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GENETIC DIVERGENCE IN LENTIL GERMPLASM

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Nature of genetic divergence using principal component analysis in 156 accessions of lentil (*Lens culnaris* Med.) germplasm belonging to different geographic regions revealed considerable diversity. The accessions were grouped into 10 clusters. Studies indicated that geographical isolation may not be the only factor causing genetic diversity. Number of pods per plant, yield per plant and seeds per pod were the most potential traits contributing to the total genetic divergence. Clusters IV and cluster X were important because they comprised accessions with high yield per plant, high pods per plant and high number of seeds per pod and by utilizing accessions from these clusters there is a sufficient scope for varietal improvement through hybridization.

Key words : Lentil, principal component analysis, genetic divergence

Lentil (*Lens culnaris* med.) is an important food crop of the world and is originated in the Fertile Crescent of the Near East. The Indian subcontinent is by far the largest lentil producing region in the world. The majority of lentils produced throughout the world are local land races and only a few released cultivars are available to farmers. The improvement work in the crop is limited, though a wide range of genetic diversity is available in collection of lentils (Solth and Erskine 1981). The utility of these collections in crop improvement programmes is limited unless they are systematically evaluated. Therefore attempt has been made to evaluate and classify one hundred and fifty six accessions of lentil germplasm with the help of non hierarchical euclidian cluster analysis.

MATERIAL AND METHODS

The experiment was conducted with one hundred and fifty six accessions of lentil germplasm from Syria-25 and India-131 {Andhra Pradesh (2), Bihar (2), Haryana (2), Himachal Pradesh (6) and Madhya Pradesh (2) and Uttar Pradesh (117)}. These accessions along with four checks were sown during rabi 1995-96 at Issapur farm of National Bureau of Plant Genetic Resources, Delhi. All the germplasm accessions were evaluated in an augmented block design with four randomized checks namely PL406, PL639, L830 and L4076 and replicated in each block of 10 accessions. Each plot consisted of three rows of 3m length. Observations were recorded on different agromorphological characters. Among these five quantitative characters viz. days to 50% flowering, plant length, number of seeds per plant, number of seeds per pod and yield per plant were subjected to statistical analysis by augmented block design (Peterson 1985). Non-hierarchical euclidian cluster analysis using five principal components was followed for grouping of genotypes as described by Beale (1969) and elaborated by Spark (1973). F test was utilised for assigning appropriate number of clusters.

RESULTS AND DISCUSSION

Ranges, means and coefficient of variability (Table 1) reflected the presence of genetic variability in the material under study. Maximum range (23.7 - 495.3) and coefficient of variability (58%) was observed in number of pods per plant followed by yield per plant and seeds per pod. Similar type of variability in lentil germplasm was reported by Sapra *et al.* (1984), and Thakur and Bajpal (1993).

Table 1. Range and check means of various quantitative characters in lentil germplasm

	Days to 50% flowering	Plant height (cm)	Pod number/ plant	Seeds/Pod	Yield/Plant
Accession range	69-102	18.0-41.3	23.7-495.3	1-2	2.0-20.6
mean	87.25	28.71	144.47	1.79	8.81
Check means					
PL406	87.75	36.00	25.02	2.00	9.40
PL639	90.00	36.07	212.30	2.00	12.50
L830	78.75	34.75	165.90	2.00	10.15
L4076	83.25	33.57	196.05	1.75	9.72
CV%	8.00	19.30	58.25	22.91	39.05

For quantifying the degree of divergence based on phenotypic observations, principal component analysis was applied. The first principal component had highest eigen root (1.727) and also showed highest proportion of the total variation (34.53%) followed by second principal component with variation of 20.84 % (Table 2). Variation explained by first five components were used for non-hierarchical euclidian cluster analysis.

One hundred and fifty six accessions of lentil germplasm were grouped in to 10 different non-overlapping clusters. The sequential F ratio test for comparison of cluster solutions also revealed that 10 clusters were most suited. Cluster VI was largest, comprising of 36 accessions and cluster IX was smallest with 4 accessions only. Among other clusters 27 accessions were grouped in cluster VII, 25 in Cluster X, 10 in cluster III, 8 in cluster IV and 5 in cluster II, respectively. Clustering pattern indicated that exotic material received from Syria did not group in to single cluster but were distributed over seven different clusters along with indigeneous accessions. This suggested that there is no firm relationship between genetic divergence and geographical distances as was reported by Moalemi and Vojdani (1994) in lentil germplasm of Iran. Genetic drift and selection under diverse environment could cause greater diversity than geographical distance (Bhatt 1970, Chahota *et al.* 1994).

The intera cluster distances ranged from 1.026 (Cluster I) to 1.589 (Cluster X) (Table 2). Cluster X and IX were most diverse, the inter cluster distances between them being maximum (5.088). Similarly cluster XI and IV were also quite diverse (5.024). The minimum distance was observed between cluster III and II (2.022), indicating close relationship among the accessions contained in them.

