

Assessment of yield and horticultural potency through genetic parameter studies for early genotypes of garden pea under wet sub-temperate conditions of North Western Himalaya

HIMANI, SHIVAM SHARMA*, D.R. CHAUDHARY, ANKUSH SHARMA AND KETAN

Department of Vegetable Science and Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh-176062, India

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ABSTRACT

The current study was planned to assess yield and horticultural potency in order to identify most promising early genotypes of garden pea in which 22 diverse genotypes were assessed through genetic variability, character association and path coefficient analysis for 16 agro-morphological traits during rabi 2020-21 in randomized complete block design with three replications at CSK HPKV, Palampur. Genotypes viz., 2019/PMVAR-4, 2018/PEVAR-1, 2018/PEVAR-4, 2018/PEVAR-2 and 2019/PEVAR-8 were the top-ranking genotypes for pod yield per plant which significantly out yielded all the genotypes with a significant increase of 76.25, 47.83, 42.36, 41.60, 41.51 per cent respectively over standard check, Palam Triloki. High PCV than GCV indicated the considerable influence of environment on the performance of the genotypes. The high heritability along with moderate genetic gain was observed for pod length, average pod weight and plant height. Traits viz., days to 50% flowering, average pod weight and pods per plant were the important pod yield determinants as these displayed high direct effects and significant positive correlation with pod yield per plant.

Keywords: Correlation, direct effects, heritability, mean performance, IIVR

INTRODUCTION

Garden pea (*Pisum sativum* L.), grown on commercial scale for its tender and immature seeds as winter vegetable in Northern plains and during spring in high hills. Consumers prefer hill grown peas because of their distinct flavour, crispness, sweetness, and freshness. Unlike cereals, being leguminous vegetable, it is rich in lysine, protein, vitamin-A and C. Currently, India is largest producer of pea in the world and owing to its diverse agroclimatic condition, it is grown round the year and hence bringing handsome lucrative returns to the growers (Katoch *et al.* 2013). The green pods from hilly areas become available at a time (April-October), when these cannot be grown in the plains on account of adverse weather conditions especially high temperature. As a result, the produce sells at premium, fetching lucrative returns to the growers. On account of its relatively higher economic importance, the productivity especially of early genotypes is still low owing mostly to the lack of varieties with stable, high yielding potential and losses due to several biotic and abiotic stresses (Rahman *et al.* 2019). Hence, there is a need to explore genetic variability which is considered as an important pre requisite for crop improvement program to obtain high

yielding progenies (Sharma *et al.* 2020). Thus, the information on nature and magnitude of genetic variability present in the genetic stocks, along with correlation, path coefficient and multivariate analysis are of considerable use in selecting the suitable genotypes to be included in future pea improvement programmes.

MATERIALS AND METHODS

The experimental material comprised of 22 genotypes of garden pea (early group) received from Indian Institute of Vegetable Research (IIVR), Varanasi as part of AICRP on Vegetable crops and other genotypes collected from IARI, New Delhi; PAU, Ludhiana and CSK HPKV, Palampur. The experiment was designed in Randomized Complete Block Design (RBD) with three replications during rabi 2020-2021. Each experimental unit consisted of two rows of 1.8 m length and plants were spaced at inter and intra row spacing of 45 cm and 10 cm, respectively. The observations were recorded on 10 randomly selected competitive plants from each entry per replication for 16 traits viz., days to 50 % flowering, days to first picking, harvest duration (days), pod length (cm), pod diameter (cm), average pod weight (g), seeds per pod, shelling

percentage (%), branches per plant, nodes per plant, inter nodal length (cm), plant height (cm), pods per plant, TSS (⁰b), ascorbic acid (mg/100g) and pod yield per plant (g).

