

Original Research Article

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## Heterosis and Combining Ability for Grain Yield and Yield Associated Traits in 10 X 10 Diallel Analysis in Pea (*Pisum sativum* L.)

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### ABSTRACT

#### Keywords

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Combining ability and heterosis studies for yield and quality traits in pea were conducted at Lovely Professional University Phagwara, Punjab. Ten genotype including of half-diallel fashion during winter 2016 and forty-five hybrids along with Ten parents were evaluated in 2017. Significant means squares due to line, hybrids, half diallel, parents Vs hybrids observed for yield its contributing traits. The SCA/GCA variance ratio were less than unity for day taken to 75% flowering, plant length, seeds per pod, pod density, yield per plant, 100-seed weight, indicating predominance of additive gene effects for these character, therefore, it is suggested that selection in F<sub>1</sub> generation may be either following progeny or simple recurrent selection. Among male VRPE-32, Rachana, KSP-2, PB-01, Jyoti, were observed to be the best general combiner for yield and quality traits. ie. Pod per plant, day to maturity, yield per plant. Some crosses were observed superior for the SCA effects as well as for heterosis which includes Pearpolo-5\*Jyoti for primary branches, AP-3\*KSP-2 for pod density, PB-01\*KSP-2 for plant height. These observed can be further utilized to develop and enhance the yield potential of pea cultivars and breeding programme.

### Introduction

Pea (*Pisum sativum* L.) is an important legume grown as a garden and field crop throughout the temperate region of the world; it is also grown as a cool season crop. It ranks third in production among the grain legumes after soybeans and beans in the worlds. Pea is the valued primarily for the nutritional quality having high protein as 20-30%, vitamin A - 5%, beta carotene 4%., and sufficient carbohydrates. The growth and development of peas are determined by the interaction of genetic factors, the environment and agricultural practices (Acikgoz *et al.*, 2009). An improvement in yield of self-pollinated

crop like garden pea is effected of mainly through selection of genotypes with superior characters for variation. Through recombination followed by selection heterosis in F<sub>1</sub> generation as heterosis crosses may give a segregating and transgressive for economic traits in move forward generation. Breeding for superior varieties requires selection of parents capable of transmitting their desirable qualities. A rational approach for breeding is to select parents based on their combining ability rather than visual observations of their traits. The concept of combining ability analysis has significant practical importance

in plant breeding (Tyagi and Srivastava, 2001). Precious steps for operation of heterosis in any crop are to study the GCA of the parents and SCA of hybrid. Ability of parents to combine well depends on the complex interaction among genes and its cannot to be estimated by yield performance of the parents. There the knowledge of combining ability and nature(environment) of gene effects is necessary for the selection of best parents hybridization in order to improve the existing cultivars, Although some information on a additive and non-additive effects of associated with yield and yield contributing traits in garden pea is available but that relevant the specific region, genetics material involved and particular environment conditions. India is the second largest producer of vegetables, next only to China, in the world with a production of 40 million tonnes from four million hectares of land area. In spite of that, this seemingly high level of production can provide only 208 grams of vegetables per capita (Sharma, 2003), as against the suggested dietary intake of 275g and 250 g per capita per day for adult male and female, respectively for undertaking moderate work (Swaminathan, 2002). There for the presents investigated were carried out to obtain information regarding general and specific combining ability effects and finding of out heterosis combinations for yield and yields quality traits in garden pea.

### **Materials and Methods**

The presented investigation was carried out at the Department of Plant Breeding and Genetics Lovely Professional University Phagwara, Punjab, during 2016-17. The experiment materials consist of garden pea, ten genotype viz., Pearpolo-5, vrpe-32, vrpe-24, Jyoti, Rachana, KSP-2, l-116, Sonali-10, PB-01, AP-3, were selected as lines for half-diallel crosses. All the parents along with their 45 'F<sub>1</sub>' were grown in a random block

design with three replications. The distance between the parents was maintained at 18cm while the rows were spaced 25cm apart. The standard plant protection and others cultivars practices were followed to maintain uniform experiments conditions. The analysis of variance was done for all character as per method given by Hayman (1954). Heterosis was works out over better parents was (heterobeltiosis) and standard check (standard heterosis) by Kempthorne (1957). Quantitative data were collected on five plants in each plot. Days to 75% flowering plant height, number of primary branches, pods/plant, pod length (cm), pod density, number of seeds per pod, days to maturity, 100-seed and yield/plant were recorded. Regarding the statistical analysis data recorded on parents and the F<sub>1</sub> hybrids were analyzed together as suggested by Singh and Chaudhary (1979). The combining ability analysis was done by Kempthorne (1957), which statistical analysis was applied also give references.

### **Results and Discussion**

#### **Heterosis**

Heterosis is the superiority of F<sub>1</sub> over its parent. Heterosis was calculated in per cent over better parent on F<sub>1</sub> generation for all the 10 characters. Estimates of heterosis are presented in Table 8. Negative and significant values of heterosis were considered desirable for days to 75% flowering, plant height and days to maturity and on the other hand positive and significant values were considered desirable for other characters. The extent of heterosis over better parent for days to 75% flowering ranged from -2.03 to -16.43 per cent showing desirable heterosis for 44 hybrids (Table 5) out of 45 exhibited significant and desirable hybrids. Heterosis over better parent for plant height varied from -0.67 to -21.42 per cent showing desirable

heterosis for 37 hybrids. The primary branches per plant are associated with positively desirable and significant. Significant heterosis was observed in six hybrids out of 45 were, Pearpolo-5/Jyoti (88.30), L-116/Jyoti (80.89), Pearpolo-5/L-116(72.83), Jyoti/PB-01(45.35), AP-3/VRPE-24(39.80), VRPE-4 /Sonali-10(36.15), and the better parent heterosis as estimated for days to maturity was significant and negative for all the hybrids. The range of variation from -0.88 to -7.54 exhibiting desirable heterosis; out of these range 33 hybrids were desirable and significant. Some of these were Rachana/Jyoti (-7.54), VRPE-24/PB-01(-6.60), VRPE-32/PB-01, (-6.45), Rachana/PB-01, (-6.24). The heterosis over better parent for pod length were positively associated and ranged from -1.00 to 22.40. The highest value of heterosis were observed in AP-3/Rachana (22.42), KSP-2/Rachana (20.26), L-116/KSP-2(16.94), AP-3/KSP-2(16.70), Pearpolo-5/AP-3 (6.56) from the Table 8. It is clearly shown that the heterosis over better parent for Seeds per pod were ranged from -1.44 to 21.11 per cent exhibiting desirable and significant hybrid in eight cases. Heterosis over better parent for number of pod density ranged from -2.16 to 44.56 percent showing desirable and significant hybrids in fourteen cases. Out of these, high heterosis was observed in AP-3/KSP-2(44.56), Pearpolo-5/AP-3(34.76), AP-3 /Rachana (34.44), L-116/KSP-2(33.98), VRPE-32/L-116(28.25), VRPE-32/L-116 (28.25), Jyoti/KSP-2(26.21), Crosses. Heterosis over better parent for 100-seed weight ranged from -0.48 to 18.94 percent observed desirable and significant in twenty three cases. 100-seed weight was positively associated so highly significant and positively associated hybrids were VRPE-32/VRPE-24 (18.94), Pearpolo-5/AP-3 (17.09), Pearpolo-5/PB-01 (12.84), AP-3/Jyoti (11.79), VRPE-24/PB-01(11.76) and VRPE-24/Jyoti (10.36). Similar results were also reported by Alam *et al.*, (2008). Pods per

