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Divergence Analysis in Chickpea (*Cicer arietinum* L.)

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ABSTRACT

Genetic divergence using Mahalanobis D^2 statistic of 70 chickpea genotypes of different ecogeographic regions revealed considerable diversity and were grouped into 16 clusters indicating that the geographic distribution and genetic diversity were not related. Seed yield per plant, number of pods per plant and 100-seed weight contributed maximum to genetic diversity. The cluster XII showed high genetic divergence with cluster XVI and VIII.

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INTRODUCTION

Multivariate analysis by means of Mahalanobis D^2 statistic has been recognised as a powerful tool in the hands of breeders to quantify the degree of divergence between genotypes. The present investigation in chickpea has been undertaken to assess the extent of genetic diversity in 70 genotypes. It will help in selection of suitable parents for crosses.

MATERIALS AND METHODS

Seventy geographically diverse genotypes were planted in *rabi* 1992 at Instructional Farm of Agriculture College, Junagadh. The material was sown in single row plots of 5 m length with inter and intra-row distance of 30 and 10 cm, respectively, in a randomised block design with three replications. Five competitive plants, selected at random from each plot, were used for recording observations on 10 quantitative characters (Table 3). The data were subjected to Mahalanobis D^2 statistic to measure genetic divergence as suggested by Rao (1952). On the basis of magnitude of D^2 values varieties were grouped into different clusters by Tocher method.

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant divergence among the varieties for all the characters studied. The 70 genotypes were grouped into 16 clusters (Table 1). The magnitude of D^2 values suggested considerable diversity among the genotypes. The cluster II was the largest which consisted of 20 genotypes from Gujarat, Rajasthan, Andhra Pradesh, Bihar, Maharashtra, Uttar Pradesh and New Delhi. Cluster III was second largest accommodating 16 genotypes from Gujarat,

TABLE 1

Grouping of 70 genotypes of chickpea in various clusters on the basis of D^2 statistic.

Cluster	*Genotypes included in the cluster*	*Total genotypes*	*Source*
1.	*2.*	*3.*	*4.*
I	BG 380	1	New Delhi (IARI)
	NDG 8601	1	Uttar Pradesh
	GNG 752	1	Rajasthan
	Total	3	
II	Vadatala 4, JCP 125, DCP 8, JCP 29, JCP 39, Dahod yellow, Saradpuri, JCP 124, 377/310, JCP 271, JCP 91.		
	DCP 4	12	Gujarat
	DHPG 89-9	1	Bihar
	BKG 45, RSG 286-1	2	Rajasthan
	ICCC 4, ICCC 32	2	Andhra Pradesh (ICRISAT)
	BCP 41	1	Maharashtra
	T 1	1	Uttar Pradesh
	BG 385	1	New Delhi (IARI)
	Total	20	
III	JCP 188, DCP 31, JCP 141, JCP 27, JCP 109, JCP 212, 764/752, 3260	8	Gujarat
	BDNG 154, BCP 5, BCP 3	3	Maharashtra
	L 550, L 545	2	Punjab
	ICCC 43	1	Andhra Pradesh
	BG 369	1	New Delhi (IARI)
	T_{12}	1	Uttar Pradesh
	Total	16	
IV	EC 1538, EC 12409, EC 13068, EC 12411	4	Punjab
	RSG 514, GNG 798	2	Rajasthan
	BG 360	1	New Delhi (IARI)
	Total	7	

1.	2.	3.	4.
V	JCP 274, JCP 270, JCP 89, JCP 245, ICCC 820499	4	Gujarat
	ICC 81098-1	2	Andhra Pradesh (ICRISAT)
	AKG 46	1	Maharashtra
	HR 86	1	Haryana
		Total 8	
VI	ICCC 10539	1	Andhra Pradesh (ICRISAT)
VII	Chaffa	1	Maharashtra
	HR 2-236	1	Haryana
		Total 2	
VIII	BM 76	1	New Delhi (IARI)
	K 850	1	Uttar Pradesh
		Total 2	
XI	H 89 - 18	1	Haryana
	PDG 83-13	1	Uttar Pradesh
	JG 315	1	Madhya Pradesh
		Total 3	
X	PG 88-6	1	Uttar Pradesh
XI	GL 88395	1	Punjab
XII	DGM 127	1	Rajasthan
XIII	H 87-65, H 89-11	2	Haryana
XIV	ICCV 81-201	1	Andhra Pradesh (ICRISAT)
XV	ICCV 10	1	Andhra Pradesh (ICRISAT)
XVI	ICCV 820065	1	Andhra Pradesh (ICRISAT)

Maharashtra, Punjab, Andhra Pradesh, New Delhi and Uttar Pradesh. Cluster V had eight genotypes, whereas, cluster IV had seven genotypes originating from Gujarat, Andhra Pradesh, Maharashtra and Haryana and Punjab, Rajasthan and New Delhi. Cluster I and IX included three genotypes. The clusters VII, VIII and XIII possessed two genotypes from Maharashtra, Haryana, New Delhi and Uttar Pradesh. The cluster VI, X, XII were single variety clusters which included varieties from Andhra Pradesh, Uttar Pradesh, Punjab and Rajasthan, respectively whereas, cluster XIV, XV and XVI had also single genotype each from Andhra Pradesh. Thus, the distribution of genotypes was not as per their geographical

