Per se Performance of Parents and Hybrids for Yield and Yield Realted Traits in Pea

Jayashri Barcchiya[1*], A. K. Naidu[1], A. K. Mehta[2], Anubha Upadhyay[3] and H. L. Sharma[4]

[1]Department of Horticulture, [2]Department of Plant Breeding & Genetics, [3]Department of Plant Physiology,
[4]Department of Mathematics & Statistics,
Jawaharlal Nehru Krishi Vishwavidyalaya, Adhartal, Jabalpur - 482004, India

ABSTRACT

The experiment conducted on twelve parents involving seven lines and five testers of pea and their respective hybrids. The experimental material consist seven lines viz., Arkel, Kashi Shakti, Kashi Samarth, Kashi Uday, Azad Pea -3, Matar Ageta- 6, Pant Sabji Matar- 3, and five testers viz., Arka Karthik, Kashi Nandini, Kashi Mukti, Arka Ajit, and Pusa Pragati and their 35 F_1 s obtained by crossing generated through L x T fashion were evaluated for their per se performance for 15 characters. The maximum pod yield per plant was recorded by Kashi Shakti followed by Azad Pea-3, Kashi Samarth, Matar Ageta-6, Kashi Samarth, and Pusa Pragati among the parents. The crosses Kashi Shakti x Kashi Nandini, Kashi Shsakti x Arka Ajit, Kashi Shakti x Pusa Pragati, Arkel x Pusa Pragati, Matar Ageta-6 x Arka Ajit and showed superior performance for green pod yield per plant and number of pods per plant.

Key words: *Pea, Per se performance, Pisum sativum, Line, Tester*

INTRODUCTION

Per se performance is the most simple and effective way to get preliminary information on the genotypes. Crosses between parents with good *per* se performance are expected to yield desirable recombinants in the segregating generations and the potentialities of such genotypes will also reflect in the performance of hybrids. Its improvement is based mainly on exploiting the natural sources of germplasm by means of selection or hybridization followed by selection[14]. For development of elite strains, identification of genetically superior parents is an important prerequisite. It can be further utilized to exploit recombination breeding or heterosis[12]. Pea (*Pisum sativum* L.) is an annual herbaceous, self pollinated crop belongs to the family Leguminoseae and genus *Pisum*. The Central Asia was regarded as the birth place of all legumes including pea whereas Asia Minor is the secondary centre of origin. Pea (*Pisum sativum* L.) is an important vegetable crop grown throughout India for its tender and immature seeds which is used as vegetable. It is grown as winter vegetable in the plains of north India and summer vegetable in hills.

Large proportion of peas is processed (canned, frozen or dehydrated) for consumption in off season. Pea is an excellent source of protein (27.8%), carbohydrates (42.65%), vitamin, minerals, dietary fibers and antioxidant compounds. Peas can supply the required nutrients to various age groups owing to their high protein content and favorable composition of amino acids and low trypsin inhibitor levels[2]. Pea protein is low in sulphur containing amino acids, Cysteine and Methionine but rich in Lysine and other essential amino acids[5]. In India area of 1320.04 ('000 ha) with production of 20931.21 ('000 Mt) and its productivity is 10.15 t/ha. Madhya Pradesh is one of the leading state in the cultivation of pea, occupied area of 69.70 ('000 ha) with production of 707.46 ('000 Mt) and its productivity is 10.45 t/ha (http://*nhb.gov.in,* 2016-17). Its cultivation is further spreading to every nook and corner of the state, but for the last few years, the productivity has remained static although total area has increased. This could be attributed to the lack of suitable cultivars for different regions. The important factor that reduces the pea production is low yielding potential of existing varieties and lack of stability in yield. With this objective in view, twelve parents and their resultant hybrids were evaluated based on mean *per* se performance.

