Environment and Ecology 41 (3A) :1662—1665, July—September 2023
Article DOI: https://doi.org/10.60151/envec/BECM1320
ISSN 0970-0420

Estimation of Genetic Divergence in Garden Pea (*Pisum sativum* L.) Germplasm

A. B. Asha, Devaraju, G. K. Latha, C. S. Ravi, Chitra K.

Received 15 December 2022, Accepted 12 June 2023, Published on 18 August 2023

ABSTRACT

Genetic diversity among thirty garden pea genotypes was worked out using Mahalanobis D^2 statistics. Based on genetic distance, genotypes were grouped into ten clusters of the ten clusters, cluster I was the largest, having 11 genotypes, followed by cluster IV, cluster VIII, cluster III, cluster V and clusters II, VI, VII, IX and X, with one genotype in each. The average intra-cluster distance was maximum in cluster VIII (487.04) and minimum in cluster V (125.72). The maximum inter-cluster distance was observed between cluster VIII and cluster X (3439.67), indicating the genotypes in these clusters are more diverged and they can be used as parents in the hybridization program to obtain superior segregants. Cluster means for various traits revealed that cluster VIII was found superior for plant height at 60 DAS, number of branches per plant at 60 DAS, and number of pods per plant. Thus, genotypes from this cluster could be used as divergent parents to improve these particular characters. Pod yield per plant contributed the maximum (38.16 %) to the genetic diversity among the characters studied.

Keywords D^2 analysis, Divergence, Garden pea, *Pisum sativum* L.

INTRODUCTION

The garden pea is an important cool-season vegetable crop grown worldwide for its green pods. It has important value in the agricultural economy of the country and is important as a pulse and vegetable crop in the human diet. A large proportion of peas are processed (canned, frozen or dehydrated) for consumption in the off-season. Processed shelled peas are marketed in three forms, viz., frozen, canned and dehydrated, but more than 95 % of shelled peas are used in frozen form. India occupies second place in vegetable production in the world next to China. Garden pea is grown in an area of 549,000 hectares with a production of 5,680,000 metric tons and productivity of 10.34 metric tons per hectare (Anonymous 2022).

A. B. Asha[1], Devaraju[2], G. K. Latha[1]*, C. S. Ravi[3], Chitra K[1].

[1]PG Scholar, [2]Assistant Professor
Department of Vegetable Science, College of Horticulture, Mudigere 577132, Karnataka, India

[3]Assistant Professor
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mudigere 577132, Karnataka, India

Email : lathagombe555@gmail.com
*Corresponding author

It is a leading vegetable crop in the North-Western Himalayan region of India comprising the states of Uttar Pradesh, Madhya Pradesh, Punjab, Jharkhand, Himachal Pradesh, West Bengal, Chhattisgarh and Haryana. The area under the garden pea is confined to hilly regions rather than plains. In recent years many improved varieties have evolved for the plains of India. High-yielding varieties need to be developed to enhance productivity in hilly areas.

Generally, diverse genotypes are expected to give high hybrid vigour (Harrington 1940). Hence, it necessitates the study of genetic divergence among different genotypes to identify divergent parents for the hybridization program. The information on the genetic divergence of various traits, particularly those that contribute to yield and quality, would be most useful in properly planning the breeding program. D^2 statistics developed by Mahalanobis (1928) provide a measure of magnitude for divergence between two genotypes under comparison. Grouping of genotypes based on D^2 analysis will be useful in choosing suitable parental lines for heterosis breeding which in turn helps the farmers to choose elite varieties. Therefore, an attempt has been made in the present studies to estimate genetic divergence among thirty genotypes of a pea.

Table 1. List of genotypes used in the study.

Sl. No.	Name of the genotype	Source
1	Arka Ajith	ICAR, IIHR, Bengaluru
2	Arka Apoorva	ICAR, IIHR, Bengaluru
3	Arka Chaithra	ICAR, IIHR, Bengaluru
4	Arka Harini	ICAR, IIHR, Bengaluru
5	Arka Karthik	ICAR, IIHR, Bengaluru
6	Arka Mayur	ICAR, IIHR, Bengaluru
7	Arka Nirmal	ICAR, IIHR, Bengaluru
8	Arka Pramod	ICAR, IIHR, Bengaluru
9	Arka Priya	ICAR, IIHR, Bengaluru
10	Arka Sampoorna	ICAR, IIHR, Bengaluru
11	Arka Tapas	ICAR, IIHR, Bengaluru
12	Arka Uttam	ICAR, IIHR, Bengaluru
13	IIHR-21	ICAR, IIHR, Bengaluru
14	IIHR-28	ICAR, IIHR, Bengaluru
15	IIHR-33	ICAR, IIHR, Bengaluru
16	IIHR-34	ICAR, IIHR, Bengaluru
17	IIHR-41	ICAR, IIHR, Bengaluru
18	IIHR-44	ICAR, IIHR, Bengaluru
19	IIHR-47	ICAR, IIHR, Bengaluru
20	IIHR-48	ICAR, IIHR, Bengaluru
21	IIHR-50	ICAR, IIHR, Bengaluru
22	IIHR-124	ICAR, IIHR, Bengaluru
23	AFA-10	Ashoka seeds
24	IS-10	Indu seeds
25	SS-101	Solar seeds
26	SAKURA-109	Sakura seed corporation
27	JK-124	JK seeds
28	PS-101	Nutech seeds
29	TSX-10	Tokita seeds
30	GS-10	Golden seeds