plant exhibited the heterosis ranged from -0.08 to 26.90 per cent. Significant and positive heterosis for Jyoti/Sonali-10(26.90), VRPE-24/PB-01(26.85), L-116/AP-3(25.910), AP 3/Jyoti (25.06), VRPE-32/AP-3(18.33). Heterosis over better parent for yield per plant ranged from -2.56 to 4.40 per cent. Similar results were reported by Mehmet *et al.*, (2008) for yield per plant. Likewise, similar finding had also reported by Ceyhan *et al.*, (2003) in pea and Motamedi *et al.*, (2014). Significant and positive heterosis for Pearpolo-5/Sonali-10(4.40), AP-3/Sonali-10 (4.49), VRPE-24/PB-01(2.56), were most considerable.

### **Means and variability in parents, F<sub>1</sub>S**

The mean values and range for all the traits in parents their F<sub>1</sub>s hybrids generation mentioned in Table 2. The mean performance of F<sub>1</sub> hybrids was higher than parents for number of primary branches /plant, pod length, pod per plant, pod density. Revealed maximum variation within parents for days to 75% flowering, plant height, days to maturity, but their magnitude varied from character to character. The variability among parents was fairly high for plant height (62.21-82.76), days to maturity (92-104), yield /plant (70.39-82.12) followed by pod per plant (50.12-58.97). The variation in F<sub>1</sub> progenies was maximum for plant height (60.40-75.87), followed by days to maturity (91.33-103.66), yield per plant (62.01-79.37), 100 –seed weight (11.43-15.77) pod density (0.82-1.26) primary branches per plant (2.46-5.30) Pod per plant (53.36-71.82) seed per pod (6.63-9.53) Pod length (6.83-9.34).

### **Combining ability analysis**

Analysis of variance for combining ability: The analysis of variance for combining ability was carried out for all the characters in F<sub>1</sub> generations and result are presented in Table

1. Griffings (1956b) presented a model to show that variance for gca involves additive and additive x additive gene action. The mean squares due to general combining ability (GCA) effects and specific combining ability (SCA) effect were found highly numbers for all the characters in F<sub>1</sub> generations. The magnitude of estimates of GCA variances were higher for days to 75% flowering, plant height, primary branches per plant, days to maturity, seeds per pod, pod density, pod per plant and yield per plant than the respective

estimates of SCA variances F<sub>1</sub> in generations. General predictability ratio did not reach near to unity for any of the traits in F<sub>1</sub> generations.

In the previous studies Singh *et al.*, (2010), Motamedi *et al.*, (2014) and Singh *et al.*, (2014) revealed that estimates of SCA variances were higher than GCA variances for all the traits studied, thus indicating predominance of non-additive gene action for these traits

**Table.1** ANOVA for combining ability and related statistics of 10 characters in a 10 parent Half-Diallel cross in F<sub>1</sub> generations of pea

Source of variation	d.f.	Days to 75% flowering	Plant Height (cm)	Primary Branches/ Plant	Pod Length (cm)	Seeds/ Pod
		F <sub>1</sub>	F <sub>1</sub>	F <sub>1</sub>	F <sub>1</sub>	F <sub>1</sub>
<b>GCA</b>	9	4.14	10.26	1.07	0.71	0.94
<b>SCA</b>	45	11.83	23.97	0.53	0.37	0.61
<b>Error</b>	108	0.92	0.02	0.00	0.00	0.01
$\sigma^2_g$		-0.64	-1.14	0.04	0.03	0.02
$\sigma^2_s$		10.90	23.95	0.52	0.36	0.59
<b>GPR</b>		-0.13	-0.10	0.14	0.14	0.08

**Table.1** Contd.

Source of variation	d.f.	Pod Density (cm)	Pods/ Plant	Days to Maturity	100 seed Weight (g)	Yield/ Plant G(kg)
		F <sub>1</sub>	F <sub>1</sub>	F <sub>1</sub>	F <sub>1</sub>	F <sub>1</sub>
<b>GCA</b>	9	0.01	56.65	13.36	1.59	21.42
<b>SCA</b>	45	0.02	26.67	8.94	1.51	22.26
<b>Error</b>	108	0.00	0.24	0.26	0.03	0.08
$\sigma^2_g$		-0.00	2.49	0.36	0.00	-0.06
$\sigma^2_s$		0.02	26.43	8.67	1.47	22.18
<b>GPR</b>		-0.03	0.15	0.07	0.00	-0.00

\* Significant at 5% level; \*\* significant at 1% level; GCA= general combining ability; SCA= specific combining ability;  $\sigma^2_g$  = estimates of gca variance;  $\sigma^2_s$  = estimates of sca variance; GPR =general predictability ratio

**Table.2** Estimates of GCA effects corresponding mean performance of the parents for 10 characters in a 10 parents Half-Diallel cross in F<sub>1</sub> generations of pea

