Biological Forum – An International Journal **15(4): 829-833(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Genetic variability and Selection Parameters for Green Pod Yield in Table Pea (*Pisum sativum* L. var. *hortense*)

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(Received: 09 February 2023; Revised: 16 March 2023; Accepted: 20 March 2023; Published: 18 April 2023)
(Published by Research Trend)

ABSTRACT: An experiment consisting 43 diverse genotypes of table pea derived from 10 lines and 3 testers (13 parents + 30 F_1s) were evaluated in a randomized block design replicated thrice at Vegetable Research Farm of C. S. Azad University of Ag. & Tech., Kanpur, (U.P.) during Rabi of 2020-21. The data were collected on days to 50% per cent flowering, node number of first flower, inter-nodal length, number of primary branches, days to first picking of pods, average pod length, number of pods per plant, average pod weight, number of seeds per pod, average plant height, seed shell per cent, green pod yield per plant.
The result showed high level of genetic variability both for genotypic and phenotypic coefficients. Highest PCV and GCV was noted for plant height followed by number of primary branches, number of pods per plant and average pod weight and green pod yield per plant based on F_1 while it was lowest for seed shell per cent, days to first picking of pods, average pod length and days to 50% flowering. High heritability in broad sense was noted for all the characters. The genetic advance was high for plant height, days to 50% flowering, number of pods per plant and days to first picking of pods, the highest genetic gain in the tune of 73.10% for plant height followed by number of primary branches (48.89%) and average pod weight (48.45%) and number of pods per plant (48.11%) at 5% selection intensity over mean.
Simple selection procedure followed by pedigree method will be more appropriate for improving the green pod yield while making selection.

Keywords: Table pea, *Pisum sativum*, genetic variability, heritability, genetic advance, selection parameters.

INTRODUCTION

Table pea (*Pisum sativum* L. var. *hortense*) is one of the most important leguminous crops grown for its green pods in India. It is a nutritious, cool-season vegetable crop cultivated widely throughout the world. Besides rich source of vegetable protein and amino acids it is also rich source of Ca, P, Fe and Vitamins B and C. India is the second largest producer of table pea in the world after China. At the global level, garden pea is produced over an area of about 2.18 million hectare with sharing 19.87 million tonnes production as the average productivity is about 1.63 tonnes per hectare while India occupies 0.573 million hectare with a production of 5.82 million tonnes having productivity of 1.35 tonnes per hectare (National Horticulture Board, 2020-21). It is a leading vegetable crop among all the legume vegetables. Its dried seeds are used for various preparations of dishes after soaking in water. Being a leguminous crop it also helps in biological nitrogen fixation in soils with the help of *Rizobium* bacteria and improves the soil fertility. Genetic studies for better selection has got lot of attention on improvement of grain yield and its components in field pea since the Mendalean era but it is extremely limited in case of table pea as vegetable crop. For better selection in any crop, the genetic variability is must for selection of superior genotypes practised for the character concern. The heritability and genetic advance coupled with phenotypic and genotypic coefficient of variability is prime tool for a breeder for preparation of efficient strategy during effective selection. Hence, the present investigation is an attempt to improve the green pod yield and its components through selection based on F_1s.

MATERIAL AND METHOD

The experimental material of this study was comprised of 13 parents (10 lines and 3 testers) were crossed in

line × tester fashion to produce 30 F1s during the year 2019-20. The F_1s were evaluated in a randomized block design in three replications at vegetable Research Farm of C. S. A. University of agriculture and technology, Kanpur during Rabi 2020-21. Each genotype was sown in single row of three meter long spaced at 45 cm × 10 cm. among the rows and plants respectively. The field was surrounded by additional two rows of same crop to minimize the border effects. All there commended package of practices was applied for growing a healthy crop. The data were recorded on days to 50% per cent flowering, node number of first flower, inter-nodal length, number of primary branches, days to first picking of pods, average pod length, number of pods per plant, average pod weight, number of seeds per pod, average plant height, seed shell per cent, green pod yield per plant at appropriate stage of the crop from five randomly selected plants from each line and each replication. The mean data were statistically analysed as usual procedures. The genotypic and phenotypic coefficient of variability was estimated following the method of Burton (1952). The heritability in broad sense (h^2) was estimated according to the method proposed by Burton and Devane (1953); similarly the genetic advance at p=0.05 was calculated by the method of Johnson *et al.* (1955). The correlation coefficients were estimated following the method given by Al- Jibouri *et al*. (1958).

