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Research Note

Genetic divergence of inbred lines in sunflower (*Helianthus annuus L.*)

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Abstract:
Genetic divergence of 79 inbred lines of sunflower using eight agronomic characters was studied. Analysis of variance revealed the existence of divergence among the inbred lines. Mahalanobis D^2 statistics indicated the presence of substantial genetic diversity. Based on intercluster D^2 value and cluster mean for various characters, potential inbred lines were identified. Intercrossing of these inbreds will exhibit more variability for yield and yield component traits. The character oil yield was found to be important as the major contributor for genetic divergence. The usefulness of genetic divergence for the identification of parents for heterosis breeding is not proved and needs further research.

Keywords: Sunflower, diversity, variability, correlation.

Genetic diversity plays an important role in plant breeding because crosses between diverse parental lines display a greater heterosis than those between closely related parents. Hence, it is important to identify best parents with wide genetic divergence for desired characters to obtain better heterotic hybrids. The D^2 statistics enables to discriminate between different cultivars according to the diversity of parents (Mahalanobis, 1936). It is a powerful tool in quantifying the degree of genetic divergence among parents (Muppidathi *et al*., 1995; Sujatha *et al*., 2002 and Punitha *et al*., 2010). With this background, the present investigation was aimed to assess the genetic divergence and to identify promising parents among 79 genotypes of sunflower (*Helianthus annuus* L.).

The material used in the present study consisted of 79 genotypes obtained from Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore. All the 79 parents were raised in a randomized block design with two replications in the field during *kharif,* 2010. Among these genotypes, 78 genotypes were crossed with cms 234 A during *rabi*/Summer 2009-10. The 78 hybrids were also evaluated in a separate trial during *kharif* 2010. A spacing of 60 x 30 cm was adopted. Standard agronomic practices were followed throughout the period of crop growth. Each parent was raised in 5.4 m^2 plot. Observations were recorded on five randomly selected competitive plants of each genotype on days to 50 per cent flowering, plant height (cm), head diameter (cm), volume weight (g/100 ml), 100- seed weight (g), oil content (%), seed yield per plant (g), and oil yield per plant (g). Genetic divergence was studied as suggested by Mahalanobis (1936).

In the present investigation, the genetic divergence among 79 inbred lines was studied by D^2 statistics of Mahalanobis (1928) followed by clustering of genotypes by Tocher's method. The analysis of variance indicated the presence of significant differences among the inbreds for all characters. This suggested the existence of considerable variability and justified further calculation of genetic divergence. The D^2 analysis resulted in the grouping of 79 inbreds into 22 clusters. Grouping pattern of different clusters is given in Table 1**.** The intra and inter cluster D^2 values are provided in Table 2. Maximum intra cluster value was observed for cluster XXII (53.48) and minimum by cluster I (1.78). The maximum inter-cluster distance D^2 was observed between clusters X and XIX (112.43) followed by XV and XIX (111.52), XIV and XIX (102.97) and cluster XVII and XIX (87.76). Since these clusters have higher inter-cluster distance among them, crossing between these clusters is expected to result in increased heterosis.

Cluster mean value of eight characters is furnished in Table 3. Cluster XV had the highest mean values for volume weight/100ml (g), oil content (%), seed yield/plant (g) and oil yield/plant (g). Cluster X recorded the highest mean values for days to 50 % flowering, plant height (cm), head diameter (cm) while cluster XIX had the maximum mean value for 100-seed weight (g). Among the diverse clusters, cluster XV and cluster XIX recorded superiority for most of the yield and component characters. Hence, intercrossing of genotypes of these clusters will throw out more variability for yield and yield component traits.

The contribution towards genetic divergence indicated that the oil yield per plant (26.74 %), followed by plant height (17.72 %) and 100-seed weight (17.46 %) contributed higher to the total genetic divergence and least by head diameter and seed yield per plant (Table 4). Sasikala (2000), Loganathan *et al*., (2006), Punitha (2010) reported that oil yield per plant contributed high towards genetic divergence in sunflower.