Parents	Day to 75% Flowering		Plant Height (cm)		Primary Branches/ Plant		Pod Length (cm)		Seeds/ Pod	
	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean
	F <sub>1</sub>		F <sub>1</sub>		F <sub>1</sub>		F <sub>1</sub>		F <sub>1</sub>	
Pear Polo-5	-1.08***	72.33	-0.51***	71.46	0.26***	3.30	0.37***	8.52	0.15***	7.66
VRPE-32	-0.31	72.66	-1.07***	68.82	0.25***	4.30	0.13***	7.74	0.09**	8.53
L-116	0.63*	84.33	-1.23***	71.84	0.15***	2.83	0.26***	8.81	-0.23***	7.36
AP-3	0.41	79.66	0.23***	74.81	-0.01	3.46	-0.24***	6.74	-0.20***	8.73
Rachana	-0.61*	74.66	1.04***	82.76	-0.48***	3.26	-0.15***	7.23	0.35***	8.60
VRPE-24	0.43	80.33	0.58***	74.79	-0.11***	3.06	0.07**	9.26	0.13***	8.43
Jyoti	0.35	80.00	-0.98***	62.21	-0.53***	2.40	-0.22***	7.68	-0.25***	8.50
PB-01	-0.50	75.00	0.52***	81.57	0.13***	3.33	0.12***	8.86	0.41***	8.50
KSP-2	0.16	76.33	0.01	74.50	0.31***	4.53	-0.42***	6.77	-0.44***	7.90
Sonali-10	0.52	80.33	1.41***	82.27	0.02	4.03	0.08**	9.37	-0.02	6.70
Gi--Gj at 95%	0.89***		0.15***		0.05***		0.08***		0.11***	
Gi--Gj at 99%	1.27***		0.22***		0.08***		0.12***		0.17***	

**Table.2** Contd.

Parents	Pod Density (cm)		Pods/ Plant		Days to Maturity		Yield/ Plant G(kg)		100 seed Weight (g)	
	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean	GCA effect	Mean
	F <sub>1</sub>		F <sub>1</sub>		F <sub>1</sub>		F <sub>1</sub>		F <sub>1</sub>	
Pear Polo-5	0.02**	1.10	-3.06***	52.49	-0.93***	95.00	-0.31***	71.28	-0.32***	12.70
VRPE-32	0.00	0.90	-1.60***	56.45	-1.05***	97.66	-0.20*	75.82	-0.04	13.02
L-116	0.06***	1.19	-1.33***	50.12	0.58***	101.66	-1.63***	70.39	-0.05	14.89
AP-3	-0.01	0.76	-2.36***	47.75	-0.55***	94.66	0.30***	77.09	-0.36***	11.96
Rachana	-0.06***	0.84	-1.30***	54.65	2.31***	104.33	-1.78***	78.48	0.36***	15.74
VRPE-24	-0.02**	1.09	1.32***	56.77	-0.66***	98.00	-0.84***	72.67	-0.01	12.67
Jyoti	0.01*	0.90	2.90***	54.33	0.33*	103.33	0.27***	80.64	0.05	13.86
PB-01	-0.04***	1.04	2.02***	56.36	0.89	104.00	2.87***	82.12	-0.46***	11.73
KSP-2	0.00	0.85	2.51***	58.97	-0.10	97.66	0.44***	77.93	0.09	14.75
Sonali-10	0.02	1.40	0.89***	57.19	-0.82***	92.00	0.87***	73.90	0.77***	15.69
Gi--Gj at 95%	0.02***		0.45***		0.47***		0.26***		0.18***	
Gi--Gj at 99%	0.03***		0.65***		0.68***		0.38***		0.26***	

Significant at 5% level; \*\* significant at 1% level

**Table.3** Best general combiners on the basis of *per se* performance and GCA effect for 10 characters in a 10 parent Half-Diallel cross in pea

Characters	<i>Per se</i> performance	Gca		Common parent
		F <sub>1</sub>		
Day to 75% Flowering	Pearpolo-5, VRPE-32, Rachana, PB-01, KSP-2	Pearpolo-5, VRPE-32, Rachana, PB-01		Pearpolo-5, VRPE-32, Rachana, PB-01
Plant Height (cm)	Pearpolo-5, VRPE-32, L-116, Jyoti, KSP-2	L-116, VRPE-32, Pearpolo-5, Jyoti		-116, VRPE-32, Pearpolo-5, Jyoti
Primary Branches/ Plant	KSP-2, VRPE-32, Sonali-10, AP-3, PB-01	KSP-2, Pearpolo-5, VRPE-32, PB-01		KSP-2, VRPE-32, PB-01
Pod Length (cm)	Sonali-10, VRPE-32, PB-01, L-116, Pearpolo-5,	Pearpolo-5, L-116, VRPE-32, PB-01, Sonali-5		Pearpolo-5, L-116, VRPE-32, PB-01,
Seeds/ Pod	AP-3, Rachana, VRPE-32, Jyoti, PB-01	PB-01, Rachana, Pearpolo-5, VRPE-32		PB-01, Rachana
Pod Density (cm)	Sonali-10, Pearpolo-5, L-116, VRPE-32, PB-01,	L-116, Sonali-10, Peearpolo-5, Jyoti		L-116, Sonali-10, Peearpolo-5,
Pods/ Plant	KSP-2, Sonali-10, VRPE-32, VRPE-24, PB-01	Jyoti, KSP-2, PB-01, VRPE-24		KSP-2, PB-01, VRPE-24
Days to Maturity	Sonali-10, AP-3, Pearpolo-5, KSP-2	VRPE32, Pearpolo-5, Sonali-10, VRPE-24, KSP-2		VRPE32, Pearpolo-5, Sonali-10, VRPE-24,
Yield/ Plant G(kg)	PB-01, Jyoti, Rachana, AP-3, KSP-2	PB-01, KSP-2, Sonali-10, AP-3		PB-01, KSP-2, AP-3
100 seed Weight (g)	Rachana, Sonali-10, L-116, KSP-2, Jyoti	Rachana, Sonali-10, KSP-2, Jyoti		Sonali-10, KSP-2, Jyoti

**Table.4** Estimation of SCA and corresponding mean performance for 10 characters in a 10 parents half diallel cross in F<sub>1</sub> generations of pea