Analysis of variance was calculated as per the methodology suggested by Panse and Sukhatme (1987) and other genetic parameters were estimated following standard formulae suggested by Johnson et al. (1955), Burton (1952) and Lush (1940). Correlation and path coefficient analysis was done as per standard procedure provided by Al-Jibouri et al. (1958); Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance

The analysis of variance revealed highly significant differences for all of the traits under study revealed ample amount of genetic variability found among the genotypes (Table 1). The results were in confirmation with the findings of Mohanty et al. (2020), Rahman et al. (2019) and Devi et al. (2017) who observed sufficient genetic diversity amongst the experimental material evaluated.

Table 1: ANOVA for pod yield and its components in pea

Sources of variation/Traits	Mean squares		
	Replication	Genotype	Error
df	2	21	42
Days to 50 % flowering	7.91	30.74*	8.57
Days to first picking	37.92	26.48*	8.48
Harvest duration (days)	6.56	18.08*	8.32
Pod length (cm)	0.77	2.38*	0.35
Pod diameter (cm)	0.01	0.10*	0.02
Average pod weight (g)	0.50	2.86*	0.35
Seeds per pod	0.05	0.89*	0.19
Shelling percentage (%)	15.93	35.47*	15.13
Branches per plant	0.01	0.03*	0.02
Nodes per plant	1.44	9.65*	1.21
Inter nodal length (cm)	0.29	0.62*	0.12
Plant height (cm)	33.12	181.22*	20.21
Pods per plant	0.57	2.25*	1.19
TSS (b)	0.26	2.75*	1.51
Ascorbic acid (mg/100g)	2.91	21.41*	9.27
Pod yield per plant (g)	88.54	527.02*	120.66

*Significant at 5 % level of significance

Mean performance

Based on mean performance, 2019/PMVAR-4, 2018/PEVAR-1, 2018/PEVAR-4, 2018/PEVAR-2 and 2019/PEVAR-8 were the top-ranking genotypes for pod yield per plant which significantly out yielded all the genotypes with a significant margin of 76.25, 47.83, 42.36, 41.60 and 41.51 per cent, respectively over standard check, (Palam Triloki) in Table 2. The superior performance of these genotypes for pod yield per plant was mainly attributed to their best performance for average pod weight and pods per plant. On the same line, Sekhon et al. (2017) reported average pod weight and pods per plant as most significant yield influencers.

Genetic parameters of variability

High phenotypic coefficient of variation (PCV) was reported when compared to genotypic coefficient of variation (GCV) indicated presence of additive gene effect influenced by environmental factors (Table 3). The phenotypic coefficient of variation ranged from 3.11 % for days to first picking to 23.86 % for pod yield per plant while genotypic coefficient of variation ranged from 2.00 % for days to first picking to 17.35 % for pod yield per plant. Hence, pod yield per plant was the only trait to exhibit both high PCV and GCV. Finding of Bhardwaj et al. (2020) and Kumar et al. (2019) followed the same pattern of high PCV and GCV for pod yield per plant.