Table 2. Eigen vectors, eigen roots and associated variance for different components in lentil germplasm

Characters	Eigen vectors				
	1	2	3	4	5
Days to 50% flowering	0.314	0.395	0.516	0.427	0.546
Plant height (cm)	–0.726	0.593	–0.222	0.267	–0.012
No of pods/plant	0.219	–0.233	–0.315	0.837	–0.314
No of seeds/pods	–0.570	–0.611	0.484	0.216	0.144
Yield/plant (g)	–0.038	–0.254	–0.592	0.002	0.764
Eigen roots	1.727	1.042	0.824	0.739	0.668
Variations (%)	34.53	20.84	16.48	14.78	13.36

The cluster mean and coefficient of variation also provided an interesting picture of the nature of diversity (Table 3). Considerable differences in cluster means occurred for almost all the characters. The coefficient of variation for different characters indicated that major forces of discrimination were number of pods per plant (55%), yield per plant (36%) and seeds per pod (30%). These characters could therefore, form the basis for selection of parents from distinctly placed clusters to obtain high heterotic effect. The results are in agreement with those obtained by Bhatt (1970) and Chahota *et al.* (1994). The maximum cluster mean was observed in cluster IV for yield per plant and seeds per pod; cluster X for pods per plants and seeds per pods; cluster IX for days

Table 3. Average inter and intra cluster distances in lentil germplasm

Cluster no	1	2	3	4	5	6	7	8	9	10
1	**1.026**									
2	3.491	**1.452**								
3	2.174	2.022	**1.469**							
4	4.784	2.612	3.529	**1.051**						
5	2.725	3.649	2.910	3.178	**1.240**					
6	3.383	3.212	2.660	2.354	1.640	**1.114**				
7	3.366	3.351	3.141	3.101	2.296	2.404	**1.257**			
8	3.805	3.084	2.819	2352	2.901	2.135	2.216	**1.014**		
9	2.616	4.036	3.405	5.024	3.732	3.769	2.941	4.622	**1.430**	
10	4.614	3.802	3.097	2.979	3.270	2.105	3.478	2.406	5.088	**1.589**

Values in bold show intra cluster distances

Table 4. Cluster mean for different characters

Cluster	Days to 50% flowering	Plant height (cm)	Pods/ plant	Seeds/pod	Yield/plant (g)
1	87.57	23.30	65.05	1.00	4.38
2	85.80	35.20	129.26	1.00	13.44
3	88.52	28.85	192.13	1.00	8.49
4	89.38	35.79	140.75	2.00	15.71
5	92.08	26.96	82.00	2.00	6.65
6	90.17	25.50	167.96	2.00	10.87
7	77.11	30.79	111.59	2.00	7.57
8	89.75	36.21	180.49	2.00	7.79
9	71.75	19.33	61.42	1.25	7.48
10	91.18	29.21	335.45	2.00	10.79
SD	6.6377	5.598	80.954	0.489	3.389
$\overline{X}$	86.331	29.114	146.61	1.625	9.317
CV%	7.690	19.229	55.217	30.120	36.376

to 50% flowering (earliness) and cluster VIII for plant height and seeds per pod. These clusters could be regarded as useful sources of genes for different traits and some of the promising germplasm accessions for different traits are listed in Table 5. In view of considerable genetic diversity in lentil germplasm there is sufficient scope for varietal improvement through hybridization.

Table 5. Potential genetic donors for different characters in lentil germplasm

Character	Cluster number	Genotype
Grain yield/plant	IV	IC-201778, IC-201711, IC-201688, EC-299648
Pods/plant	X	NIC 23643, NIC-201777, IC-201656, EC-299673, EC-300190
Days to 50% flowering	IX	IC-201745, IC-201746, IC-201758.
Plant height	VIII	EC-299638, EC-201704, IC-201668, IC-201731

REFERENCES

Balyam, H.S. and Singh, Shobir 1986. Genetic divergence in Lentil *LENS* Newsletter 13: 3-4.

Beae, E.M.L. 1969. Euclidian cluster analysis. *Bull. Int. Stat. Inst.* **43**: 92-94.

Bhatt, G.M. 1970. Multivariate analysis approach for selection of parents for hybridization in aiming at yield improvement in self pollinated crops. *Aust. J. Agric. Res.* **21**: 1-7.

Chahota, R.K., Sharma, S.K. and Lal, C. 1994. Genetic divergence in microsperma lentil. *Legume Research* **17**: 132-134.

Moalemi, M and Vojdani, P. 1994. Study of the genetic diversity and correlation among characters of lentil in relation of ecogeographical conditions. *Seed And Plant* **9**: 1-9.

Peterson, R.G. 1985. Augmented design for preliminary yield trials (Revised). *Rachis* ICARDA **4**: 27-32.

Sapra, R.L., Kumar, Basant and Mehra, K.L. 1984. Non hierarchical cluster analysis in Lentil. *LENS Newsletter* **11**: 7-9.

Solh, M and Erskine, W. 1981. Genetic Resources. In Lentils (Eds Webb. C. and Hawtin, G.), CAB, The INT. Centre for Agric. Res. In the Dry areas.

Spark, D.N. 1973. Euclidian cluster analysis. *Algorithm Apl. Stat.* **22**: 126-130.

Thakur, H.K. and Bajpal, G.C. 1993. Characterization of lentil germplasm for phonological and yield characters. *Indian Journal Of Pulse Research* **6**: 89-91.