MATERIAL AND METHODS

The experimental materials for the present investigation comprised of 12 genotypes of pea including 7 lines and 5 testers were grown in a randomized block design with three replications at Horticulture research Farm, Department of Horticulture, JNKVV, Jabalpur, Madhya Pradesh. The 12 parental lines were agronomically and morphologically diverse. The genotypes were Arkel, Kashi Shakti, Kashi Samarth, Kashi Uday, Azad Pea-3, Matar Ageta- 6, Pant Sabji Matar- 3, Arka Karthik, Kashi Nandini, Kashi Mukti, Arka Ajit, and Pusa Pragati. Out of twelve genotypes, seven as lines viz., Arkel, Kashi Shakti, Kashi Samarth, Kashi Uday, Azad Pea -3, Matar Ageta- 6, Pant Sabji Matar- 3, and

five as testers viz., Arka Karthik, Kashi Nandini, Kashi Mukti, Arka Ajit, and Pusa Pragati were crossed in a L x T fashion during *rabi* 2015 and evaluated in *rabi* 2016. Thus line x tester mating was carried out between these six lines and four testers and the experimental materials, Lines (7), Testers (5) and their crosses (35) Observations were recorded on five randomly chosen plants in each replication both for parents (12) and hybrids (35) for the twelve quantitative characters viz., Observations were recorded on five randomly selected plants from each treatment on twelve characters viz. days to 50 % flowering, days to maturity, plant height at maturity (cm), branches per plant, effective node per plant, pods per plant, pod length (cm), seeds per pod, green pod yield per plant (g), biological yield per plant (g), harvest index (%), shelling percent (%) and their mean obtained. The data were statistically analyzed for computation of genetic coefficient of variation using appropriate statistical analysis. Analysis of variance was carried out as per the procedure given by Panse and Sukhtame[9].

RESULTS AND DISCUSSIONS

Analysis of variance details for the twelve characters are furnished in Table 1. Analysis of variance (Table 1) revealed significant variability among parents and among hybrids for all the twelve characters studied. This is an essential pre requisite for further study of the genotypes. The mean performance of parents and hybrids is given in Table 2. Lower mean values is desirable for days to 50% flowering, days to maturity and plant height, it reflects better performance because early flowering and maturity and dwarf bushy types are preferred. For other characters high mean value indicate better performance. Early flowering is the important character and an advantageous feature in pea to have early access to market. Taking the over all mean as criteria, top ranking superior parents were identified for different characters.

Days to 50% flowering
Days to 50% flowering ranged from 34.24 to 75.67 days for parents and 33.29 days to 74.37

with overall mean of 55.81 days. Line K. Uday recorded a minimum days to 50 % flowering, while tester A. Karthik (76.67 days) showed maximum days to 50% flowering. For F_1 hybrid minimum days to 50% flowering took by K.Uday x K.Mukti (33.29) followed by Arkel x K.Nandini (33.77), while the hybrid PSM-3 x K.Nandini (74.37) showed maximum days. Similar findings reported by Sharma *et al.*[11], Kumar et al.[7], Ahmad *et al.*[1], Subh and Dhara[16], Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10].

Days to maturity

Over all mean value of days to maturity 97.16 days with range from 86.68 to 118.00 for parents and 78.21 to 118.81 for crosses. Parents PSM-3 (86.68) showed minimum days to maturity while, K. Samarth (118) showed maximum days. F_1 hybrids, K.Shakti x P.Pragati (118.82) followed by K.Samarth x A.Karthik (118.62) showed maximum days to maturity while, MA-6 x P.Pragati (78.21) showed minimum days to maturity. Similar findings were registered by Borah[4], Suman *et al.*[15], Kumar *et al.*[7], Ahmad *et al.*[1], Bhardwaj and Vikarm[3].

Plant height (cm)

Overall average plant height 59.57 cm and it varied from 34.32 cm to 90.56 cm for parents and 37.20 to 94.03 cm for crosses. Parent K. Nandini (34.32 cm) recorded lowest plant height and K. Shakti (90.56) showed maximum plant height. For F_1 hybrids highest plant height was recorded by cross K. Shakti x A. Karthik (94.03 cm) followed by K. Shakti × K. Nandini (89.57 m) and K. Shakti × A. Ajit (88.27), while the hybrid K.Uday × Pusa Pragati (37.20 cm) produced the shortest height. It is in confirmation with Ceyhan *et al.*[6], Borah[4], Suman *et al.*[15], Sharma *et al.*[11], Kumar *et al.*[7], Ahmad *et al.*[1], Subh and Dhara[16], Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora *et al.*[4],

Number of branches per plant

Number of branches per plant ranged from 11.21 to 14.36 for parents and 11.17 to 15.32 for crosses with overall mean value 13.17. The line K. Samarth (14.36) recorded the highest mean value whereas; Arka Karthik recorded

lowest value (11.21) for this trait. The hybrid Arkel x P.Pragati (15.32) followed by K.Shakti x K.Nandini (15.28) recorded the highest number of branches per plant whereas, K.Samarth x A. Karthik (11.17) showed the lowest value for this trait. The findings corroborated with Borah[4], Suman *et al.*[15], Sharma and Bora[14], Pal and Singh[10], Bora *et al.*[4].