Table 2: Mean performance of garden pea genotypes for different traits

Genotype	Days to 50% flowering	Days to first picking	Harvest duration (days)	Pod length (cm)	Pod diameter (cm)	Average pod weight (g)	Seeds per pod	Shelling percentage (%)	Branches per plant	Nodes per plant	Inter nodal length (cm)	Plant height (cm)	Pods per plant	TSS (°b)	Ascorbic acid (mg/100g)	Pod yield per plant (g)
2019/PEVAR-1	76.33	119.67	17.33	9.26	3.69	5.60	6.50	48.22	1.27	16.47	4.25	70.04	11.30	15.93	23.53	63.30
2019/PEVAR-2	72.97	117.33	15.67	8.65	3.58	5.43	6.73	49.33	1.13	16.27	4.88	79.33	10.63	16.67	27.43	58.52
2019/PEVAR-3	74.43	123.33	17.33	10.03	3.31	5.83	6.50	54.77	1.33	16.80	4.19	70.26	9.90	18.47	25.40	57.70
2019/PEVAR-4	76.47	119.67	17.33	9.06	3.68	5.40	7.16	50.16	1.20	17.13	5.11	87.37	11.67	17.07	20.91	62.98
2019/PEVAR-5	76.90	120.00	14.33	8.69	3.67	4.90	6.67	50.28	1.20	14.73	4.30	63.33	11.60	16.23	24.38	57.43
2019/PEVAR-6	75.40	118.00	16.00	10.24	3.39	6.27	7.73	50.04	1.23	15.87	4.24	67.07	11.57	19.37	27.43	72.23
2019/PEVAR-7	80.47	123.33	19.00	9.55	3.73	5.23	6.57	51.22	1.17	15.60	4.22	65.67	11.47	18.43	28.95	60.78
2019/PEVAR-8	80.33	121.33	16.67	10.75	3.66	6.67	8.20	51.80	1.23	15.80	4.23	66.44	12.07	17.80	23.92	80.58
2019/PEVAR-9	79.50	127.00	14.67	10.72	3.25	6.07	6.77	50.26	1.23	15.07	4.74	71.59	11.30	18.40	28.95	68.51
2019/PEVAR-10	82.97	122.00	17.33	8.77	3.72	6.57	7.17	50.30	1.13	14.33	4.67	66.76	10.67	18.53	23.04	70.03
2019/PMVAR-4	79.67	122.00	23.33	9.94	3.71	7.89	7.90	53.63	1.27	18.47	4.55	83.98	12.70	17.43	21.06	100.36
2019/PMVAR-8	80.63	124.33	17.67	10.35	3.30	3.62	6.83	54.50	1.53	22.40	3.47	77.80	10.59	17.60	25.62	38.28
2018/PEVAR-1	80.17	126.00	20.33	11.10	3.57	6.67	7.40	53.07	1.33	17.60	4.12	72.13	12.43	17.13	24.38	84.18
2018/PEVAR-2	79.40	121.33	18.33	9.33	3.72	6.53	6.90	48.06	1.27	15.47	4.79	73.94	12.37	17.23	26.33	80.63
2018/PEVAR-3	81.97	124.00	18.67	9.74	3.56	5.47	7.30	53.70	1.27	16.07	4.64	74.38	12.27	16.80	21.87	67.19
2018/PEVAR-4	82.13	125.33	20.67	10.34	3.38	6.10	7.67	48.70	1.53	19.07	4.54	86.41	13.23	18.63	19.81	80.78
2018/PEVAR-5	83.80	127.67	18.33	10.48	3.97	6.67	7.77	48.04	1.27	16.93	4.89	82.88	10.37	16.77	22.14	69.37
2018/PEVAR-6	81.27	123.67	18.67	11.42	3.39	6.97	7.93	53.47	1.33	17.00	4.45	75.23	10.73	18.54	23.76	74.61
2018/PEVAR-7	82.20	117.33	20.33	8.89	3.65	6.23	6.50	49.74	1.27	14.93	4.79	70.88	10.23	15.87	21.72	63.88
Pusa Shree	74.67	125.67	21.00	8.35	3.61	4.33	6.47	43.63	1.43	15.50	5.12	79.40	11.93	18.10	26.05	51.69
Palam Triloki	74.00	121.67	22.33	8.73	3.73	4.89	7.13	42.47	1.27	16.80	3.38	56.67	11.63	18.20	24.10	56.94
Matar Ageta	77.33	122.67	22.33	8.98	3.61	4.76	6.83	43.53	1.33	18.60	4.00	74.27	11.83	17.77	20.38	55.57
Mean	78.77	122.42	18.53	9.70	3.59	5.82	7.12	49.95	1.28	16.68	4.44	73.45	11.48	17.59	24.15	67.07
Range	72.97- 83.80	117.33- 127.67	14.33- 23.33	8.35- 11.42	3.25-3.97	3.62- 7.89	6.47- 8.20	42.47- 54.77	1.13-1.53	14.33- 22.40	3.38- 5.12	56.67- 87.37	9.90- 13.23	15.87- 19.37	19.81- 28.95	38.28- 100.36
SE (m) ±	1.69	1.68	1.67	0.34	0.08	0.34	0.25	2.25	0.07	0.64	0.20	2.60	0.63	0.71	1.76	6.34
SE (d) ±	2.39	2.38	2.36	0.48	0.11	0.48	0.35	3.18	0.10	0.90	0.28	3.67	0.89	1.00	2.49	8.97
CD (5%)	4.84	4.82	4.77	0.97	0.21	0.98	0.72	6.43	0.20	1.82	0.57	7.44	1.80	2.03	5.03	18.16
CV (%)	3.72	2.38	15.57	6.07	3.61	10.13	6.09	7.79	9.60	6.60	7.81	6.12	9.49	6.99	12.61	16.38