To conclude, by considering the cluster mean and divergence values, the genotypes of clusters XIV (I-20-1, I-28-3), XV (I-2-1, I-5-2, I-26-4), XVII (I-29-1, I-29-2) and XIX (I-21-2, I-28-1, I-3-2) are important and intercrossing of these genotypes will exhibit more variability for yield and yield component traits. The character oil yield was found to be important as the major contributor for genetic divergence.

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Table 1. Clustering pattern of 79 genotypes based on D^2 analysis

Cluster No	Number of genotypes clustered	Parental lines
I	02	I-31-1 , MR 234
II	02	I-27-1 , I-32-2
III	02	I-11-1 , GPB-61
IV	02	I-13-1 , I-24-3
V	02	I-3-3, I-20-2
VI	02	I-3-1, I-3-2
VII	02	I-5-1, I-6-2
VIII	02	I-9-2, I-27-2
IX	02	I-22-1, I-34-1
X	02	I-17-1, I-26-2
XI	02	I-6-1, I-17-4
XII	02	I-8-1, I-21-1
XIII	02	I-4-1 , CSFI 5304
XIV	02	I-20-1, I-28-3
XV	03	I-2-1, I-5-2, I-26-4
XVI	18	I-2-2, I-2-3, I-4-2, I-4-3, I-5-3, I-6-3, I-6-4, I-8-2, I-10-1, I-10-2, I-11-2, I-12-1, I-12-2, I-13-2, I-17-3, I-2-3, I-23-1, I-24-2
XVII	02	I-29-1, I-29-2
XVIII	02	GPB 18, IOH-07-45
XIX	03	I-21-2, I-28-1, I-3-2
XX	06	I-21-3, I-22-2 , I-23-2, I-24-1, I-26-1, I-27-3
XXI	03	I-24-4, I-30-2, CSFI 5317
XXII	14	I-24-5, I-26-3, I-28-2, I-30-1, I-30-3, I-31-3, I-32-1, I-34-2, I-34-3, GPB 51 , GPB 60, IOH-07-9, PCSP09-01, CMS 234A

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Table 2. Inter and Intra Cluster D^2 Values

Clusters	I	II	III	IV	IV	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII
I	1.8	15.4	13.0	21.2	7.3	12.3	21.4	25.4	15.9	33.7	27.5	13.0	13.5	19.9	51.3	29.5	25.3	20.3	53.3	24.9	30.8	29.6
II		1.8	15.1	6.9	4.3	11.9	5.5	42.1	27.2	9.8	9.5	7.9	10.9	17.3	51.3	27.1	9.8	16.2	71.5	21.5	55.1	31.7
III			2.1	25.0	13.1	23.1	23.3	30.8	26.8	34.8	33.7	20.5	15.6	35.3	77.0	37.8	28.8	7.7	58.1	32.9	42.0	34.8
IV				2.7	7.1	7.0	8.6	35.5	24.1	22.6	5.9	11.1	14.1	24.7	47.8	26.1	19.5	33.3	57.7	22.2	48.6	34.8
V					3.3	6.3	9.1	29.4	19.2	18.3	12.4	6.9	9.9	14.7	49.2	24.7	15.3	18.1	58.9	18.9	41.2	28.4
VI						3.3	14.2	30.3	21.9	30.2	12.2	10.6	10.8	19.3	45.9	27.1	24.2	33.8	45.8	21.1	36.8	31.3
VII							3.5	54.1	33.6	16.8	9.3	17.4	17.5	14.1	45.7	30.7	14.1	22.0	81.7	29.7	62.9	35.6
VIII								3.7	9.0	75.1	41.4	26.5	43.4	60.4	96.5	39.7	48.2	50.4	37.7	38.9	22.3	50.1
IX									3.9	55.5	24.4	16.7	31.0	42.4	70.2	27.5	29.1	41.1	40.9	30.1	21.3	39.3
X										3.9	22.3	17.8	25.2	24.0	53.2	44.5	13.0	26.4	112.4	35.3	93.3	47.4
XI											4.2	11.0	21.7	23.2	49.6	26.1	11.5	37.9	66.3	25.3	54.5	38.0
XII												4.3	13.8	23.0	52.0	24.0	10.0	26.3	55.5	17.9	41.5	31.2
XIII													4.4	32.3	48.6	33.7	26.9	27.0	46.9	25.1	42.9	32.8
XIV														4.7	51.8	40.2	19.7	27.4	103.0	36.6	71.8	42.2
XV															43.1	65.3	55.6	78.5	111.5	65.5	96.5	67.9
XVI																40.8	30.5	45.3	68.2	37.9	51.8	47.5
XVII																	5.0	23.6	87.8	29.1	65.5	38.7
XVIII																		5.7	93.2	41.4	66.7	41.1
XIX																			31.7	64.2	32.6	73.9
XX																				37.6	51.4	44.5
XXI																					34.7	58.2
XXII																						53.5