Number of effective nodes per plant

Number of nodes per plant ranged from 7.12 to 9.47 for parents and 7.19 to 9.58 for crosses with overall average of 8.35. Among the lines, MA-6 (9.47) recorded highest mean value for this trait and K. Mukti (7.12) had the minimum mean value for this trait. F_1 hybrid K.Shakti x A.Karthik (9.58) followed by K.Shakti x K.Mukti recorded highest value for this trait and lowest value was shown by PSM-3 x K. A.Karthik (7.19). Ceyhan *et al.*[6], Borah[4], Suman *et al.*[15], Sharma *et al.*[11], Kumar *et al.*[7], Ahmad *et al.*[1], Subh and Dhara[16],Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora *et al.*[4].

Number of pods per plant

Number of pods per plant ranged from 10.56 to 20.83 for parents and 12.47 to 22.44 for crosses with overall parental mean of 16.73. Lines K.Shakti (20.83) had highest number of pods per plant while, lowest mean value was observed for K. Mukti (10.56). F_1 hybrid K. Shakti x P.Pragati (22.44) followed by K.Shakti x K.Nandini (22.13) had highest number of pods per plant while, PSM-3 x A.Ajit (12.47) showed minimum number of pods per plant. Similar findings reported by Ceyhan *et al.*[6], Borah[4], Suman *et al.*[15], Sharma *et al.*[11], Kumar *et al.*[7], Ahmad *et al.*[1], Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora *et al.*[4].

Pod length (cm)

Pod length for parents ranged from 6.94 cm to 9.39 cm for parent and 6.93 cm to 10.20 cm for crosses cm with overall mean of 8.24 cm. The line AP-3 (9.39 cm) had longest pod while, MA-6 (6.94 cm) had smallest pod. The hybrids AP-3 x A.Karthik, followed by AP-3 x K.Nandini (10.12), Arkel x K.Nandini (9.16) had longest pod while, MA-6 x A. Ajit (6.93

cm) had smallest pod length for this trait. This result in confirmation with the result of Borah[4], Suman et al.[15], Sharma et al.[11], Kumar et al.[7], Ahmad et al.[1], Subh and Dhara[16],Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora et al.[4].

Number of seeds per pod

The average number of seeds per pod ranges from 6.01 to 7.75 for parents and 5.36 to 9.44 for crosses with an overall mean of 7.44. Line PSM-3 (7.75) recorded highest mean value for this trait and lowest mean value was shown by Arkel (6.01). The crosses Arkel x K.Nandini (8.55) followed by K.Shakti x A.Karthik (8.47) showed highest value for this trait and lowest value was shown by AP-3 x A.Ajit (7.18). Similar results were obtained by Ceyhan et al.[6], Borah[4], Suman et al.[15], Sharma et al.[11], Kumar et al.[7], Ahmad et al.[1], Subh and Dhara[16], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora et al.[4].

Green pod yield per plant (g)

Green pod yield per plant ranged for parents from 43.50 to 85.12 g and for crosses 39.81 to 93.8 g with an overall average of 68.34 g. The highest green pod yield was recorded by line K. Shakti (85.12 g) while, the lowest mean for K. Uday (43.50 g). The highest marketable green pod yield was recorded by K. Shakti x K.Nandini (93.82 g) followed by K.Shakti x A.Ajit (92.15 g) while, the lowest value for green pod yield per plant was noted by K.Uday x A.Karthik (39.81) followed by K.Uday x K. Mukti (40.33 g). These results are in agreement with Ceyhan et al.[6], Borah[4], Suman et al.[15], Sharma et al.[11], Kumar et al.[7], Ahmad et al.[1], Subh and Dhara[16],Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora et al.[4].

