Indian J. Pl. Genet. Resources 12(1): 16-19, 1999

GENETIC DIVERSITY IN LINSEED

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Two hundred ninety eight accessions of linseed (*Linum usitatissimum* L.) comprising 101 exotic and 197 indigenous collections were studied for genetic divergence for a set of 9 characters. The accessions were grouped into 10 clusters. The genetic diversity was not related to the geographic diversity. Based on divergence and superior clusters mean, crosses among the genotypes from cluster V, VI, VII and IX may result in superior types. The genotypes viz. EC-41646, EC-41495, EC-41767 and IC- 61322 for high oil, EC-236, EC-1413, IC-53262, IC-53291, IC-59012 and IC-60431 for high yield and EC-236, EC-1475, EC-41737 and EAC-41764 for fiber may be used in hybridization programme as superior parents.

Key words: Linseed, *Linum usitatissimum*, genetic divergence, germplasm

Linseed (*Linum usitatissimum* L) is an important oilseed crop though it is grown for fibre also. In India, linseed is cultivated primarily for its oil. It occupies fifth place after groundnut, rapeseed and mustard, soybean and sesame. It is grown in about 1200 thousand hectares with seed production of nearly 350 thousand tonnes. The productivity of linseed is not very encouraging. An attempt was made to study the genetic diversity at NBPGR, Regional Station, Akola, Maharashtra.

MATERIALS AND METHODS

The experimental material consisted of 298 germplasm lines including 101 exotic from, Argentina (68), Australia (21), Belgium (1), Romania (1), France (1), Hungary (1), Japan (2), Poland (1), USA (3) and USSR (2) and 197 indigenous from, Maharashtra (80), Madhya Pradesh (109), Bihar (7) and Andhra Pradesh (1). These accessions were grown in augmented block design, using three checks i.e. C-429, Jawahar 7, and Jawahar 10 at Experimental Farm, NBPGR, Regional Station, Akola during *rabi* 1996. The rows were 3 meter long and 75 cm apart. Observations were recorded on days to 50 per cent flowering, days to maturity, plant height, number of primary and lateral branches per plant, number of seeds per capsules, yield per plant and oil content. Non-hierarchical euclidean cluster analysis was used for assessing the genetic divergence among 298 genotypes of linseed. The genotypes were grouped into number of clusters as suggested by Spark (1973). The analysis was carried out using SPAR 1 package.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the accessions for 9 characters studied. The range, mean and standard deviation are presented in Table 1. Based on divergence values the accessions were grouped into 10 clusters

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(Table 2). Cluster I has 39 accessions, cluster II 17, cluster III 55, cluster IV 25, cluster V 29, cluster VI 33, cluster VII 42, cluster VIII 44, cluster IX 12 and cluster X had 2 accessions. The clustering pattern in the present study indicated that the genotypes from one source were distributed into different clusters. This suggests the lack of distance build up of geographical diversity. Mishra and Dash, (1997) and Umesh Chandra (1997) have reported that geographical diversity is not necessarily related to genetic divergence. The clustering of genotypes from different eco-geographic locations into one cluster could be attributed to possibly free exchange of breeding materials or even varieties from one place to another (Verma and Mehta, 1976). This may also be due to the fact that unidirectional selection practiced for a particular trait in several places produced similar phenotype which were aggregated in one cluster irrespective of their distant geographic origin (Singh and Gupta, 1968). This is true in these indigenous linseed genotypes. On the other hand, many genotypes originating from one place were scattered over different clusters (Table 2). Such genetic diversity among the genotypes of common geographic origin could be due to factors like heterogeneity, genetic architecture of the populations, past history of selection, developmental traits and degree of general combining ability (Murthy and Arunachalam, 1966).

The average intra and inter cluster distances have been presented in Table 3. Average inter-cluster distance values ranged from 1.845 to 8.300. The maximum distance existed between cluster V and X (8.300). In general, cluster X had more distance from rest of the clusters. Intra-cluster distance was 0 for all the clusters indicating similarity among the clusters. Cluster III contained the maximum number of genotypes (55) followed by cluster VIII, I, VI, V and IV with 44,42,33,29 and 25 respectively.

