et al.,* (2017).

3.3. Specific combining ability (SCA) effect

The study of combining ability helps in selection of best combination and provides opportunity for use of these combinations in hybridization programs. General combing ability is a primarily function of additive gene action and additive × additive interaction whereas specific combining ability is due to non allelic gene inactions. In self- pollinated crops like wheat, (SCA) effects are not much important as they are mostly related to non-additive gene effects excepting those arising from complementary gene action or linkage effects they cannot be fixed in the pure line or the end product inbred line. Jinks and Jones (1958) emphasized that the superiority of the hybrids might not indicate their ability to yield transgressive segregants, rather SCA would provide satisfactory criteria. However, if a cross combination exhibited high (SCA) as well as high *per se* performance having at least one parent as good general combination for a specific traits. It is expected to throw desirable transgressive segregants in later generation (Kumar *et al.*, 2011).

The magnitude of (SCA) effects is of vital importance in selecting cross combination with higher probability of generating transgressive segregates. Significant grain yield per plant performance in the specific crosses was due to the involvement of best general combiners in our study. The desirable (SCA) effects are presented in (Table 3). The cross, HD-2967 × PBW-343, HD-2967 × DPW-621-50, HD-2967 × RAJ-3765, HD-2967 × PBW-502, PBW-343 × DPW-621-50, PBW-343× PBW-154, PBW-343× K-9107, PBW-343× RAJ-3765, PBW-343× PBW-502, DPW-621-50 × K-9107, DPW-621-50 × UP-2338, DPW-621-50 × PBW-502, PBW-154 × K-9107, PBW-154 × UP-2338, PBW-154 × K-7903, PBW-154 × PBW-502, k-9107 × SUPER-111, K-9107 × PBW-502, SUPER-111× UP-2338, RAJ-3765 × K-7901, RAJ-3765 × PBW-502, UP-2338 × PBW-502 and K-7903× PBW-502 showed positive desirable, significant for grain yield per plant in twenty two crosses out of forty five cross. As for the rest of the crosses, they showed significant in the undesirable direction or did not reach the statistical significant. The results agreed with (Akram *et al.*, 2011; Afridi *et al.*, 2017; Salam *et al.*, 2019; Kamboj *et al.,* 2020; Tariq *et al.*, 2023; Muhammad *et al.*, 2023; Sharma *et al.,* 2019; Roy *et al.*, 2021: Kumar *et al.,* 2015; Chaudhary *et al.*, 2022 and Kumar *et al.,* 2017; Patel, 2017; Kumar *et al.*, 2011; Singh *at al.*, 2013).

It is clear from above discussion, that on the basis of (SCA) effects and *per se* performance of these crosses, emerged as good specific cross combination for grain yield per plants. An overall appraisal revealed that the cross HD-2967 × DPW-621-50, PBW-343× K-9107, PBW-343× PBW-154, and PBW-343 × PBW-502 these crosses were the results of good × good, poor × poor and good × poor general combiners. These crosses hold great promise in improving the grain yield in future breeding programme of bread wheat The cross that have significant of effect of (SCA) and one of its parents had effects (GCA) significant will be using in heterosis breeding program. While the crosses that were not significant and at least one parents possessed a (GCA) significant can be used in breeding program to from distinct genotypes due to the absence of dominance in these crosses, and their parents possessed a desirable influence for the general combining ability.

Author Contributions

YPS prepared the manuscript and SK & SK helped in preparing the final version of the manuscript and correspond to the journal.

Ethical Approval

This article does not contain any studies involving human or animal participants performed by any of the authors.

Conflicts of Interest:

The authors declare no conflict of interest.

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