Biological yield per plant

Biological yield per plant ranged from (3.14) to (4.61) for parents and 40.43 to 64.68 for crosses with overall average value of 4.20. K. Shakti (4.61) had highest biological yield per plant while, lowest mean value was obtained for Arka Karthik (3.14) as compared to testers mean of 3.54. F_1 hybrid K.Samarth x K.Nandini (64.68 g) followed by K. Samarth x A.Ajit (64.63 g) recorded the highest mean value for this trait while, AP-3 x K.Mukti (40.43 g) showed the lowest value. This confirmed the findings of Kumar et al.[7].

Harvest index

Harvest index for parents ranged from 39.71 to 47.68 and for crosses 35.77 to 51.41 with overall average of 42.95. Line K. Samarth recorded a minimum harvest index 39.71 and MA-6 showed maximum harvest index 47.68. F_1 hybrid (K.Samarth x K.Mukti) 51.41 followed by PSM-3 x K.Nandini (47.34). K.Uday X A.Karthik (35.88) followed by Arkel x A.Karthik (37.20) crosses recorded a minimum harvest index. These results are in confirmation with the results reported by Kumar et al.[7].

Shelling percent

Shelling percent ranged from 41.63 to 61.73 for parents and 41.24 to 61.60 for crosses with overall average of 48.39. Lines, AP-3 (61.73) recorded the highest mean value for this trait while, tester Arka Ajit (41.64). F_1 hybrid AP-3 x K.Mukti (61.60) followed by K. Samarth x K. Mukti (56.54) recorded the highest value exhibited for this trait while, K. Uday x K. Nandini (41.24) followed by K. Shakti x K. Nandini (41.51) showed the lowest value. These results are in agreement with Ceyhan et al.[6], Sharma et al.[11], Sharma and Bora[14], Bhardwaj and Vikarm[3], Pal and Singh[10], Bora et al.[4].

Table 1: Mean sum of square for yield and its components in pea (mean sum of square)

S.V.	d.f.	Mean sum of square					
		1	2	3	4	5	6
Replication	2	4.7497	4.5814	4.5814	0.4037	0.1127	1.4861
Treatment	46	443.0455**	415.6095**	1029.9009**	3.2053**	1.7133**	26.1787**
Error	92	5.4944	2.7128	3.7499	0.2442	0.1834	1.2398
Total	140						

S.V.	Df	Mean sum of square					
		7	8	9	10	11	12
Replication	2	0.0956	0.0500	2.3483	0.0802	0.2956	4.0751
Treatment	46	1.5876**	1.7992**	166.7729**	0.5816**	26.2437**	84.1317**
Error	92	0.1163	0.2331	1.3255	0.0901	10.8041	1.4137
Total	140						

1.Days to 50% flowering   4. Branches per plant   7. Pod length   10. biological yield per plant

2. Days to maturity (cm),   5. Effective node per plant   8. Seed per pod   11. Harvest index

3. plant height at maturity   6. Pods per plant   9. Green pod yield per plant   12. Shelling percent

*,** significant at 5% and 1% level of significance respectively

Table 2: Mean performance of parents (line x testers) and their F_1 crosses for yield and its component in pea