Cross combination	Days to 75% Flowering		Plant height (cm)		Primary branches/plant		Pod length (cm)		Seeds/pod	
	SCA	Mean	SCA	Mean	SCA	Mean	SCA	Mean	SCA	Mean
Pear Polo-5*VRPE-32	-0.39	70.33	-6.83**	61.23	0.12*	4.60	0.43***	9.12	0.18	8.43
Pear Polo-5*L-116	-0.67	71.00	-7.49**	60.41	0.92***	5.30	0.10	8.92	0.48***	8.40
Pear Polo-5*AP-3	1.88*	73.33	-0.58**	68.79	0.05	4.27	1.03***	9.34	-0.54***	7.40
Pear Polo-5*RACHANA	0.58	71.00	-0.84**	69.34	-0.33***	3.40	-0.28**	8.12	0.96***	9.47
Pear Polo-5*VRPE-24	-2.14	69.33	0.47**	70.19	0.02	4.13	-0.75***	7.87	1.24***	9.53
Pear Polo-5*JYOTI	-2.72**	68.67	3.52**	71.68	1.67***	5.37	0.12	8.46	-0.86***	7.03
Pear Polo-5*PB-01	-0.86	69.67	6.20**	75.87	-0.02	4.33	0.45***	9.13	-0.38**	8.20
Pear Polo-5*KSP-2	-0.86	70.33	1.51**	70.66	0.29***	4.83	-0.36***	7.77	-0.37**	7.33
Pear Polo-5*sonali-10	0.43	72.00	-1.63**	68.88	-0.34***	3.90	0.03	8.67	0.56***	8.70
VRPE-32*L-116	-0.44	72.00	6.40**	73.74	0.16**	4.53	0.44***	9.02	-1.16***	6.70
VRPE-32*AP-3	0.43	72.67	2.52**	71.34	0.53***	4.73	0.19*	8.25	0.50***	8.40
VRPE-32*RACHANA	0.46	71.67	-3.75**	65.87	-0.09	3.63	0.42***	8.58	-0.91***	7.53
VRPE-32*VRPE-24	0.41	72.67	-0.69**	68.47	0.43***	4.53	0.21*	8.60	0.13	8.37
VRPE-32*JYOTI	0.16	72.33	2.52**	70.12	-0.41***	3.27	-0.72***	7.37	0.09*	7.93
VRPE-32*PB-01	1.02	72.33	-4.47**	64.63	0.48***	4.83	0.46***	8.89	0.28	8.80
VRPE-32*KSP-2	-0.64	71.33	1.28**	69.88	-0.09	4.43	-0.03	7.85	-0.19**	7.47
VRPE-32*sonali-10	-3.33**	69.00	0.35**	70.34	-0.80***	3.43	-0.01	8.38	0.39***	8.47
L-116*AP-3	-3.17**	70.00	-1.20**	67.45	0.99***	5.10	-0.72***	7.47	-0.92***	6.63
L-116*RACHANA	-3.14**	69.00	-6.22**	63.24	-0.76***	2.87	0.16	8.46	1.01***	9.13
L-116*VRPE-24	-3.86***	69.33	2.43**	71.44	-0.23***	3.77	-0.39***	8.12	0.47	8.37
L-116*JYOTI	-4.44**	68.67	2.86**	70.29	1.15***	4.73	-0.59***	7.63	0.06	7.53
L-116*PB-01	-1.92*	70.33	0.45**	69.39	-0.41***	3.83	0.36***	8.93	0.12	8.30
L-116*KSP-2	-0.25	72.67	-4.57**	63.86	-0.16**	4.27	1.08***	9.11	-0.68***	6.63
L-116*sonali-10	-3.94**	69.33	-1.99**	67.83	1.19***	5.33	-0.67***	7.85	0.96***	8.70
AP-3*RACHANA	-0.58	71.33	1.70**	72.64	-0.66***	2.80	0.77***	8.55	-0.14	8.00
AP-3*VRPE-24	-3.97**	69.00	-4.65**	65.83	0.73***	4.57	-0.09	7.92	-1.32***	6.60
AP-3*JYOTI	-2.56**	70.33	-0.02	68.88	-0.24***	3.17	0.61***	8.33	0.12	7.67
AP-3*PB-01	-1.69	70.33	-6.67**	63.74	0.52***	4.60	-0.40***	7.65	0.85***	9.07
AP-3*KSP-2	-1.03	71.67	-0.53**	69.37	0.50***	4.77	0.37***	7.88	-0.65***	6.70
AP-3*sonali-10	-2.72**	70.33	0.07	71.37	-1.50***	2.47	0.11	8.12	-0.17	7.60
RACHANA*VRPE-24	-0.61	71.33	-5.73**	65.56	0.33***	3.70	0.22*	8.32	-0.11	8.37
RACHANA*JYOTI	-0.53	71.33	-0.26	69.45	-0.24***	2.70	-0.24**	7.56	-1.33***	6.77
RACHANA*PB-01	-0.67	70.33	-1.56**	69.67	0.26***	3.87	-0.24**	7.90	-0.23	8.53
RACHANA*KSP-2	-1.67	70.00	1.92**	72.64	0.91***	4.70	0.81***	8.42	0.58***	8.50
RACHANA*sonali-10	-1.36	70.67	-7.27**	64.84	0.03	3.53	-0.37***	7.73	0.40**	8.73
VRPE-24*JYOTI	-1.25	71.67	0.99**	70.25	-0.48***	2.83	0.39***	8.43	-1.21***	6.67
VRPE-24*PB-01	-0.39	71.67	-0.15	70.62	0.25***	4.23	-1.40***	6.97	-0.27*	8.27
VRPE-24*KSP-2	-1.39	71.33	1.49**	71.75	-0.69***	3.47	-0.18	7.67	1.34***	9.03
VRPE-24*sonali-10	-1.42	71.67	-2.11**	69.53	0.96***	4.83	0.10	8.44	-0.61***	7.50
JYOTI*PB-01	-1.97*	70.00	-2.61**	66.57	0.60***	4.17	0.09	8.18	0.90***	9.07
JYOTI*KSP-2	0.35	73.00	0.33*	69.02	-0.44***	3.30	0.04	7.58	-0.50***	6.80
JYOTI*sonali-10	-1.33	71.67	3.58***	73.66	-0.61***	2.83	0.38***	8.43	0.74***	8.47
PB-01*KSP-2	-1.44	70.33	-6.71**	63.48	-0.57***	3.83	0.41***	8.30	-0.97***	7.00
PB-01*sonali-10	0.18	72.33	-6.20**	65.39	0.65***	4.77	-0.62***	7.76	0.34**	8.73
KSP-2*sonali-10	-0.81	72.00	-4.37**	66.71	0.36***	4.67	-1.02***	6.82	-0.10	7.43

