

Original Research Article

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Genetic Evaluation for Yield and Yield Attributes in Garden pea (*Pisum sativum* var. *hortense* L.) under North Indian Gangetic Plain Conditions

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ABSTRACT

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The present investigation was carried out to estimate phenotypic and genotypic coefficient of variation, heritability (broad sense), genetic advance and genetic gain for 15 quantitative traits in 21 different genotypes of Garden pea during Rabi2011-12 at Vegetable Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U. P.). Significant differences among the genotypes were observed for all the characters under study. Mean performance recordings showed genotype VRP-38 has earliest flowering, VRP-3 has maximum number of primary branches, VRP-7 for pod yield and VRP-372 recorded maximum seed yield. The PCV and GCV values were high for plant height, seed weight per pod and number of primary branches per plant. High heritability and moderate genetic gain was observed for characters like days to 50% flowering, days to 100% flowering, length of garden pea pods and width of garden pea pods. This indicated the influence of non additive gene action and environment in the expression of these traits.

Introduction

Garden pea (*Pisum sativum* var. *hortense* L.), belongs to leguminosae family, is one of the most popular vegetable crop grown all over the world, both for fresh market and the food processing industry. It has a prominent place among vegetables due to its high nutritive value, particularly proteins and other health building substances like carbohydrates vitamin A, vitamin C, calcium and phosphorus. It is grown commercially as a winter crop in the northern Indian plains and as a summer crops in the high hills. It is one of the most popular off season vegetable crops

grown in north-western Himalayan region in India. For development of effective breeding programme and efficiency of selection largely depends upon the magnitude of significant variability present in a plant population.

The study of genetic parameters like genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as per cent of mean provide a clear data about extent of variability present in a plant population and a relative measure of efficiency of selection of genotypes based on

phenotype in a highly variable population. The present investigation was carried out to ascertain magnitude and extent of genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as per cent of mean in 21 different genotypes for 15 traits under Varanasi conditions.

Materials and Methods

The experimental material comprises of 21 different genotypes of garden pea collected from Indian Institute of Vegetable Research, Varanasi. The experiment was carried out at Vegetable Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during Rabi season of 2011-2012. The experiment was laid out in Randomized Complete Block Design (RBD) with three replications and plants were spaced at 30 cm distance between rows and 8 cm distance between plants with in a row. Cultural and agronomic practices were followed as per the standard recommendations and need based plant protection measures were taken up to maintain a healthy crop stand.

Observations were recorded on five competitive plants excluding border plants in each replication of each genotype for 15 traits viz., days to 1st flowering, days to 50% flowering, days to 100% flowering, length of pod (cm), width of pod (cm), number of primary branches per plant, plant height(cm), number of seeds per pod, average pod weight (g), number of pods per plant, seed weight per pod (g), seed yield per plot (g), seed yield per hectare ($q\ ha^{-1}$), pod yield per plant(g) and pod yield per hectare ($q\ ha^{-1}$).

The mean for each trait over 3 replications was computed for each genotype and analysed statistically. Both the genotypic and phenotypic coefficient of variance were estimated using the formula given by Burton

(1952), heritability (broad sense) was estimated as the ratio of genotypic variance to the total of phenotypic variance as suggested by Lush (1949) and genetic advance and genetic advance as per cent of mean were estimated by using the method suggested by Johnson *et al.*, (1955).

Results and Discussion

The results of Analysis of Variance for 15 traits in 21 different genotypes of garden pea were presented in table 1. Results indicated highly significant differences among the genotypes for all the characters indicating presence of sufficient amount of variability in all the characters studied.

The mean performance for 15 characters of 21 genotypes of garden pea was presented in table 2. On the basis of mean performance; the genotype VRP-38 is earliest in flowering. Genotypes VRP-61, VRP-284 and VRP-392 are good for plant height. For obtaining the maximum number of primary branches per plant, genotype VRP-3 is best. VRP-195, VRP-3, VRP-241 and VRP-48 are found promising for number of pods per plant. For better pod length, genotypes PC-531, AP-1 and Pant Uphar are good, whereas, the genotypes AP-1, VRP-82 and VRP-196 are good for pod width. The mean performance of genotypes VRP-7, VRP-284, Pant Uphar and VRP-248 is best for average pod weight. For high seed weight per pod, genotypes VRP-248, AP-1 and PC-531 has been selected. VRP-7, VRP-241 and VRP-196 are found promising for pod yield whereas VRP-372, VRP-48, VRP-196 and VRP-392 have been used as a source for high seed yield.

While, studying the phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) it was observed that the magnitude of PCV was higher than GCV for all the traits under study suggesting the role of environmental variance (Table 3).