S.No.	Crosses	Days to 50% flowering	Days to maturity	Plant height at maturity	Branches per plant	Effective node per plant	Pods per plant
	Lines						
1	Arkel (L_1)	37.29	91.41	55.15	13.07	9.13	16.46
2	K.Shakti(L_2)	59.34	114.20	90.56	13.81	9.34	20.83
3	K.Samarth(L_3)	64.81	118.49	80.53	14.36	8.35	14.48
4	K.Uday(L_4)	34.24	90.20	49.56	12.80	7.59	11.85
5	AP-3(L_5)	48.05	90.89	46.26	13.57	7.72	15.44
6	MA-6(L_6)	45.35	92.70	42.77	13.16	9.47	17.47
7	PSM-3(L_7)	47.00	86.68	70.79	11.51	7.32	16.50
	Testers						
8	A.Karthik(T_1)	75.67	95.66	77.70	11.22	8.44	13.99
9	K.Nandini(T_2)	37.50	86.92	34.32	11.73	7.63	15.41
10	K.Mukti(T_3)	38.74	94.59	56.50	13.44	7.12	10.56
11	A.Ajit(T_4)	62.86	115.06	82.57	11.46	8.67	14.45
12	P.Pragati(T_5)	49.88	100.37	56.38	11.76	8.96	13.29
	Crosses						
13	Arkel x A.Karthik	68.49	96.28	51.29	13.13	9.26	15.35
14	Arkel x K.Nandini	33.77	86.85	52.51	13.44	8.79	16.98
15	Arkel x K.Mukti	34.31	87.56	45.55	13.88	9.08	18.43
16	Arkel x A.Ajit	66.51	93.33	47.01	13.64	8.95	15.55
17	Arkel x P.Pragati	49.44	86.97	43.94	15.33	8.64	15.63
18	K.Shakti x A.Karthik	67.77	114.50	94.03	12.48	9.59	21.46
19	K.Shakti x K.Nandini	59.14	102.39	89.57	15.29	7.61	22.13
20	K.Shakti x K.Mukti	62.40	105.48	86.65	14.27	9.51	21.14
21	K.Shakti x A.Ajit	61.79	116.45	88.27	14.25	8.74	19.92
22	K.Shakti x P.Pragati	55.59	118.82	87.66	15.14	7.80	22.44
23	K.Samarth x A.Karthik	65.69	118.62	81.05	11.17	8.31	15.35
24	K.Samarth x K.Nandini	62.99	90.98	40.84	14.41	8.13	21.84
25	K.Samarth x K.Mukti	72.21	103.53	39.35	12.49	8.42	17.92
26	K.Samarth x A.Ajit	64.15	112.28	73.82	12.83	8.97	16.34
27	K.Samarth x P.Pragati	66.10	116.37	72.92	14.34	8.48	16.47
28	K.Uday x A.Karthik	64.82	96.43	43.93	13.01	7.88	13.17
29	K.Uday x K.Nandini	35.37	82.42	39.34	13.59	7.58	14.35
30	K.Uday x K.Mukti	33.29	86.36	38.79	13.65	7.37	12.68
31	K.Uday x A.Ajit	59.85	111.50	45.47	12.51	7.96	12.52
32	K.Uday x P.Pragati	54.45	97.60	37.20	13.57	7.38	20.11
33	AP-3 x A.Karthik	54.07	87.42	41.56	14.21	7.46	14.88
34	AP-3 x K.Nandini	53.03	81.97	43.50	13.55	7.50	17.75
35	AP-3 x K.Mukti	64.02	81.49	43.57	13.93	7.31	16.55

36	AP-3 x A.Ajit	58.27	103.80	76.90	12.43	7.67	15.94
37	AP-3 x P.Pragati	66.41	106.82	38.67	12.51	8.00.	16.59
38	MA-6 x A.Karthik	73.09	95.99	42.9033	13.58	9.45	17.36
39	MA-6 x K.Nandini	42.20	106.44	44.39	12.52	9.22	21.62
40	MA-6 x K.Mukti	46.19	88.91	46.65	13.54	9.27	17.48
41	MA-6 x A.Ajit	64.61	84.43	81.49	13.55	7.85	17.25
42	MA-6 x P.Pragati	58.83	78.22	44.37	12.53	9.06	17.37
43	PSM-3 x A.Karthik	47.23	88.37	67.61	12.90	7.19	17.83
44	PSM-3 x K.Nandini	74.37	87.14	72.06	12.76	8.94	21.40
45	PSM-3 x K.Mukti	59.49	88.28	72.31	12.65	7.76	15.51
46	PSM-3 x A.Ajit	67.32	95.74	75.28	12.64	9.26	12.47
47	PSM-3 x .Pragati	55.05	89.68	66.16	11.34	8.08	15.78
	Overall mean	**55.81**	**97.16**	**59.57**	**13.17**	**8.35**	**16.73**
	S.E(diff)mean	1.35	0.95	1.118	0.29	0.25	0.64
	C.D. 5%	3.80	2.67	3.14	0.80	0.70	1.81