Significant at 5% level; \*\* significant at 1% level

**Table.4** Contd.

Cross combination	Pod Density (cm)		Pods/plant		Days to maturity		Yield/ Plant G(kg)		100-seed weight(g)	
	SCA	Mean	SCA	Mean	SCA	Mean	SCA	Mean	SCA	Mean
Pear Polo-5*VRPE-32	0.02	1.08	-0.61	55.41	-2.64***	92.67	-4.22***	66.57	-0.48*	12.85
Pear Polo-5*L-116	-0.06*	1.06	0.35	56.66	-1.28*	95.67	1.29***	70.66	0.54**	13.86
Pear Polo-5*AP-3	0.21***	1.26	2.20***	57.48	-1.80***	94.00	1.57***	72.87	1.42***	14.44
Pear Polo-5*RACHANA	-0.13***	0.85	1.01*	57.35	-3.33***	95.33	-1.16***	68.05	0.12	13.86
Pear Polo-5*VRPE-24	-0.21***	0.82	1.01*	59.98	-2.69***	93.00	-0.65*	69.49	0.28	13.64
Pear Polo-5*JYOTI	0.12***	1.20	0.19	60.74	1.30**	98.00	2.33***	73.60	-0.80***	12.62
Pear Polo-5*PB-01	0.09***	1.11	-1.05*	58.62	-0.25	97.00	0.58*	74.45	0.87***	13.79
Pear Polo-5*KSP-2	-0.00	1.05	-0.18	59.97	5.08***	101.33	-4.84***	66.60	0.24	13.72
Pear Polo-5*sonali-10	-0.09**	0.99	1.24**	59.78	6.47***	102.00	3.91***	75.78	-1.50***	12.64
VRPE-32*L-116	0.24***	1.35	2.91***	60.68	-2.50***	94.33	-0.68*	68.78	-1.96***	11.63
VRPE-32*AP-3	-0.02	1.00	4.92***	61.65	0.97*	96.67	-3.83***	67.57	1.32***	14.62
VRPE-32*RACHANA	0.16***	1.14	3.75***	61.55	3.44***	102.00	7.38***	76.71	-0.33	13.68
VRPE-32*VRPE-24	0.01	1.02	0.21	60.64	2.74***	98.33	-4.22***	66.04	1.64***	15.28
VRPE-32*JYOTI	-0.12***	0.92	-0.49	61.51	-0.58	96.00	-5.93***	65.43	0.70***	14.41
VRPE-32*PB-01	0.02	1.01	-5.46***	55.66	-2.80***	94.33	-2.78***	71.19	0.23	13.42
VRPE-32*KSP-2	0.01	1.05	-3.85***	57.76	0.52	96.67	1.82***	73.38	-1.06***	12.68
VRPE-32*sonali-10	-0.07**	0.98	0.72	60.71	-4.08***	91.33	2.62***	74.60	1.12***	15.55
L-116*AP-3	0.038	1.12	4.61***	61.62	-2.00***	95.33	-4.60***	65.38	1.37***	14.65
L-116*RACHANA	-0.11***	0.92	5.91***	63.99	3.47***	103.67	-0.40	67.48	0.70***	14.71
L-116*VRPE-24	-0.11***	0.96	3.97***	64.68	0.10	97.33	2.47***	71.30	-1.96***	11.66
L-116*JYOTI	-0.10***	1.01	3.28***	65.56	-2.55***	95.67	-1.45***	68.49	-0.04	13.65
L-116*PB-01	0.015	1.07	-2.98***	58.41	0.22	99.00	2.15***	74.70	-0.55**	12.63
L-116*KSP-2	0.27***	1.37	-2.02***	59.86	-0.78	97.00	1.25***	71.38	-2.05***	11.68
L-116*sonali-10	-0.22***	0.90	-0.21	60.05	-1.05*	96.00	-4.74***	65.80	1.35***	15.77
AP-3*RACHANA	0.12***	1.08	5.24***	62.29	3.27***	102.33	-6.21***	63.61	-1.30***	12.40
AP-3*VRPE-24	0.03	1.03	3.00***	62.67	-0.75	95.33	-1.90***	68.86	-1.86***	11.46
AP-3*JYOTI	0.04	1.08	2.59***	63.84	-2.75***	94.33	-1.29***	70.59	1.03***	14.43
AP-3*PB-01	-0.13***	0.84	-4.46***	55.90	-0.30	97.33	-2.86***	71.62	-1.22***	11.65
AP-3*KSP-2	0.15***	1.17	0.68	61.54	1.35**	98.00	2.38***	74.44	0.30	13.74
AP-3*sonali-10	0.01	1.06	-2.35***	56.87	5.08***	101.00	6.40***	78.89	0.96***	15.08
RACHANA*VRPE-24	0.04	0.99	-7.36***	53.37	1.38**	100.33	-0.80**	67.87	1.33***	15.38
RACHANA*JYOTI	0.13***	1.11	-0.86	61.45	-3.94***	96.00	-7.78***	62.01	-2.58***	11.54
RACHANA*PB-01	0.00	0.92	4.17***	65.60	-2.83***	97.67	-6.70***	65.69	1.65***	15.25
RACHANA*KSP-2	0.01	0.99	-3.10***	58.82	-3.50***	96.00	-4.85***	65.12	0.30	14.46
RACHANA*sonali-10	-0.11***	0.88	-1.88***	58.41	-2.78***	96.00	-0.92**	69.47	-2.51***	12.32
VRPE-24*JYOTI	0.23***	1.26	4.59***	69.53	-0.97*	96.00	5.09***	75.83	0.90***	14.64
VRPE-24*PB-01	-0.13***	0.84	7.69***	71.76	-3.19***	94.33	6.04***	79.38	0.41*	13.64
VRPE-24*KSP-2	-0.16***	0.85	6.06***	70.61	-1.86***	94.67	-5.14***	65.76	0.44*	14.23
VRPE-24*sonali-10	0.08**	1.12	-6.02***	56.90	1.19*	97.00	-6.99***	64.34	0.79***	15.25
JYOTI*PB-01	-0.11***	0.89	6.18***	71.82	1.47**	100.00	-2.44***	72.01	0.40*	13.70
JYOTI*KSP-2	0.05*	1.11	2.63***	68.76	-1.53**	96.00	-4.30***	67.72	0.12	13.98
JYOTI*sonali-10	0.07*	1.15	6.26***	70.77	-1.14*	95.67	-1.80***	70.65	0.15	14.69
PB-01*KSP-2	0.18***	1.18	6.56***	71.81	-3.08**	95.00	-0.87**	73.75	0.75***	14.09
PB-01*sonali-10	-0.13***	0.88	6.14***	69.77	0.97*	98.33	-3.27***	71.78	-0.47*	13.53
KSP-2*sonali-10	-0.15***	0.91	6.71***	70.83	2.63***	99.00	3.10***	75.73	-0.78***	13.79