TABLE 2

Average inter and intra-cluster D ($\sqrt{D^2}$) in chickpea.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
I	8.81	34.59	30.84	33.23	40.87	24.72	36.44	39.39	23.94	34.21	42.30	35.87	46.98	26.90	19.17	44.86
II		14.27	19.40	47.38	19.52	20.44	19.57	21.23	22.84	22.06	49.78	58.17	53.68	30.25	37.91	29.83
III			14.47	40.57	19.57	20.65	17.61	29.69	22.91	21.16	39.74	49.77	45.34	22.52	35.10	25.10
IV				15.57	45.91	38.80	48.76	52.85	33.52	34.61	22.17	20.50	23.34	45.61	48.46	56.99
V					16.76	27.49	21.08	26.23	28.60	24.90	46.96	59.81	51.93	31.76	44.47	24.88
VI						0.00	21.71	28.90	21.58	19.87	43.92	48.54	47.98	27.29	31.66	37.87
VII							10.14	43.99	30.29	27.12	46.40	58.22	54.56	22.52	37.08	24.19
VIII								9.13	26.11	30.14	58.38	63.84	59.78	39.88	42.33	36.58
IX									13.44	19.76	40.34	43.28	41.95	31.84	33.99	38.51
X										0.00	37.93	46.92	37.47	36.61	44.73	39.80
XI											0.00	27.49	21.10	43.95	54.30	51.48
XII												0.00	27.66	49.37	48.97	64.00
XIII													15.42	53.43	60.74	59.80
XIV														0.00	21.49	23.58
XV															0.00	40.83
XVI																0.00

LE 3

Cluster means for different characters in chickpea.

Cluster	Seed yield per plant (g)	Days to 50 per cent flowerig	Days to maturity	Plant height (cm)	Plant spread (cm)	Number of primary branches per plant	Number of pods per plant	Number of seeds per pod	100-seed weight (g)	Harvest index (%)
I	5.53	62.00	108.33	35.71	29.87	3.44	31.37	1.78	13.78	50.47
II	6.80	51.98	97.65	35.06	35.27	3.63	37.28	1.25	20.00	48.51
III	5.25	53.04	99.77	34.83	33.22	3.07	25.22	1.31	19.57	45.17
IV	3.42	78.52	114.71	34.05	29.17	2.69	22.09	1.44	13.41	42.81
V	6.44	50.79	98.29	32.51	31.92	3.56	27.71	1.13	24.08	50.00
VI	6.22	55.33	107.00	31.93	32.20	2.20	38.40	1.42	13.67	51.91
VII	3.66	45.33	89.83	28.43	33.50	2.77	28.06	1.29	13.48	46.35
VIII	10.56	57.33	103.66	35.93	32.70	4.22	45.10	1.23	32.56	57.32
IX	6.93	63.89	104.67	41.89	33.00	3.89	36.01	1.39	19.70	48.64
X	6.72	62.00	107.00	42.40	41.80	2.87	33.67	1.14	16.47	45.28
XI	1.25	73.67	103.67	29.93	22.50	2.03	8.23	1.30	13.07	39.42
XII	2.25	82.00	113.33	33.27	29.70	2.40	13.13	1.70	12.30	26.87
XIII	1.93	80.16	116.50	42.05	28.60	2.10	12.42	1.22	17.88	22.22
XIV	3.68	48.33	88.00	29.93	31.50	2.67	18.20	1.65	18.77	48.16
XV	5.66	53.00	94.33	31.40	33.10	3.37	29.20	1.95	17.33	48.96
XVI	4.34	44.00	80.33	29.60	26.10	3.21	15.40	1.31	30.20	39.74
Overall Mean	5.04	60.09	101.69	34.31	31.51	3.01	26.34	1.41	18.52	44.49
S. Em. ±	0.59	3.11	2.51	1.12	1.05	0.16	2.66	0.06	1.50	2.25
C. D. at 5%	1.64	8.62	6.96	3.10	2.91	0.44	7.37	0.17	4.16	6.24
C. V. (%)	46.58	20.73	9.87	13.08	13.32	21.59	40.46	17.01	32.43	20.23

origin as the varieties of same geographic areas were grouped in different clusters and that of different areas in the same cluster which is in accordance with the finding of Vijay Kumar *et al.* (1991), Yadav *et al.* (1991) and Kumar and Arora (1992). Such clustering pattern may be because of genetic drift and selection in different environments resulting in considerable diversity than the geographical isolation (Murthy and Arunachalam, 1966).

The inter clusters distance (Table 2) was maximum (D = 64.00) between cluster XII and XVI followed by cluster VIII and XII (D = 63.84), suggesting wide diversity between them. It was minimum (D = 17.61) between cluster III and VII, indicating relative closeness of genotypes of these clusters. The intra-cluster distance ranged from 00.00 to 16.76 which was the highest in cluster V and the lowest in cluster I (D = 8.81). Cluster VI, X, XI, XII, XIV, XV and XVI had no intra-clusters value and such clusters are supposed to have maximum diversity with the other varieties.

The cluster means of various clusters presented in Table 3 denoted high co-efficient of variation for the traits like seed yield per plant, number of pods per plant and 100-seed weight, indicating wide diversity for these characters between clusters. Cluster VIII had high mean values for seed yield per plant, number of primary branches per plant, number of pods per plant, 100-seed weight and harvest index. Therefore, genotypes of the cluster VIII should be included in breeding programme for getting best/superior segregants to improve seed yield in chickpea. Cluster X was good for plant height and plant spread, while cluster XVI was desirable in respect of days to 50 per cent flowering and days to maturity. The genotype ICCV 820065 could be included in selection for getting early types. High mean value for number of seeds per pod was observed in cluster XV. In the present case, crosses between genotypes from clusters XII and XVI, VIII and XII should be attempted as these crosses are expected to generate combinations of desirable characters for high seed yield in chickpea.

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