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences of treatments for all the characters under study (Table 1). Highest PCV and GCV was noted for plant height followed by number of primary branches, number of pods per plant, average pod weight and green pod yield per plant based on F_1s (Table 2) while it was lowest for seed shell per cent, days to first picking of pods, average pod length and days to 50% flowering. Higher the variances of coefficient for phenotypic and genotypic indicate high level of variability which provides ample chance to select suitable genotypes from variable population. Similar findings has also been reported by Singh *et al*. (2019) high value of GCV and PCV was recorded for seed yield per plant, number of pods per plant, shell weight per plant, green pod yield per plant, plant height, length of first fruiting node and number of first fruiting node, Pujari *et al*. (2020) for number of primary braches per plant, number of pods per plant, and plant height (cm). Heritability is estimates of genotypic variance to phenotypic ones and provides opportunities for a breeder to direct selection based on characters to improve. Heritability alone could not provide the clear picture of diverse material unless it linked with genetic advance. High heritability in broad sense was noted for all the characters. The genetic advance was high for plant height, days to 50% flowering, number of pods per plant and days to first picking of pods. High heritability coupled with high genetic advance indicated the presence of additive genetic variances while high heritability with low genetic advance is indication of the presence of both additive and non-additive variances and low heritability coupled with low genetic advance is fully reflected the non-additive gene action and could not helpful for selection in self-pollinated crops like table pea without certain modifications. The characters under study showed high amount of coefficient of variations for both at genotypic and phenotypic level which can easily harvest in terms of superior genotypes. Lush (1940) reported that the GCV together with heritability estimates would give the best picture of the amount of genetic advance to be expected from single cycle of selection at p=0.05. The information on heritability estimates was also helpful for study of inheritance of quantitative characters as well as for preparing a suitable plan of breeding programme with desired degree of expected genetic progress. Heritability in broad sense was of tremendous significance for a breeder at its magnitude indicates the reliability with which a genotype can be recognized by its phenotypic expressions. Burton and Devane (1953) suggested that coefficient of variation alone could not be useful for partitioning of heritable components of variation. The highest genetic gain in the tune of 73.10% for average plant height followed by number of primary branches (48.89%) and average pod weight (48.45%) and number of pods per plant (48.11%) at 5% selection intensity over mean. Similar findings based on various characters of table pea have also been reported by Kumar *et al*. (2018) plant height, number of pods per plant, number of primary branches, number of pods per plant, pod length and number of seeds per pod, Archi *et al*. (2020) for seed yield per plant, number of pods per plant, length of first fruiting node.

Correlation coefficient. The correlations which are arise due to linkages or pleiotropic effects of gene are helpful for formulation of selection indices and indirectly express the characters *via.* its component traits. In present study the genotypic correlations are higher than corresponding phenotypic ones but same in direction, it revealed that these correlations are due to pleitropic effects of gene rather than linkages. In general the only genotypic correlations are of practical utility as compared with phenotypic correlations as phenotypic correlations are highly influenced by environmental interactions which are not heritable and transferable during selection. Positive and significant correlations with number of pods per plant, average pod weight and number of seeds per pod with green pod yield indicated that the pod yield can be improved through improving these characters. While negative and significant correlation with plant height expressed that enhancement of plant height results lower the pod yield and *vice versa*. It might be due to excess translocation of photosynthates from leaves to growth of plants instead of economic part *i.e.* pod/grain yield It is why plant breeder always trying to develop short statured plants rather than tall one which can give higher economic yield in leguminous crops like peas. These findings are in accordance with earlier reports of Pal and Singh (2012) for plant height, days to first flower emergence, days to 50 per cent flower emergence, days to first pod set, days to maturity of edible green pod, number of primary branches per plant, number of seeds

per pod and number of pods per plant at phenotypic and genotypic level, Khan *et al*. (2017) for days to first flowering, average plant height, number of branches per plant, pod length, number of pods per plant, hundred seed weight, number of seeds per pod exhibited that they were controlled by additive gene action, Ban *et al*. (2019) for yield and its component characters in twenty one different genotypes of pea and correlation studies revealed that green pod yield per plant was positively and significantly associated with number of seeds per green pod and pod length, Tasnim *et al*. (2022); Vinayaka *et al*. (2022) for plant height, pod per plant, hundred seed weight, and seed yield per plot.