Table 3. Cluster mean values for different characters

Clusters \ Characters	Days to 50% flowering	Plant height (cm)	Head diameter (cm)	Volume weight/100 ml (g)	100- seed weight (g)	Oil content (%)	Seed yield/plant (g)	Oil yield / plant (g)
I	54.75	95.17	9.33	35.35	4.25	39.45	15.15	5.92
II	57.75	118.33	10.04	37.65	3.93	31.75	16.19	5.05
III	57.25	90.58	8.83	28.25	3.43	30.13	9.83	2.91
IV	56.00	118.03	9.75	40.30	4.15	30.92	9.91	3.08
V	56.00	110.50	9.67	36.75	4.05	34.61	12.08	4.12
VI	56.25	107.57	8.82	38.85	4.63	34.64	8.17	2.88
VII	58.50	116.73	8.58	40.75	3.23	32.57	10.53	3.42
VIII	49.00	84.50	8.08	29.25	4.13	31.20	10.08	3.20
IX	50.25	89.62	8.25	36.50	3.98	34.18	17.82	6.11
X	60.75	140.50	11.66	37.10	4.60	32.48	26.42	8.72
XI	56.50	120.75	8.54	41.70	4.08	29.97	15.96	4.79
XII	55.75	115.58	10.00	36.00	4.93	32.72	22.90	7.47
XIII	58.50	103.99	10.75	38.70	5.15	34.17	18.19	6.21
XIV	58.25	118.80	7.42	37.90	3.28	38.70	8.32	3.26
XV	58.83	127.17	10.94	45.53	5.58	42.38	26.96	11.62
XVI	54.42	107.25	8.88	38.13	4.17	33.19	17.62	5.97
XVII	58.00	122.83	8.66	36.40	4.00	30.87	26.28	8.33
XVIII	59.25	102.00	8.37	26.85	2.80	30.62	11.58	3.58
XIX	52.17	68.83	8.50	36.80	5.82	30.75	12.60	3.88
XX	55.25	112.13	10.07	37.28	4.78	33.61	17.86	5.86
XXI	50.33	70.19	7.80	35.83	4.58	35.50	12.22	4.31
XXII	56.61	102.66	8.86	35.30	4.26	34.24	15.62	5.56

Table 4. Contribution of characters towards genetic divergence

Characters	Number of times ranked first	Percentage of contribution
Days to 50% flowering	323	10.48
Plant height (cm)	546	17.72
Head diameter (cm)	116	3.77
Volume weight/100 ml (g)	345	11.20
100- seed weight (g)	538	17.46
Oil content (%)	238	7.72
Seed yield/plant (g)	151	4.90
Oil yield / plant (g)	824	26.74