S.No.	Crosses	Pod length(cm)	Seeds/ pod	Green Pod yield per plant(g)	Biological yield per plant (g)	Harvest index	Shelling %
	Lines						
1	Arkel (L$_1$)	8.22	6.01	65.35	4.19	44.34	48.00
2	K.Shakti(L$_2$)	7.89	7.42	85.12	4.61	43.23	51.01
3	K.Samarth(L$_3$)	7.66	7.00	74.05	4.46	39.71	51.43
4	K.Uday(L$_4$)	7.75	6.09	43.50	3.87	40.32	46.16
5	AP-3(L$_5$)	9.39	7.03	81.77	4.43	45.35	61.73
6	MA-6(L$_6$)	6.94	6.94	74.52	3.77	47.68	49.26
7	PSM-3(L$_7$)	8.07	7.75	69.14	4.21	41.84	45.85
	Testers						
8	A.Karthik(T$_1$)	8.15	7.12	53.35	3.14	44.12	42.65
9	K.Nandini(T$_2$)	7.26	7.45	61.98	3.59	43.24	42.18
10	K.Mukti(T$_3$)	8.06	7.40	52.15	3.65	40.26	46.99
11	A.Ajit(T$_4$)	8.22	7.31	69.85	3.70	44.75	41.64
12	P.Pragati(T$_5$)	8.51	7.21	72.05	3.63	44.04	46.72
	Crosses						
13	Arkel x A.Karthik	9.05	7.84	74.59	4.07	37.20	44.47
14	Arkel x K.Nandini	9.16	8.55	54.07	4.28	42.34	41.76
15	Arkel x K.Mukti	8.86	8.25	55.17	4.27	44.96	46.65
16	Arkel x A.Ajit	8.42	7.52	73.68	4.75	44.16	48.25
17	Arkel x P.Pragati	8.28	7.33	74.01	4.37	38.54	42.72
18	K.Shakti x A.Karthik	8.24	8.47	69.02	3.87	44.57	47.38
19	K.Shakti x K.Nandini	8.29	7.79	93.82	5.02	42.08	41.52
20	K.Shakti x K.Mukti	8.22	8.03	69.34	4.71	44.98	43.51
21	K.Shakti x A.Ajit	7.53	7.07	92.15	4.91	45.09	52.37
22	K.Shakti x P.Pragati	7.86	7.25	91.56	4.59	41.40	49.55
23	K.Samarth x A.Karthik	8.35	8.06	63.91	3.98	40.01	49.16
24	K.Samarth x K.Nandini	8.67	7.92	72.61	4.51	45.16	46.59
25	K.Samarth x K.Mukti	8.33	7.89	65.61	3.69	51.49	56.54
26	K.Samarth x A.Ajit	8.57	7.53	74.54	4.99	41.68	52.96
27	K.Samarth x P.Pragati	8.75	8.12	76.91	3.69	46.64	50.12
28	K.Uday x A.Karthik	8.22	7.25	39.81	4.04	35.78	41.75
29	K.Uday x K.Nandini	8.63	8.20	43.35	4.35	44.64	41.24
30	K.Uday x K.Mukti	7.44	6.67	40.33	3.70	37.89	48.42

31	K.Uday x A.Ajit	7.51	6.18	52.83	3.89	45.12	44.90
32	K.Uday x P.Pragati	7.63	7.25	54.48	3.64	41.68	53.55
33	AP-3 x A.Karthik	10.20	8.62	72.29	4.13	43.15	54.59
34	AP-3 x K.Nandini	10.12	8.70	77.88	4.15	38.69	54.35
35	AP-3 x K.Mukti	8.56	7.74	75.07	3.86	45.43	61.60
36	AP-3 x A.Ajit	8.07	7.15	86.11	4.60	44.84	56.38
37	AP-3 x P.Pragati	9.71	8.14	78.67	4.48	41.09	47.45
38	MA-6 x A.Karthik	7.23	9.44	65.39	4.00	43.32	51.67
39	MA-6 x K.Nandini	7.61	7.01	75.24	4.68	44.36	46.59
40	MA-6 x K.Mukti	7.18	6.54	65.85	4.31	43.95	51.79
41	MA-6 x A.Ajit	6.93	5.64	85.75	4.50	43.63	49.35
42	MA-6 x P.Pragati	8.20	6.77	61.12	3.97	43.41	56.39
43	PSM-3 x A.Karthik	8.57	7.57	59.60	4.31	38.42	41.53
44	PSM-3 x K.Nandini	8.54	8.22	73.30	4.54	47.35	44.57
45	PSM-3 x K.Mukti	7.79	7.22	56.43	4.19	43.22	43.50
46	PSM-3 x A.Ajit	7.69	6.40	72.72	4.09	42.52	43.43
47	PSM-3 x .Pragati	8.50	6.53	71.89	5.19	40.86	54.40
	Overall mean	**8.24**	**7.44**	**68.34**	**4.20**	**42.95**	**48.40**
	S.E(diff)mean	0.20	0.28	1.47	0.17	1.89	0.69
	C.D. 5%	0.55	0.78	4.13	0.49	5.33	1.93