Table 3: Estimates of phenotypic, genotypic coefficients of variation, heritability and genetic gain for different traits in garden pea

Trait	Mean \pm SE(m)	Range	PCV (%)	GCV (%)	Heritability (h^2) (%)	Genetic gain
Days to 50% flowering	78.77 \pm 1.69	72.97-83.80	5.07	3.45	46.30	4.84
Days to first picking	122.42 \pm 1.68	117.33-127.67	3.11	2.00	41.44	2.65
Harvest duration (days)	18.53 \pm 1.67	14.33-23.33	18.36	9.74	28.11	10.63
Pod length (cm)	9.70 \pm 0.34	8.35-11.42	10.43	8.48	66.09	14.20
Pod diameter (cm)	3.59 \pm 0.08	3.25-3.97	5.80	4.55	61.44	7.35
Average pod weight (g)	5.82 \pm 0.34	3.62-7.89	18.71	15.73	70.69	27.24
Seeds per pod	7.12 \pm 0.25	6.47-8.20	9.12	6.79	55.38	10.41
Shelling percentage (%)	49.95 \pm 2.25	42.47-54.77	9.37	5.21	30.94	5.97
Branches per plant	1.28 \pm 0.07	1.13-1.53	11.43	3.45	29.47	6.94
Nodes per plant	16.68 \pm 0.64	14.33-22.40	12.03	10.06	69.87	17.32
Internodal length (cm)	4.44 \pm 0.20	3.38-5.12	12.09	9.23	58.31	14.52
Plant height (cm)	73.45 \pm 2.60	56.67-87.37	11.70	9.97	72.64	17.51
Pods per plant	11.48 \pm 0.63	9.90-12.70	10.81	5.18	22.94	5.11
TSS ($^{\circ}$ b)	17.59 \pm 0.71	15.87-19.37	7.89	3.65	21.40	3.48
Ascorbic acid (mg)	24.15 \pm 1.76	19.81-28.95	15.11	8.33	30.40	9.46
Pod yield per plant (g)	67.07 \pm 6.34	38.28-100.3	23.86	17.35	52.89	26.00

Heritability estimates were high for plant height (72.64%), average pod weight (70.69%), nodes per plant (69.87%), pod length (66.09%) and pod diameter (61.44%) indicated that they were less impacted by environment and selection based on phenotypic performance would be more reliable. Similar results were reported by Katoch *et al.* (2014) and Pal and Singh (2013) for plant height, pod length and pod yield per plant. Moderate values of genetic gain were observed for average pod weight, pod yield per plant, plant height, inter nodal length, pod length, harvest duration and seeds per pod. The results were in agreement with the findings of Chauhan *et al.* (2020); Singh and Dhali (2018) for moderate genetic advance for pod weight and seeds per pod. Among above mentioned traits pod length, average pod weight and plant height exhibited both high heritability couple with moderate genetic gain suggested that effective selection for these traits would be effective due to additive gene action. Similar finding for pod length by Bhardwaj *et al.* (2020) also observed high heritability with moderate genetic gain for average pod weight

Character association

The correlation studies revealed that in general, genotypic correlations were greater in magnitude than phenotypic correlation, indicating inherent relationship with days to 50% flowering, pod length, average pod weight, seeds per pod and pods per plant at both

phenotypic and genotypic level which indicated that selection based on these traits would be more effective and rewarding (Table 4). Asha *et al.* (2020) and Singh *et al.* (2019) confirmed same trend for findings of above-mentioned traits.