Table.1 Analysis of Variance (ANOVA) of 21 genotypes of garden pea for 15 characters

Source of Variation	Degree of freedom	Mean Sum of Squares														
		Days to 1 st flowering	Days to 50% flowering	Days to 100% flowering	Length of pod (cm)	Width of pod (cm)	Number of primary branches per plant	Plant height (cm)	Number of seeds per pod	Average pod weight (g)	Number of pods per plant	Seed weight per pod (g)	Seed yield per plot (g)	Seed yield (q/ha)	Pod yield per plant (g)	Pod yield per hectare (q/ha)
Replication	2	6.33	2.04	0.39	0.26	0.00	0.07	36.04	0.52	0.25	0.40	0.44	28621.76	1.99	4.17	46.34
Treatment (Genotype)	20	235.01**	195.61**	226.17**	2.56**	0.04**	1.88**	2268.91**	3.43**	0.39**	1.36**	0.76**	79537.21*	5.52**	6.89**	76.62**
Error	40	3.56	3.78	4.14	0.08	0.00	0.27	105.16	0.24	0.22	0.74	0.10	12904.38	0.89	4.25	47.24
SEm ±		1.54	1.58	1.66	0.23	0.04	0.43	8.37	0.40	0.38	0.70	0.26	92.75	0.77	1.68	5.61

Table.2 Mean performance for 15 characters of 21 genotypes of garden pea

Sl. No.	Genotypes	Days to 1 st flowering	Days to 50% flowering	Days to 100% flowering	Length of pod(cm)	Width of pod (cm)	No. of primary branches per plant	Plant height (cm)	No. of seeds per pod	Average pod weight (g)	No. of pods per plant	Seed weight per pod (g)	Seed yield per plot (g)	Seed yield (q/ha)	Pod yield per plant (g)	Pod yield per hectare (q/ha)
1	AP-1	55.33	60.00	65.66	9.66	1.77	3.93	61.46	8.73	5.39	10.66	2.90	1303.00	10.85	56.85	189.52
2	PC-531	54.33	65.00	72.33	9.68	1.48	3.33	46.00	7.93	5.69	10.13	2.63	1400.00	11.66	57.54	191.82
3	VRP-387	53.66	59.66	63.33	8.54	1.56	4.00	70.16	6.53	5.41	10.53	2.10	1272.00	10.60	56.95	189.85
4	VRP-196	53.66	60.66	65.33	7.96	1.59	3.26	72.06	4.73	5.59	10.73	1.53	1707.67	14.23	59.66	198.86
5	VRP-174	42.00	47.66	53.66	8.43	1.52	4.46	57.46	5.60	5.67	10.06	2.20	1345.00	11.20	56.02	186.74
6	VRP-222	41.66	54.66	63.66	6.42	1.20	3.46	68.00	5.33	5.56	10.40	1.63	1423.33	11.86	57.82	192.73
7	VRP-3	38.66	45.00	53.00	8.11	1.52	5.46	52.86	5.93	4.98	11.53	2.00	1375.67	11.46	57.07	190.24
8	VRP-48	63.33	69.33	76.33	7.57	1.48	3.20	72.80	6.93	5.23	11.40	2.00	1725.00	14.37	59.65	198.84
9	VRP-4	42.66	54.33	62.33	7.50	1.42	3.40	64.80	6.66	5.52	10.20	2.03	1617.33	13.48	56.37	187.91
10	VRP-82	42.00	51.66	55.66	8.70	1.62	4.73	64.30	7.26	5.05	10.86	2.56	1539.33	12.82	54.32	181.09
11	VRP-284	58.66	63.00	67.00	6.96	1.46	2.80	132.00	6.13	5.87	9.80	1.70	1628.67	13.57	57.46	191.54
12	VRP-241	57.66	64.00	71.00	7.54	1.47	3.06	72.20	5.33	5.21	11.46	2.33	1548.00	12.90	59.80	199.34
13	VRP-195	55.66	61.66	74.66	7.77	1.48	3.80	84.00	6.80	4.72	11.93	2.33	1527.00	12.72	55.60	185.32
14	VRP-61	61.00	69.00	78.00	7.22	1.32	3.40	133.36	5.73	5.67	10.20	1.03	1614.67	13.45	57.80	192.66
15	VRP-38	36.00	42.00	50.00	7.37	1.40	2.13	49.53	4.73	6.10	9.20	1.63	1458.00	12.15	56.10	187.00
16	VRP-392	58.33	62.66	70.66	6.22	1.40	3.13	126.50	5.20	5.44	10.33	1.66	1706.33	14.22	56.24	187.46
17	VRP-248	61.66	65.66	73.66	8.71	1.55	3.00	60.00	7.73	5.72	10.06	3.13	1540.00	12.83	57.52	191.76
18	VRP-7	67.33	72.33	81.33	8.16	1.44	2.33	45.73	6.33	6.30	9.53	1.80	1299.00	10.82	60.04	200.13
19	VRP-372	52.33	59.66	64.66	7.66	1.57	2.86	59.66	5.26	5.64	10.10	2.03	1887.00	15.72	56.76	189.21
20	VRP-299	54.33	61.33	74.33	7.87	1.52	3.00	99.46	5.60	5.61	10.33	2.46	1450.67	12.09	57.77	192.57
21	Pant Uphar	59.66	67.66	72.66	9.21	1.34	2.60	41.53	6.53	5.73	10.36	2.60	1413.33	11.78	59.10	197.02
*	Grand Mean	52.86	59.86	67.11	7.97	1.48	3.40	73.04	6.24	5.53	10.47	2.11	1513.38	12.61	57.45	191.51
*	SEM ±	1.09	1.12	1.18	0.17	0.03	0.30	5.92	0.18	0.27	0.50	0.19	65.59	0.55	1.19	3.97
*	CD at 5%	3.12	3.21	3.36	0.48	0.09	0.87	16.92	0.81	0.78	1.42	0.54	187.05	1.56	3.40	11.34
*	CD at 1%	4.17	4.29	4.50	0.64	0.13	1.17	22.64	1.08	1.03	1.91	0.72	250.84	2.09	4.55	15.18