Table 1: GCV & PCV %, heritability %, genetic advance and genetic advance % over mean.

Genotypes	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance	Genetic Advance % over mean
	F1	F1	F1	F1	F1
Days to 50% flowering	11.17	11.29	97.98	11.97	22.78
Node no. of first flower	16.55	16.8	97.03	3.29	33.58
Inter-nodal length(cm.)	17.02	17.87	90.78	1.9	33.41
No. of primary branches	25.44	27.28	87	0.88	48.89
Days to first picking of pods	7.68	7.76	97.91	13.44	15.66
Average pod length(cm.)	10.46	10.65	96.47	1.61	21.17
No. of pods per plant	23.62	23.9	97.74	15.03	48.11
Average pod weight (g.)	23.59	23.67	99.36	1.45	48.45
No. of seeds per pod	20.03	20.16	98.74	2.9	41.01
Plant height (cm.)	35.7	35.92	98.79	74.32	73.1
Seed shell %	7.2	7.21	99.82	7.57	14.82
Green pod yield per plant	23.19	23.24	97.05	41	47.07

Table 2: Genotypic correlation.

Characters	Days to 50% flowering	Node no. of first flower	Inter-nodal length (cm.)	No. of primary branches	Days to first picking of pods	Average pod length(cm.)	No. of pods per plant	Average pod weight (g.)	No. of seeds per pod	Plant height (cm.)	Seed shell %	Protein content %	Lysine content (% of protein)	Iron content (mg/100g)	Green pod yield per plant (g.)
Days to 50% flowering	1.000	0.239**	-0.116	-0.278**	0.618**	-0.543**	0.017	0.024	-0.443**	0.043	0.017	-0.183*	0.038	-0.217*	0.112
Node no. Of first flower			0.023	0.035	0.021	-0.259**	-0.072	0.162	-0.256**	0.191*	-0.084	0.021	0.321**	0.224*	0.037
Inter-nodal length(cm.)				0.317**	-0.107	-0.078	0.285**	-0.261**	0.184*	0.345**	0.075	-0.031	-0.102	-0.321**	-0.004
No. of primary branches					-0.153	0.225*	0.088	0.114	0.285**	0.040	-0.544**	0.199*	-0.086	0.271**	0.108
Days to first picking of pods						-0.549**	0.061	-0.100	-0.240**	0.212*	-0.046	-0.408**	-0.232**	-0.200*	0.011
Average pod length(cm.)							-0.170	0.498**	0.496**	-0.474**	-0.124	0.196*	0.049	0.101	0.242**
No. of pods per plant								-0.285**	-0.250**	0.315**	0.078	-0.196*	-0.127	-0.297**	0.532**
Average pod weight (g.)									0.332**	-0.536**	-0.156	0.006	0.283**	-0.133	0.625**
No. of seeds per pod										-0.239**	-0.119	0.043	-0.257**	0.032	0.058
Plant height (cm.)											-0.179*	-0.324**	-0.076	0.218*	-0.207*
Seed shell %												0.002	-0.045	-0.346**	0.012
Protein content %													0.187*	0.209*	-0.179*
Lysine content (% of protein)														-0.048	0.163
Iron content (mg/100g)															-0.404**
Green pod yield per plant (g.)															1.000

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

Table 3: Genotypic path analysis with green pod yield per plant.