Path coefficient analysis

In addition, path coefficients studies revealed that days to 50% flowering, average pod weight and pods per plant were the important yield determinants for direct selection as these traits exhibited highest direct effects coupled with significant positive correlation with pod yield per plant (Table 5). These traits can be considered as the best selection indices for increasing pod yield in garden pea. The results by Asha *et al.* (2020), Raj *et al.* (2020) and Katoch *et al.* (2013), also observed direct positive effects of pod length, pods per plant, average pod weight on pod yield per plant at both genotypic and phenotypic level.

CONCLUSION

Therefore, it was concluded that 2019/PMVAR-4, 2018/PEVAR-1, 2018/PEVAR-4 2018/PEVAR-2 and 2019/PEVAR-8 were the top-ranking genotypes out of which traits viz., days to 50% flowering, average pod weight and pods per plant were emerged as the important pod yield influencer and determinants for future pea improvement program.

Table 4 Estimates of Phenotypic (P) and genotypic (G) coefficients of correlation among different characters in garden pea

Character		Days to first picking	Harvest duration (days)	Pod length (cm.)	Pod diameter (cm.)	Average pod weight (g)	Seeds per pod	Shelling percentage (%)	Branches per plant	Nodes per plant	Inter nodal length (cm)	Plant height (cm)	Pods per plant	TSS (⁰ b)	Ascorbic acid (mg/100g)	Pod yield per plant (g)
Days to 50% flowering	P	0.406**	0.089	0.376**	0.121	0.356**	0.255**	0.229	0.058	0.124	0.043	0.154	0.009	-0.037	-0.216	0.288**
	G	0.435**	0.145	0.541**	0.145	0.474**	0.555**	0.548**	0.233	0.047	0.233	0.237	0.142	-0.075	-0.522**	0.467**
Days to first picking	P		0.105	0.445**	-0.053	0.041	0.095	0.129	0.396**	0.286**	-0.015	0.256**	0.223	0.141	0.050	0.134
	G		0.366**	0.548**	-0.254*	-0.032	0.243*	-0.039	0.621**	0.280*	-0.024	0.247*	0.063	0.594**	-0.069	-0.013
Harvest duration (days)	P			-0.141	0.230	0.042	0.062	-0.291*	0.175	0.194	-0.144	0.054	0.258*	0.081	-0.246*	0.15
	G			-0.062	0.312*	0.133	0.239	-0.399**	0.782**	0.570**	-0.220	0.359**	0.630**	0.031	-0.951**	0.323**
Pod length (cm)	P				-0.277*	0.489**	0.492**	0.468**	0.319**	0.291*	-0.117	0.157	0.133	0.066	0.002	0.465**
	G				-0.562**	0.458**	0.738**	0.740**	0.296*	0.368**	-0.233	0.148	-0.002	0.694**	0.110	0.425**
Pod diameter (cm)	P					0.185	0.065	-0.347**	-0.236	-0.200	0.158	0.006	0.172	-0.331**	-0.183	0.222
	G					0.141	0.051	-0.463**	-0.746**	-0.401**	0.280*	-0.089	-0.049	-0.713**	-0.423**	0.104
Average pod weight (g)	P						0.500**	0.233	-0.122	-0.184	0.218	0.095	0.196	-0.034	-0.175	0.884**
	G						0.737**	0.477**	-0.501**	-0.308*	0.419**	0.166	0.111	0.206	-0.252*	0.942**
Seeds per pod	P							0.101	-0.020	0.139	0.019	0.185	0.153	0.157	-0.220	0.460**
	G							0.441**	0.129	0.234	-0.049	0.231	0.661**	0.516**	-0.528**	0.881**
Shelling percentage (%)	P								-0.064	0.069	0.060	0.108	-0.120	-0.042	0.156	0.143
	G								0.093	0.318**	-0.141	0.158	-0.233	0.087	-0.037	0.422**
Branches per plant	P									0.543**	-0.269*	0.218	0.273*	-0.017	-0.113	0.054
	G									0.937**	-0.294*	0.575**	0.115	0.612**	-0.459**	-0.432**
Nodes per plant	P										-0.507**	0.429**	0.135	0.033	-0.185	-0.046
	G										-0.460**	0.482**	0.123	0.147	-0.438**	-0.212
Inter nodal length (cm)	P											0.553**	0.016	-0.130	-0.061	0.153
	G											0.551**	0.030	-0.362**	-0.112	0.374**
Plant height (cm)	P												0.173	-0.094	-0.265*	0.161
	G												0.228	-0.190	-0.572**	0.232
Pods per plant	P													-0.030	-0.140	0.623**
	G													0.402**	-0.473**	0.435**
TSS (⁰ b)	P														0.119	-0.06
	G														0.641**	0.306*
Ascorbic acid (mg/100g)	P															-0.195
	G															-0.354**