REFERENCES

1. Ahmad, H.B., Rauf, S., Rafiq, C.M., Mohsin, A.U. and Iqbal, A., Estimation of Genetic variability in pea (*Pisum sativum* L.). *Journal of Global Innovations in Agricultural and Social Sciences* **2(2):** 62-64 (2014).

2. Aysh, F.M., Habib, N.J., Najla, S., Murshed, R. and Trabj, B., Genetic variability and association of quality character and pod yield in garden pea (*Pisum sativum* L.). Walailak Journal of Science and Technology **12(3):** 259-265 (2015).

3. Bhardwaj, R.K. and Vikram, A., Genetics of yield and other characters in a cross of garden pea (*Pisum sativum* L.). *Indian Journal of Agricultural Sciences,* **38(2):** 154-156 (2004).

4. Borah, H.K., Studies on combining ability and heterosis in field pea (*Pisum sativum* L.). *Legume Research*, **32(4):** 255-259 (2009).

5. Ceyhan, E. and Avci, M.A., Combining ability and heterosis for grain yield and some yield components in pea (*Pisum ativum* L.). *Pak. J. Biol. Sci.* **8(10):** 1447-1452 (2005).

6. Ceyhan Ercan, Ali Avci Mehmet and Karada Serdar., Line X tester analysis in pea (*Pisum sativum* L.) identification of superior parents for seed yield and its components. *African Journal of Biotechnology* **7(16):** 2810-2817 (2008).

7. Kumar, M., Jeberson, M.S., Singh, N.B. and Sharma, R., Genetic analysis of seed yield and its contributing traits and pattern their inheritance in field pea (*Pisum sativum* L). *International Journal of Current Microbiology and Applied Sciences* **6(6):** 172-181 (2017).

8. N.H.B., NHB database, http://nhb.gov.in (2017).

9. Panse, V.G. and Shukhatme, P.V., Statistical methods for agriculture workers (2nd eds.). *Indian Council of Agriculture Research, New Delhi.* (1967).

10. Pal, A.K. and Singh, S., Assessment and genetic variability in garden pea (*Pisum sativum* L. var. Hortense). International Journal of Agricultural Science **9(1):** 293-296 (2013).

11. Sharma, A., Singh, G., Sharma, S. and Sood, S., Combining ability and heterosis for pod yield and its related horticultural traits in garden pea *(Pisum sativum* L.)

under mid-hill sub-temperate and high-hill dry-temperate conditions of Himachal Pradesh. *Indian Journal of Horticulture* **64(4):** 410-414 (2007).

12. Sharma, B.B., Sharma, V.K., Genetic analysis for earliness and yield traits in garden pea (*Pisum sativum* L.). *Vegetos* **25(1):** 63-67 (2012).

13. Sharma, B.B., Sharma, V.K., Dhakar, M.K. and Punetha, S., Combining ability and gene action studies for horticultural traits in garden pea: A review. *African Journal of Agricultural Research* **8(38):** pp. 4718-4725 (2013).

14. Sharma, V.K. and Bora, L., Studies on genetic variability and heterosis in vegetable pea (*Pisum sativum* L.) under high hills condition of Uttarakhand, India. African Journal of Agricultural Research **8(18):** 1891-1895 (2013).

15. Suman, H., Kumar B. N., Rathi, M. and Tamatam, D., Heterosis and Combining Ability for Grain Yield and Yield Associated Traitsin 10 X 10 Diallel Analysis in Pea (*Pisum sativum* L.) *International Journal Current Microbiology Applied Science* **6(12):** 1574-1585 (2017).

16. Shubha and Shri Dhar., Generation mean analysis for pod yield and its associated traits in garden pea (*Pisum sativum* L.) Vegetable Science **42(2):** 43-46 (2015).