MATERIALS AND METHODS

The present studies on thirty pea genotypes, including one check variety viz., Arka Ajith, were conducted at Experimental Farm of the Department of Vegetable Science, College of Horticulture, Mudigere (Karnataka). List of thirty genotypes presented in Table 1. The seeds of all these genotypes were collected from IIHR, Bengaluru, and other seed companies. Seeds were sown directly in the field in October 2018 at a spacing of 60×10 cm in a plot of 2×1.8 m^2. The experiment was laid out in a Randomized Complete Block Design replicated twice.

The observations were recorded from five randomly selected plants from each replication on plant height (cm) at 60 DAS, number of branches/plant at 60 DAS, days taken for first flowering, days taken for first picking, shelling %, number of pods per plant, pod length (cm), pod width (mm), pod thickness (mm), number of seeds per pod, weight of ten pods (g) and pod yield per plant (g).

The statistical analysis was carried out for each observed character under the study using MS Excel and Windostat 9.2. Genetic divergence was estimated by using the D^2 statistics of Mahalanobis (1936) and clustering of genotypes was done according to Tocher's method as described by Rao (1952). The per cent contribution of characters towards genetic divergence was calculated according to Singh and Chaudhary (1977).

RESULTS AND DISCUSSION

Thirty genotypes of garden pea were assessed for 12 characters and subjected to D^2 statistics to assess the

Table 2. Cluster composition based on D^2 statistics in garden pea genotypes.

Clusters	Number of genotypes	Genotypes included in the cluster
I	11	SS-101, JK-124, AFA-10, PS-101, IIHR-34, TSX-10, GS-10, IIHR-21, IIHR-50, SAKURA-109, Arka Sampoorna
II	1	IIHR-47
III	3	Arka Mayur, Arka Nirmal, Arka Harini
IV	5	Arka Pramodh, Arka Priya, Arka Apoorva, Arka Karthik, Arka Ajith
V	2	Arka Tapus, IIHR-41
VI	1	IIHR-28
VII	1	IS-10
VIII	4	Arka Chaithra, Arka Uttam, IIHR-48, IIHR-124
IX	1	IIHR-44
X	1	IIHR-33

Table 4. Per cent contribution from different characters to the total divergence in garden pea.

Sl. No.	Characters	Per cent contribution	Number of times ranked first
1	Pod yield per plant (g)	38.16	166
2	Plant height (cm) at 60 DAS	27.59	120
3	Days taken for first picking	8.05	35
4	Number of pods per plant	8.05	35
5	Days taken for first flowering	5.98	26
6	Shelling %	5.98	26
7	Pod width (mm)	4.83	21
8	Pod length (cm)	0.46	2
9	Pod thickness (mm)	0.46	2
10	Number of branches per plant at 60 DAS	0.23	1
11	Number of seeds per pod	0.23	1
12	Weight of ten pods (g)	0.00	0

genetic diversity. All genotypes were grouped into ten clusters using Tocher's method (Table 2) of the ten clusters studied, cluster I was the largest, having 11 genotypes, followed by cluster IV (5), cluster VIII (4), cluster III (3), cluster V (2) and clusters II, VI, VII, IX and X with one genotype in each. The findings of Rahul *et al*. (2017), Bijalwan *et al.* (2018) and Singh *et al*. (2019) are in line.

Intra and inter-cluster average D^2 values are presented in Table 3. Among the ten clusters, cluster VIII, with 4 genotypes, showed the maximum intra-cluster distance (487.04), followed by cluster IV (218.88), cluster I (157.63), cluster III (141.54) and cluster V (125.72). The clusters II, VI, VII, IX and X had no intra-cluster distance as they possessed a single genotype in each. The maximum intra-cluster distance revealed that cluster VIII, with four genotypes, indicates the presence of wide genetic divergence among the constituent genotypes. A higher degree of divergence among the genotypes within a cluster would produce more segregating breeding material. Selection within such a cluster might be based on the maximum mean value for the desirable characters. Based on inter-cluster distance, maximum divergence was observed between cluster VIII and cluster X, indicating that the genotypes in these clusters had more divergence and can be used as parents in the hybridization program to obtain superior segregants.

The contribution of different characters to total genetic divergence is important to assess the relative importance of the characters to be included in genetic

Table 3. Average intra- and inter-cluster D^2 for twelve characters formed by thirty genotypes of garden pea.