*Significant at $P \leq 0.05$, ** Significant at $P \leq 0.01$ level of significance

Table 5: Estimates of direct and indirect effects of different characters on pod yield of garden pea

		DF	DFP	HD	PL	PD	APW	SPP	SP	BP	NP	IL	PH	PP	TSS	AA	PYP
DF	P	0.001	-0.007	-0.001	0.001	0.001	0.289	-0.004	0.002	0.001	0.006	0.000	-0.002	0.004	0.001	-0.004	0.288*
	G	0.572	-0.206	0.085	0.686	-0.010	0.526	-0.652	-0.289	-0.162	0.065	0.180	-0.150	0.147	0.027	-0.351	0.467**
DFP	P	0.000	-0.017	-0.001	0.001	-0.001	0.033	-0.002	0.001	0.005	0.014	0.000	-0.003	0.103	-0.002	0.001	0.134
	G	0.249	-0.474	0.215	0.694	0.018	-0.036	-0.286	0.021	-0.433	0.387	-0.018	-0.156	0.065	-0.212	-0.046	-0.013
HD	P	0.000	-0.002	-0.006	-0.001	0.002	0.034	-0.001	-0.002	0.002	0.010	0.000	-0.001	0.120	-0.001	-0.005	0.150
	G	0.083	-0.1734	0.587	-0.078	-0.022	0.147	-0.280	0.210	-0.545	0.787	-0.169	-0.227	0.653	-0.011	-0.638	0.323**
PL	P	0.000	-0.008	0.001	0.003	-0.003	0.397	-0.008	0.004	0.004	0.014	0.000	-0.002	0.062	-0.001	0.000	0.465**
	G	0.310	-0.259	-0.036	1.266	0.039	0.508	-0.866	-0.390	-0.206	0.509	-0.180	-0.094	-0.002	-0.248	0.074	0.425**
PD	P	0.000	0.0001	-0.001	-0.001	0.009	0.150	-0.001	-0.003	-0.003	-0.010	0.000	0.000	0.080	0.005	-0.003	0.222
	G	0.083	0.120	0.183	-0.712	-0.070	0.157	-0.060	0.244	0.520	-0.554	0.216	0.056	-0.051	0.255	-0.284	0.104
APW	P	0.000	-0.001	0.000	0.002	0.002	0.812	-0.008	0.002	-0.002	-0.009	0.000	-0.001	0.091	0.001	-0.003	0.884**
	G	0.271	0.015	0.078	0.580	-0.010	1.110	-0.865	-0.251	0.349	-0.425	0.322	-0.105	0.115	-0.074	-0.169	0.942**
SPP	P	0.000	-0.002	0.000	0.002	0.001	0.406	-0.016	0.001	0.000	0.007	0.000	-0.002	0.071	-0.002	-0.004	0.460**
	G	0.317	-0.115	0.140	0.934	-0.004	0.818	-1.174	-0.232	-0.090	0.324	-0.038	-0.146	0.685	-0.185	-0.354	0.881**
SP	P	0.000	-0.002	0.002	0.001	-0.003	0.189	-0.002	0.008	-0.001	0.003	0.000	-0.001	-0.056	0.001	0.003	0.143
	G	0.313	0.019	-0.234	0.937	0.032	0.529	-0.518	-0.527	-0.065	0.440	-0.108	-0.100	-0.242	-0.031	-0.025	0.422**