Table.3 Estimates of range, mean, genotypic and phenotypic coefficient of variation (GCV and PCV), heritability (H), genetic advance (GA) and genetic gain for 15 characters of 21 genotypes of garden pea

Sl. No.	Character	Range	Grand mean	GCV	PCV	H (%)	GA	Genetic Gain (%)
1	Days to 1 st flowering	36.00 - 67.33	52.86	16.61	16.99	95.58	17.69	33.46
2	Days to 50% flowering	42.00 - 72.33	59.86	13.36	13.74	94.41	16.00	26.74
3	Days to 100% flowering	50.00 - 81.33	67.11	12.81	13.17	94.69	17.24	25.69
4	Length of pod (cm)	6.23 - 9.68	7.97	11.41	11.98	90.84	1.78	22.42
5	Width of pod (cm)	1.21 - 1.77	1.48	7.67	8.58	79.81	0.21	14.12
6	No. of primary branches per plant	2.13 - 5.46	3.40	21.54	26.55	65.83	1.22	36.00
7	Plant height (cm)	41.53 - 133.36	73.04	36.76	39.35	87.27	51.68	70.75
8	No. of seeds per pod	4.73 - 8.73	6.24	16.53	18.31	81.54	1.92	30.76
9	Average pod weight (g)	4.72 - 6.30	5.53	4.30	9.53	20.42	0.22	4.01
10	No. of pods per plant	9.20 - 11.93	10.47	4.34	9.32	21.77	0.43	4.18
11	Seed weight per pod (g)	1.03 - 3.13	2.11	22.14	26.95	67.46	0.79	37.46
12	Seed yield per plot (g)	1272–1887	1513.38	9.84	12.38	63.25	244.16	16.13
13	Seed yield (q/ha)	10.60 - 15.72	12.61	9.84	12.38	63.25	2.03	16.13
14	Pod yield per plant (g)	54.33 - 60.04	57.45	1.63	3.94	17.16	0.80	1.39
15	Pod yield per hectare (q/ha)	181.09 - 200.13	191.51	1.63	3.94	17.17	2.67	1.39

The PCV and GCV values (> 20%) were high for plant height, seed weight per pod and number of primary branches per plant. Moderate PCV and GCV values (10% - 20%) was recorded for days to 1st flowering, days to 50% flowering, days to 100% flowering and length of pod. Low PCV and GCV (less than 10%) values have been shown for seed yield per plot, seed yield per hectare, width of pod, number of pods per plant, average pod weight, pod yield per plant and pod yield per hectare indicating narrow range of variation for these characters and provides very least scope for selection. Similar type of results has also been reported by Lal *et al.*, (2011) and Singh *et al.*, (2012).

Estimates of heritability in broad sense ranged from 17.16% (pod yield per plant) to 95.58% (days to 1st flowering). Highest heritability percent was recorded in days to 1st flowering (95.58%) followed by days to 50% flowering, days to 100% flowering, length of pod, width of pod, plant height and number of seeds per pod. The above estimates gave an indication that substantial genetic improvement can be achieved in these characters. Similar kind of results was observed in garden pea for traits like plant height and length garden pea pods by Gupta *et al.*, (2006) and Kumari *et al.*, (2009). High heritability does not mean a high genetic advance for a particular quantitative character. Johnson *et al.*, (1955) reported that heritability estimated along with genetic advance would be more rewarding than heritability alone in predicting the consequential effect of selection to choose the best individual.

High heritability and moderate genetic gain was observed for characters like days to 50% flowering, days to 100% flowering, length of garden pea pods and width of garden pea pods. This indicates the influence of non additive gene action and environment in the expression of these traits which are less reliable for direct selection in crop improvement. So, breeder should adopt proper methods to utilize both additive and non additive gene effects simultaneously. This highlights the fact

that in variability studies one should not rely upon phenotype alone while making selection it is always better to consider PCV, GCV and high heritability coupled with high genetic gain. Hence, the breeder should adopt suitable breeding methodology to utilize both additive and non-additive gene effects simultaneously since varietal and hybrid development will go a long way in the breeding programmes.

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