Characters	Days to 50% flowering	Node no. of first flower	Inter-nodal length(cm.)	No. of primary branches	Days to first picking of pods	Average pod length(cm.)	No. of pods per plant	Average pod weight (g.)	No. of seeds per pod	Plant height (cm.)	Seed shell %	Protein content %	Lysine content (% of protein)	Iron content (mg/100g)	Green pod yield per plant (g.)
Days to 50% flowering	**0.1169**	-0.0226	0.0049	-0.0181	-0.0151	0.0055	0.0123	0.0208	-0.0084	0.0037	0.0022	0.0028	0.0019	0.0053	0.112
Node no. of first flower	0.0279	**-0.0944**	-0.0010	0.0023	-0.0005	0.0026	-0.0537	0.1419	-0.0048	0.0164	-0.0108	-0.0003	0.0163	-0.0055	0.037
Inter-nodal length(cm.)	-0.0136	-0.0022	**-0.0417**	0.0206	0.0026	0.0008	0.2117	-0.2284	0.0035	0.0295	0.0097	0.0005	-0.0052	0.0078	-0.004
No. of primary branches	-0.0324	-0.0033	-0.0132	**0.0652**	0.0038	-0.0023	0.0652	0.1000	0.0054	0.0034	-0.0701	-0.0031	-0.0044	-0.0066	0.108
Days to first picking of pods	0.0722	-0.0019	0.0045	-0.0100	**-0.0245**	0.0056	0.0456	-0.0878	-0.0045	0.0182	-0.0060	0.0063	-0.0118	0.0049	0.011
Average pod length(cm.)	-0.0635	0.0245	0.0032	0.0146	0.0134	**-0.0102**	-0.1264	0.4360	0.0094	-0.0405	-0.0160	-0.0030	0.0025	-0.0025	0.242**
No. of pods per plant	0.0019	0.0068	-0.0119	0.0057	-0.0015	0.0017	**0.7429**	-0.2499	-0.0047	0.0269	0.0100	0.0030	-0.0065	0.0072	0.532**
Average pod weight (g.)	0.0028	-0.0153	0.0109	0.0074	0.0025	-0.0051	-0.2120	**0.8758**	0.0063	-0.0458	-0.0201	-0.0001	0.0144	0.0033	0.625**
No. of seeds per pod	-0.0518	0.0241	-0.0077	0.0185	0.0059	-0.0050	-0.1856	0.2910	**0.0189**	-0.0204	-0.0153	-0.0007	-0.0131	-0.0008	0.058
Plant height (cm.)	0.0050	-0.0181	-0.0144	0.0026	-0.0052	0.0048	0.2338	-0.4695	-0.0045	**0.0855**	-0.0231	0.0050	-0.0038	-0.0053	-0.207*
Seed shell %	0.0020	0.0079	-0.0031	-0.0355	0.0011	0.0013	0.0578	-0.1370	-0.0022	-0.0153	**0.1287**	0.0000	-0.0023	0.0084	0.012
Protein content %	-0.0214	-0.0020	0.0013	0.0129	0.0100	-0.0020	-0.1454	0.0055	0.0008	-0.0277	0.0003	**-0.0155**	0.0095	-0.0051	-0.179*
Lysine content (% of protein)	0.0045	-0.0303	0.0042	-0.0056	0.0057	-0.0005	-0.0946	0.2475	-0.0049	-0.0065	-0.0058	-0.0029	**0.0508**	0.0012	0.163
Iron content (mg/100g)	-0.0253	-0.0211	0.0134	0.0177	0.0049	-0.0010	-0.2203	-0.1167	0.0006	0.0186	-0.0445	-0.0032	-0.0025	-0.0244	-0.404**

Resi = 0.0377; *, ** significant at 5% and 1% level, respectively.

CONCLUSIONS

From this study it can be generally indicated that there was plenty of genetic variability among the genotypes. Thus, there is vast opportunity in the improvement these table pea genotypes. Therefore, the results and information generated from current study need to be used by interested plant breeders. Studies revealed that the green pod yield per plant, Average pod weight and number of pods per plant with high heritability and high genetic advance were the major yield attributing characters so emphasis should be given for these characters at the time of simple selection.

Acknowledgement. This work was done by author for the doctor of philosophy thesis at C S Azad University of Agriculture and Technology, Kanpur, U.P. The author is highly grateful for the research facilities provided by the university and sincerely acknowledge the support of Dr. K. P.Singh, Assistant Professor and advisor for the support during whole research work.

Conflict of Interest. None.

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How to cite this article: Pratyksh Pandey, K.P. Singh, Harshit Tripathi, H.C. Singh, Pawan Kumar Saini, Rajiv, Lokendra Singh and P.K. Singh (2023). Genetic variability and Selection Parameters for Green Pod Yield in Table Pea (*Pisum sativum* L. var. *hortense*). *Biological Forum – An International Journal, 15*(4): 829-833.