Significant at 5% level; \*\* significant at 1% level

**Table.5** Estimation of heterosis over better parent for 10 characters in a 10 parents Half-diallel crosses in pea

Cross combination	Days to 75% Flowering		Plant height (cm)		Primary branches/plant		Pod length (cm)		Seeds/pod	
	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH
Pear Polo-5*VRPE-32	70.33	-2.99	61.23	-12.71**	4.60	21.05**	9.12	12.13**	8.43	4.12*
Pear Polo-5*L-116	71.00	-9.36**	60.41	-15.70**	5.30	72.83**	8.92	2.86*	8.40	11.75**
Pear Polo-5*AP-3	73.33	-3.51*	68.79	-5.95**	4.27	26.11**	9.34	22.40**	7.40	-9.76**
Pear Polo-5*RACHANA	71.00	-3.40*	69.34	-10.08**	3.40	3.55	8.12	3.00*	9.47	16.39**
Pear Polo-5*VRPE-24	69.33	-9.17**	70.19	-4.02**	4.13	29.84**	7.87	-11.50**	9.53	18.43**
Pear Polo-5*JYOTI	68.67	-9.85**	71.68	7.23**	5.37	88.30**	8.46	4.38	7.03	-12.99**
Pear Polo-5*PB-01	69.67	-5.43**	75.87	-0.85**	4.33	30.65**	9.13	4.94*	8.20	1.44
Pear Polo-5*KSP-2	70.33	-5.38**	70.66	-3.18**	4.83	23.40**	7.77	1.59	7.33	-5.78**
Pear Polo-5*sonali-10	72.00	-5.68**	68.88	-10.39**	3.90	6.36**	8.67	-3.11*	8.70	21.11**
VRPE-32*L-116	72.00	-8.28**	73.74	4.85**	4.53	27.10**	9.02	8.96**	6.70	-15.72**
VRPE-32*AP-3	72.67	-4.60**	71.34	-0.67*	4.73	21.89**	8.25	13.94**	8.40	-2.70
VRPE-32*RACHANA	71.67	-2.71	65.87	-13.09**	3.63	-3.96	8.58	14.55**	7.53	-12.06**
VRPE-32*VRPE-24	72.67	-5.01**	68.47	-4.65**	4.53	23.08**	8.60	1.10	8.37	-1.38
VRPE-32*JYOTI	72.33	-5.24**	70.12	7.02**	3.27	-2.49	7.37	-4.47**	7.93	-6.85**
VRPE-32*PB-01	72.33	-2.03	64.63	-14.05**	4.83	26.64**	8.89	7.06**	8.80	3.33
VRPE-32*KSP-2	71.33	-4.25**	69.88	-2.49**	4.43	0.38	7.85	8.20**	7.47	-9.13**
VRPE-32*sonali-10	69.00	-9.80**	70.34	-6.89**	3.43	-17.60**	8.38	-2.12	8.47	11.16**
L-116*AP-3	70.00	-14.63**	67.45	-8.02**	5.10	61.90**	7.47	-4.01**	6.63	-17.60**
L-116*RACHANA	69.00	-13.21**	63.24	-18.20**	2.87	-6.01*	8.46	5.38**	9.13	14.41**
L-116*VRPE-24	69.33	-15.79**	71.44	-2.56**	3.77	27.68**	8.12	-10.16**	8.37	5.91**
L-116*JYOTI	68.67	-16.43**	70.29	4.87**	4.73	80.89**	7.63	-7.47**	7.53	-5.04*
L-116*PB-01	70.33	-11.72**	69.39	-9.54**	3.83	24.32**	8.93	1.00	8.30	4.62*
L-116*KSP-2	72.67	-9.54**	63.86	-12.73**	4.27	15.84**	9.11	16.94**	6.63	-13.10**
L-116*sonali-10	69.33	-15.79**	67.83	-11.98**	5.33	55.34**	7.85	-13.74**	8.70	23.70**
AP-3*RACHANA	71.33	-7.56**	72.64	-7.80**	2.80	-16.83**	8.55	22.42**	8.00	-7.69**
AP-3*VRPE-24	69.00	-13.75**	65.83	-12.00**	4.57	39.80**	7.92	-1.08	6.60	-23.11**
AP-3*JYOTI	70.33	-11.90**	68.88	0.53	3.17	7.95**	8.33	15.51**	7.67	-11.03**
AP-3*PB-01	70.33	-9.05**	63.74	-18.48**	4.60	35.29**	7.65	-1.96	9.07	5.22**
AP-3*KSP-2	71.67	-8.12**	69.37	-7.08**	4.77	19.17**	7.88	16.70**	6.70	-19.44**
AP-3*sonali-10	70.33	-12.08**	71.37	-9.13**	2.47	-34.22**	8.12	0.81	7.60	-1.51
RACHANA*VRPE-24	71.33	-7.96**	65.56	-16.78**	3.70	16.84**	8.32	0.89	8.37	-1.76
RACHANA*JYOTI	71.33	-7.76**	69.45	-4.19**	2.70	-4.71	7.56	1.41	6.77	-20.86**
RACHANA*PB-01	70.33	-6.01**	69.67	-15.21**	3.87	17.17**	7.90	-1.82	8.53	-0.19
RACHANA*KSP-2	70.00	-7.28**	72.64	-7.62**	4.70	20.51**	8.42	20.26**	8.50	3.03
RACHANA*sonali-10	70.67	-8.82**	64.84	-21.42**	3.53	-3.20	7.73	-6.92**	8.73	14.16**
VRPE-24*JYOTI	71.67	-10.60**	70.25	2.54**	2.83	3.66	8.43	-0.49	6.67	-21.26**
VRPE-24*PB-01	71.67	-7.73**	70.62	-9.68**	4.23	32.29**	6.97	-23.16**	8.27	-2.36
VRPE-24*KSP-2	71.33	-8.94**	71.75	-3.88**	3.47	-8.77**	7.67	-4.39**	9.03	10.61**
VRPE-24*sonali-10	71.67	-10.79**	69.53	-11.46**	4.83	36.15**	8.44	-9.42**	7.50	-0.88
JYOTI*PB-01	70.00	-9.68**	66.57	-7.40**	4.17	45.35**	8.18	-1.19	9.07	6.67**
JYOTI*KSP-2	73.00	-6.61**	69.02	0.96**	3.30	-4.81*	7.58	4.89**	6.80	-17.07**
JYOTI*sonali-10	71.67	-10.60**	73.66	1.96**	2.83	-11.92**	8.43	-1.17	8.47	11.40**
PB-01*KSP-2	70.33	-7.05**	63.48	-18.66**	3.83	-2.54	8.30	6.16**	7.00	-14.63**
PB-01*sonali-10	72.33	8.87**	65.39	-20.18**	4.77	29.41	7.76	-14.96**	8.73	14.9**
KSP-2*sonali-10	72.00	-8.09**	66.71	-14.90**	4.67	8.95**	6.82	-15.52**	7.43	1.83

Significant at 5% level; \*\* significant at 1% level



Table.5 Contd.