	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V	Cluster VI	Cluster VII	Cluster VIII	Custer IX	Cluster X
Cluster I	157.63	285.91	491.58	424.56	560.81	411.59	274.94	2612.22	314.68	317.64
Cluster II		0.00	659.53	559.18	243.11	141.40	640.16	2311.49	748.62	558.59
Cluster III			141.54	937.89	594.10	971.01	385.00	2182.04	345.66	1031.83
Cluster IV				218.88	611.79	668.38	754.87	1985.11	629.85	537.43
Cluster V					125.72	522.82	906.95	1346.49	981.90	1033.50
Cluster VI						0.00	928.12	3002.50	951.28	423.60
Cluster VII							0.00	3018.45	234.35	578.37
Cluster VIII								487.04	2775.63	3439.67
Cluster IX									0.00	643.81
Cluster X										0.00

Note : Diagonal values indicate intra-cluster distances.

Table 5. Mean values of 12 characters for ten clusters in garden pea genotypes.

Characters	Clusters									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Plant height (cm) at 60 DAS	50.93	50.90	50.70	69.62	66.05	45.80	37.80	114.83	48.70	54.40
Number of branches per plant at 60 DAS	17.18	15.40	18.63	21.52	19.75	18.80	17.90	27.68	18.60	14.40
Days taken for first flowering	35.36	41.00	25.17	42.30	40.00	48.50	23.50	33.00	25.00	47.00
Days taken for first picking	49.14	59.50	33.33	53.70	51.75	65.50	36.00	41.88	40.50	48.50
Number of pods per plant	26.30	31.22	19.07	33.89	27.58	23.24	25.56	42.13	29.64	23.73
Pod length (cm)	8.76	8.03	6.90	8.76	7.94	8.14	7.51	7.31	7.67	7.09
Pod width (mm)	9.40	11.30	4.26	11.77	10.75	10.40	11.22	10.27	3.64	12.72
Pod thickness (mm)	8.55	9.55	3.28	8.19	8.98	7.87	9.80	8.76	2.89	10.00
Weight of ten pods (g)	48.25	39.45	66.67	50.38	43.23	35.12	73.10	37.24	60.55	37.08
Shelling %	45.45	47.15	43.36	48.60	52.64	40.73	44.60	51.77	40.63	32.85
Number of seeds per pod	7.00	7.70	6.70	6.82	7.05	6.70	7.60	5.78	6.60	5.10
Pod yield per plant (g)	65.89	45.96	62.93	77.51	47.35	47.94	70.12	65.96	81.93	72.31

DAS- Days after sowing.

diversity studies. The relative contribution of different traits for genetic divergence (D^2) is given in Table 4. Pod yield per plant contributed the maximum (38.16 %) to the genetic diversity among the characters, followed by plant height at 60 DAS (27.59 %), days taken for first picking and number of pods per plant (8.05 %), days taken for first flowering; shelling % (5.98 %), pod width (4.83 %), pod length and pod thickness (0.46 %), number of branches per plant at 60 DAS and number of seeds per pod (0.23 %). There was no contribution for genetic divergence from the average weight of ten pods.

Based on cluster means (Table 5) for various traits studied, clusters I and IV were found superior for pod length, cluster II for number of seeds per pod, cluster V for shelling %, cluster VI for days taken for first flowering and picking, cluster VIII for plant height, number of branches per plant and number of pods per plant, cluster VII for weight of ten pods, whereas cluster IX and X obtained maximum values for pod yield per plant, width and thickness of pod respectively. Thus, genotypes from these clusters could be used as divergent parents to improve these particular characters.

ACKNOWLEDGMENT

We thank the Department of Vegetable Science, Mudigere, for their support and facilities throughout the study.

REFERENCES

Anonymous (2022) Horticulture Statistics Division Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India, p1. www.agricoop.nic.in

Bijalwan P, Raturi A, Mishra AC (2018) Genetic divergence analysis for yield and quality traits in garden pea (*Pisum sativum* L.). *Int J Bio-resources. Stress* Mgt 9(1): 083-086.

Harrington JB (1940) Yielding capacity of wheat crosses as indicated by bulk hybrid tests. *Can J Res* 18: 580-584.

Mahalanobis PC (1928) On the generalized distance in statistics. *Proc Nat Acad Sureja Sci* 19: 201-208.

Mahalanobis PC (1936) On the generalized distance in statistics. *Proc Nat Inst Sci Ind* 2: 49-55.

Rahul VP, Bhushan B, Kumar R, Krishna R (2017) Genetic Divergence Analysis of Yield and Its Contributing Traits in tall field pea (*Pisum sativum* L.). *Int J Agric Innov Res* 2(1): 60-63.

Rao CR (1952) Advanced Statistical Methods in Biometrics Research. John Wiley and Sons, New York, pp 357-369.

Singh AK, Pant SC, Paliwal A (2019) Assessment of genetic divergence and association of horticultural traits with yields in garden pea on Shivalik Hills of Uttarakhand. *Int J Agric Sci* 15(1): 184-189.

Singh RK, Chaudhary BD (1977) Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi, India, pp 88.