BP	P	0.000	-0.007	-0.001	0.001	-0.002	-0.099	0.000	-0.001	0.013	0.027	0.000	-0.002	0.127	0.000	-0.002	0.054
	G	0.133	-0.294	0.459	0.374	0.052	-0.556	-0.152	-0.049	-0.697	1.294	-0.226	-0.363	0.119	-0.219	-0.308	-0.432**
NP	P	0.000	-0.005	-0.001	0.001	-0.002	-0.149	-0.002	0.001	0.007	0.049	0.001	-0.005	0.063	-0.001	-0.003	-0.046
	G	0.027	-0.133	0.334	0.466	0.028	-0.342	-0.275	-0.168	-0.653	1.381	-0.354	-0.304	0.127	-0.053	-0.294	-0.212
IL	P	0.000	0.000	0.001	0.000	0.001	0.177	0.000	0.000	-0.004	-0.025	-0.001	-0.006	0.007	0.002	-0.001	0.153
	G	0.133	0.011	-0.129	-0.296	-0.020	0.465	0.058	0.074	0.205	-0.636	0.769	-0.348	0.031	0.129	-0.075	0.374**
PH	P	0.000	-0.004	0.000	0.001	0.000	0.077	-0.003	0.001	0.003	0.021	-0.001	-0.011	0.081	0.001	-0.005	0.161
	G	0.135	-0.117	0.211	0.188	0.006	0.185	-0.271	-0.083	-0.401	0.666	0.424	-0.631	0.236	0.068	-0.384	0.232
PP	P	0.000	-0.004	-0.002	0.000	0.002	0.159	-0.003	-0.001	0.004	0.007	0.000	-0.002	0.465	0.000	-0.003	0.623**
	G	0.081	-0.030	0.370	-0.003	0.003	0.123	-0.776	0.123	-0.080	0.170	0.023	-0.144	1.036	-0.144	-0.318	0.435**
TSS	P	0.000	-0.002	-0.001	0.000	-0.003	-0.027	-0.003	0.000	0.000	0.002	0.000	0.001	-0.014	-0.015	0.002	-0.060
	G	-0.043	-0.281	0.018	0.878	0.050	0.228	-0.606	-0.046	-0.427	0.204	-0.278	0.120	0.416	-0.358	0.430	0.306*
AA	P	-0.000	-0.001	0.002	0.000	-0.002	-0.142	0.004	0.001	-0.002	-0.009	0.000	0.003	-0.065	-0.002	0.018	-0.195
	G	-0.299	0.033	-0.558	0.139	0.029	-0.280	0.620	0.020	0.320	-0.605	-0.086	0.361	-0.491	-0.229	0.671	-0.354**

Residual effect (P) = 0.00474; (G) = -0.03631

Significant at 5; 1% level of significance

DF: Days to 50% flowering, DFP: Days to first picking, HD: Harvest duration, PL: Pod length, PD: Pod diameter, APW: Average pod weight, SPP: Seeds per pod, SP: Shelling percentage, BP: Branches per plant, NP: Nodes per plant, IL: Inter nodal length, PH: Plant height, PP: Pods per plant, TSS: Total soluble solids, AA: Ascorbic acid, PYP: Pod yield per plant

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