Cross combination	Pod density(cm)		Pods/plant		Days to maturity		Yield/ Plant g(kg)		100-seed weight (g)	
	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH	F <sub>1</sub> MEAN	BH
Pear Polo-5*VRPE-32	1.08	7.13	55.41	1.73	92.67	-3.81 **	66.57	-9.49**	12.85	-0.10
Pear Polo-5*L-116	1.06	-7.98*	56.66	10.42**	95.67	-2.71 **	70.66	-0.26	13.86	0.48
Pear Polo-5*AP-3	1.26	34.76**	57.48	14.67**	94.00	-0.88	72.87	-1.78**	14.44	17.09**
Pear Polo-5*RACHANA	0.85	-12.18**	57.35	7.06**	95.33	-4.35 **	68.05	-9.13**	13.86	-2.52
Pear Polo-5*VRPE-24	0.82	-25.45**	59.98	9.80**	93.00	-3.63 **	69.49	-3.45**	13.64	7.51**
Pear Polo-5*JYOTI	1.20	19.80**	60.74	13.72**	98.00	-1.18	73.60	-3.11**	12.62	-4.96**
Pear Polo-5*PB-01	1.11	3.58	58.62	7.70**	97.00	-2.51 **	74.45	-2.94**	13.79	12.84**
Pear Polo-5*KSP-2	1.05	7.48*	59.97	7.60**	101.33	5.19	66.60	-10.73**	13.72	-0.06
Pear Polo-5*sonali-10	0.99	-20.91**	59.78	9.00*	102.00	9.09	75.78	4.40**	12.64	-10.94**
VRPE-32*L-116	1.35	28.25**	60.68	13.87**	94.33	-5.35 **	68.78	-5.92**	11.63	-16.67**
VRPE-32*AP-3	1.00	19.12**	61.65	18.33**	96.67	0.52	67.57	-11.63**	14.62	17.03**
VRPE-32*RACHANA	1.14	30.15**	61.55	10.79**	102.00	0.99	76.71	-0.57	13.68	-4.88**
VRPE-32*VRPE-24	1.02	2.16	60.64	7.12**	98.33	0.51	66.04	-11.06**	15.28	18.94**
VRPE-32*JYOTI	0.92	2.21	61.51	11.04**	96.00	-4.48 **	65.43	-16.36**	14.41	7.23**
VRPE-32*PB-01	1.01	3.77	55.66	-1.33	94.33	-6.45 **	71.19	-9.85**	13.42	8.44**
VRPE-32*KSP-2	1.05	18.71**	57.76	0.08	96.67	-1.02	73.38	-4.55**	12.68	-8.65**
VRPE-32*sonali-10	0.98	-14.74**	60.71	6.85**	91.33	-3.69 **	74.60	-0.35	15.55	8.34**
L-116*AP-3	1.12	14.63**	61.62	25.91**	95.33	-2.89 **	65.38	-11.35**	14.65	9.14**
L-116*RACHANA	0.92	-9.51**	63.99	22.13**	103.67	0.65	67.48	-9.35**	14.71	-3.97*
L-116*VRPE-24	0.96	-15.87**	64.68	21.01**	97.33	-2.50 **	71.30	-0.32	11.66	-15.38**
L-116*JYOTI	1.01	-3.82	65.56	25.52**	95.67	-6.67 **	68.49	-9.31**	13.65	-5.07**
L-116*PB-01	1.07	-4.18	58.41	9.70**	99.00	-3.73 **	74.70	-2.05**	12.63	-5.14**
L-116*KSP-2	1.37	33.98**	59.86	9.74**	97.00	-2.68 **	71.38	-3.76**	11.68	-21.17**
L-116*sonali-10	0.90	-30.59**	60.05	11.90**	96.00	-0.86	65.80	-8.80**	15.77	3.14
AP-3*RACHANA	1.08	34.44**	62.29	21.64**	102.33	2.85	63.61	-18.22**	12.40	-10.48**
AP-3*VRPE-24	1.03	10.55**	62.67	19.91**	95.33	-1.04	68.86	-8.04**	11.46	-6.93**
AP-3*JYOTI	1.08	29.60**	63.84	25.06**	94.33	-4.71 **	70.59	-10.50**	14.43	11.79**
AP-3*PB-01	0.84	-7.01	55.90	7.38**	97.33	-2.01 **	71.62	-10.03**	11.65	-1.65
AP-3*KSP-2	1.17	44.56**	61.54	15.31**	98.00	1.91	74.44	-3.97**	13.74	2.88
AP-3*sonali-10	1.06	-1.85	56.87	8.39**	101.00	8.21	78.89	4.49**	15.08	9.04**
RACHANA*VRPE-24	0.99	2.24	53.37	-4.21 **	100.33	-0.82	67.87	-10.19**	15.38	8.25**
RACHANA*JYOTI	1.11	27.97**	61.45	12.75**	96.00	-7.54 **	62.01	-22.06**	11.54	-22.07**
RACHANA*PB-01	0.92	-1.77	65.60	18.18**	97.67	-6.24 **	65.69	-18.20**	15.25	11.01**
RACHANA*KSP-2	0.99	16.31**	58.82	3.52**	96.00	-4.95 **	65.12	-16.73**	14.46	-5.14**
RACHANA*sonali-10	0.88	-21.13**	58.41	4.45**	96.00	-2.21 **	69.47	-8.82**	12.32	-21.62**
VRPE-24*JYOTI	1.26	26.21**	69.53	25.16**	96.00	-4.64 **	75.83	-1.08*	14.64	10.36**
VRPE-24*PB-01	0.84	-21.68**	71.76	26.85**	94.33	-6.60 **	79.38	2.56**	13.64	11.76**
VRPE-24*KSP-2	0.85	-13.31**	70.61	22.01**	94.67	-3.24 **	65.76	-12.67**	14.23	3.76*
VRPE-24*sonali-10	1.12	-10.28**	56.90	-0.15	97.00	2.11	64.34	-12.20**	15.25	7.54**
JYOTI*PB-01	0.89	-7.90*	71.82	29.75**	100.00	-3.54 **	72.01	-11.52**	13.70	7.01**
JYOTI*KSP-2	1.11	26.38**	68.76	21.36**	96.00	-4.48 **	67.72	-14.59**	13.98	-2.28
JYOTI*sonali-10	1.15	-0.29	70.77	26.90**	95.67	-2.05 **	70.65	-8.57**	14.69	-0.62
PB-01*KSP-2	1.18	24.43**	71.81	24.52**	95.00	-5.79 **	73.75	-7.84**	14.09	6.42**
PB-01*sonali-10	0.88	-27.80**	69.77	2.88**	98.33	0.34	71.78	-7.99**	13.53	-1.32
KSP-2*sonali-10	0.91	-19.35**	70.83	21.94**	99.00	4.39	75.73	-0.25	13.79	-9.43**