Table 1. Range, mean and SD of 9 metric characters in 298 genotypes of linseed

Character	Range		Mean	Standard deviation
	Min.	Max.		
Days to 50% flowering	66.64	79.94	70.57	5.11
Days to maturity	102.72	114.52	107.13	5.90
Plant height (cm)	23.84	47.43	38.69	7.30
No. of primary branches/plant	2.70	10.15	3.10	0.98
No. of lateral branches/plant	5.64	23.96	12.43	4.57
No. of capsules/plant	12.76	36.00	26.72	8.23
No. of seeds/capsule	4.78	7.04	5.78	1.16
Yield/plant (g)	0.45	1.65	0.94	0.40
Oil (%)	38.07	44.08	42.06	2.92

Table 2. Grouping of 298 accessions of linseed in different clusters

Cluster	No. of entries	Source
I	39	Australia,Japan,Argentina,Romania, USA, India
II	17	Argentina, USA, India
III	55	Argentina, Australia, USA, India
IV	25	Argentina, Australia, Belgium, India
V	29	Argentina, Japan, USSR, India
VI	33	Argentina, India
VII	42	Argentina, Australia, Hungary, Poland, India
VIII	44	Argentina, Australia, USSR, India
IX	12	India
X	2	Argentina

Cluster I genotypes (39) had early flowering and maturity, moderate oil content and poor yields. Cluster II comprised 17 genotypes with late flowering and maturity, dwarf plants, low yields and low oil content. Cluster III contained 55 genotypes with early flowering and maturity,

Table 3. Cluster means for nine characters in 298 genotypes of linseed

Character	I	II	III	IV	V	VI	VII	VIII	IX	X
Days to 50% flowering	66.64	79.94	68.58	77.04	67.59	68.06	70.10	74.23	07.25	75.00
Days to maturity	102.72	110.53	104.89	112.40	103.17	102.88	107.21	114.52	109.67	108.00
Plant height (cm)	39.02	23.84	36.06	33.94	42.92	47.43	41.92	36.73	43.27	32.50
No. of prim. branches/plant	2.73	2.70	2.85	3.03	2.74	3.99	2.98	2.96	4.47	10.15
No. of lateral branches/plant	12.37	5.64	12.13	9.71	13.93	12.21	14.56	11.14	23.96	10.60
No. of capsules/plant	25.41	12.76	26.21	24.05	26.69	27.04	32.78	27.14	36.60	17.65
No. of seeds/capsule	4.78	4.98	6.58	7.04	6.81	5.58	4.65	5.79	5.92	5.20
Yield/plant (g)	0.76	0.45	0.88	0.70	1.65	0.93	1.10	0.85	1.11	1.00
Oil content (%)	40.63	39.55	42.60	38.07	42.50	43.86	44.08	41.91	43.41	42.58

Table 4. Intra and inter-cluster distance in 298 genotype of linseed

Cluster No.	1	2	3	4	5	6	7	8	9	10
1	0.000									
2	4.255	0.000								
3	1.845	4.184	0.000							
4	3.511	2.983	2.757	0.000						
5	2.990	5.737	2.223	4.056	0.000					
6	2.233	5.305	2.204	4.038	2.614	0.000				
7	2.102	5.001	2.262	3.936	2.658	1.987	0.000			
8	2.734	3.392	2.120	1.960	3.376	3.031	2.370	0.000		
9	3.976	6.785	3.668	5.002	3.630	3.190	2.917	3.951	0.000	
10	8.007	8.086	7.802	7.756	8.300	6.953	7.827	7.601	7.271	0.000

moderate yield and oil content. Cluster IV had 25 genotypes having late flowering and maturity, highest number of seeds/capsule (7.04) but low oil content. Cluster V contained the highest yield (1.65 g) and moderate oil content. Cluster VI and VII had tall plants and high oil content. The genotypes of cluster VIII had late maturing and moderate oil content. Cluster IX consisted of 12 genotypes having the highest lateral branches and capsules/plant, tall plants with average yields and oil content. The genotypes in cluster X showed the highest primary branches per plant (10.15) and moderate oil content.

Obviously, the crosses among the genotypes of cluster V, VI, VII and IX might be useful for obtaining good recombinants and transgressive segregants in segregating generations. The genotypes EC-41646, EC-41495, EC-41767 and IC-61322 in cluster VII showed more than 45% oil content and EC-236, EC-1413, IC-53262, IC-53291, IC-59012 and IC-60431 in cluster V showed good yield per plant. These genotypes are useful and can be utilised as parents in hybridisation. On the other hand, tall plants with

low primary branches e.g. EC-236, EC-1475, EC-41737 and EC-41764 in cluster VII can be utilised as parents for fibre in the hybridization programme.

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