Significant at 5% level; \*\* significant at 1% level

**General combining ability (GCA) effects**

The estimated of general combining ability effects of ten parents for all the 10 characters in F<sub>1</sub> generations along with their per se performance are given in Table 3. The lowest negative and significant values of GCA effects were considered to find out the desirable for number of days to 75% flowering. Plant height, days to maturity

while for remaining characters have positive and significant GCA effects were taken into account for sorting out the desirable general combiners. Similar, justification was also reported by Enrique Luis COUNTRY *et al.*, (2013) in which significant results for GCA and SCA for plant height was obtained. In F<sub>1</sub> generation, significant and desirable GCA effect were observed for days to 75% flowering in Pearpol-5, VRPE-32, Rachana

and PB-01, KSP-2; for plant height in Pearpolo-5, VRPE-32, L-116, Jyoti and KSP-2; for days to maturity in Sonali-10, AP-3, Pearpolo-5, VRPE-32 and KSP-2. The parents observed desirable and significant general combiners in F<sub>1</sub> the generation for days to 75% flowering was Pearpolo-5, Rachana, PB-01, VRPE-32; for plant height were L-116, VRPE-32, Pearpolo-5, Jyoti; for primary branches per plant were KSP-2, Pearpolo-5, VRPE-32, and PB-01; for pod length were Pearpolo-5, L-116, VRPE-32, PB-01 and Sonali-10; for seeds per pod PB-01, Rachana, Pearpolo-5 and VRPE-24; for pod density L-116, Sonali-10, Pearpolo-5 and Jyoti; for pods per plant Jyoti, KSP-2, PB-01, and VRPE-24; for days to maturity VRPE-32, Pearpolo-5, Sonali-10, VRPE-24, KSP-2; for yield per plant PB-01, KSP-2, Sonali-10, AP-3; for 100- seed weight Sonali-10, Rachana, KSP-2, Jyoti. The study revealed significant difference in GCA and SCA effects for the traits *viz.*, days to 75% flowering, number of primary branches per plant, pod per plant, days to maturity and seed yield per plant. These findings were supported by the previous work of Singh *et al.*, (2001) and Dixit *et al.*, (2003). Based on desirable GCA effect for different characters, the *per se* performance and best common general combiner in F<sub>1</sub> were identified for days to 75% flowering was PB-01, Pearpolo-5, Rachana, VRPE-32; for plant height were L-116, VRPE-32, Pearpolo-5 and Jyoti; for primary branches per plant were KSP-2, VRPE-32, PB-01; for pod length per plant and seeds per pods both were Pearpolo-5, VRPE-32, L-116, PB-01, Sonali-10 and Rachana, PB-01, Pearpolo-5 VRPE-24; for yield per plant.

### **Specific combining ability (SCA) effect**

The specific combining ability (SCA) effects of 45 crosses in F<sub>1</sub>s along with the mean performance for 10 characters are given in

Table 4. The significant specific combiners and desirable crosses were screened out same as in case of (SCA) effects. The significant and desirable (SCA) effects in F<sub>1</sub> generation were found in 35 combinations for days to 75 percent flowering showed negative value. Out of these, four best specific combiners with high *per se* performance were VRPE-24/KSP-2, Pearpolo-5/VRPE-24, L-116/Rachana, Pearpolo-5/Rachana-116/Sonali-10; in F<sub>1</sub> L-116/Jyoti, L-116/PB-01, AP-3/VRPE-24, L-116/Sonali-10, VRPE-32/Sonali-10. Plant height exhibited 26 significant and desirable combinations. Out of these five combinations like Pearpolo-5/VRPE-32, Pearpolo-5/L-116, PB-01/KSP-2, AP-3/PB-01, L-116/Rachana showed high *per se* performance but good specific combiner in F<sub>1</sub> were identified i.e. Pearpolo-5/L-116, Rachana/Sonali-10, Pearpolo-5/VRPE-32, L-116/Rachana. In F<sub>1</sub> days to maturity 27 combinations showed negative significant and desirable sca effect. On the basis of *per se* performance five crosses were found desirable i.e. Pearpolo-5/VRPE-32, VRPE-32/Sonali-10, Pearpolo-5/Jyoti, Pearpolo-5/VRPE-24, PB-01/KSP-2 in F<sub>1</sub> were good specific combiners.

Considering the F<sub>1</sub> generations simultaneously, superior common crosses for the days to 75% flowering was L-116/Sonali-10 based on sca and *per se* performance. For plant height PB-01/KSP-2, L-116/Rachana, Pearpolo-5/VRPE-32; for Primary branches per plant Pearpolo-5/Jyoti; for Pod length L-116/KSP-2 and Pearpolo-5/AP-3; for Seeds per pod Pearpolo-5/Rachana, Pearpolo-5/VRPE-32; for Pod density L-116/KSP-2, VRPE-24/Jyoti, Pearpolo-5/AP-3, VRPE-32/L-116; for Pods per plant were Jyoti/Sonali-10, PB-01/KSP-2, VRPE-24/PB-01, KSP-2/Sonali-10; for Days to maturity VRPE-32/Sonali-10; for Yield per plant were VRPE-24/Jyoti and AP-3/KSP-2; for 100 seed weight Rachana/PB-01 and VRPE-32/VRPE-24, were most desirable and common cross

combinations based on sca and *per se* performance.

Considerable degree of heterosis was noted for grain yield in positive response over better parent namely, Pearpolo-5/Jyoti and Pearpolo-5/AP-3. The relative ranking of the parents on the basis of *per se* performance and GCA effect in F<sub>1</sub> generations Jyoti, Pearpol-5, Rachana, Sonali-10 and AP-3 are good combiner for yield point of view. These parents could be exploited further in breeding programme for simultaneously improved in grain yield and quality attributes. The SCA effect for grain yield per plant was significant and considerable good specific combiner were four crosses in F<sub>1</sub> generations. These crosses had involved all the four possible combination between high and low GCA effects. The cross combinations involving parents Pearpolo-5, KSP-2, PB-01 and VRPE-32 were expected to have fixable, additive or additive x additive gene effects.

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