The Andhra Agric.J 55 (1): 25-32, 2008

Characterization and Diversity Analysis of Cytoplasmic Male Sterile lines in Sunflower (*Helianthus annuus* L.)

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ABSTRACT

Forty diverse cytoplasmic male sterile lines of sunflower were evaluated for different quantitative and quantitative traits. High phenotypic and genotypic coefficients of variation were recorded for filled seeds per plant, seed yield, total dry matter and harvest index. High heritability coupled with high genertic advance as per cent of mean was obtained for almost all important economic triats except days to 50% flowering and days to maturity.

Key words: Characterization, Cytoplasmic male sterile lines, Sunflower.

Intensive crop improvement programme has resulted in the development of diverse cytoplasmic male sterile lines and inbreds in sunflower and many of them are in seed production chain. During hybird seed production strict attention is thrust upon maintenance of genetic purity of CMS lines and inbreds to harness full dividends of high yeilding hybrids. Therefore, systematic characterization of the lines based on qualitative and quantitative traits is of immense value in the development of hybrids with increased yield potential, thereby breaking the yield ceiling. Hence the current study aims to estimate the amount of genetic variability, heritability and expected genetic advance for yield and yield components and morphological characterization of the diverse CMS lines as per the National test guidelines for DUS of sunflower.

MATERIAL AND METHODS

Forty diverse CMS lines were characterizel for morphological traits and evaluated for Variability, heritability, genetic advance and per se performance along with their r3spective checks CMS 234 and CMS 7-1 in a randomized block design with three replications during rabi 20004-2005 at the Directorate of oilseeds research, Rajendranagar, Hyderabad. Each line was raised in three, rows of 3m length with the spacing between and within rows being 60 and 30 cm respectively. The data for yield and yield components were recorded on five randomly selelcted plants in each replications.

The analysis of variance was carried out by the method adopted by Panse and Sukhatme (1985). The phenotypic and genotypic coefficients of variation (PCV and GCV) were computed according to Burton (1952), heritability in borad sense as per Allard (1960) and genetic advance (GA) as per the formula prosposed by Lush (1949). The divers CMS lines were characterized based on hypocotyl anthocyanin colouration, leaf shape, leaf colour, leaf fineness of serration, ray flower colour, disk flower colour, plant branching, head shape of grain side, seed base colour and seed shape. Morphological characterization was done as per the National test guidelines for DUS of sunflower.

RESULTS AND DISCUSSION

Analysis of variance for yield and yield contributing characters in Table-1 showed that mean sum of squares of genotypes were found to be significant for all the traits studied. The phenotypic and genotypic coefficients of variation, heritability in broad sense, genetic advance and genetic advance as per cent of mean estimates for these characters are presented in Table-2. High PCV and GCV were recorded for filled seeds per plant (25.60 and 24.84), seed yield (43.39 and 42.97), total dry matter (21.13 and 20.55) and Harvest index (32.55 and 31.99) indicating greater variability for these traits among the lines, suggesting ample scope for improvement in these traits through selection. Moderate PCV abd GCV were registered for plant height, head diameter,

100-seed weight, oil content, and leaf area index and were low for days to 50% flowering and days to maturity. The low variability for these traits accentuate the need for genrating more variability. Similar findings were earlier reported by Gangappa (1991) and Suma and Virupakshappa (1994).

High heritability coupled with high genetic advance as per cent of mean was obtained for the traits viz., plant height, head diameter, filled seeds per plant, 1000-seed weight, seed yield, oil content, leaf area index, tottal dry matter and harvest index indicating additive gene action controlling these traits and therby suggesting direct selelction would be rewarding for crop improvement. Similar results were reported by Anuradha (2003) and Rajeswari (2004). The traits wherein heritability was high and genetic advance as per cent of mean was low or moderate (days to maturity and days to 50% flowering) indicate greater influence of environment on the expression on these characters. The above results were in accordance with Suma and Virupakshappa (1994) and Anuradha (2003).

While characterizing the diverse CMS lines, it was noticed that there was wide variablity for majority of the qualitative characters among the genotypes studied in Table-3. Much vaiation was found for hypocotyl anthocyanin colouration, head attitutde a t maturity, head shape of grain side, seed shape and seed base colour. Among 42 genotypes (including checks CMS 7-1 and CMS 234), hypocotyl anthocyanin coluration of 11 genotypes were medium, 21 genotypes were strong and in the remaining genotypes, it was absent. It was observed turned down in 14 genotypes , vertical in two genotypes and half turned in 26 genotypes for the character, head attitude at maturity. head shape of grain side was found to be convex infour genotypes, concave in four genotypes, misshapen in one genotype and flat in the remaining genotypes. The Seeds of five genotypes were elongated, two genotypes were rounded, 14 genotypes were ovoid and the remaining genotypes were ovoid elongated. The base colour of seed was grey in five genotypes, brown in four genotypes and the rest showed black colour base fo the seeds. Similar results were reported by Rajencra Prasad *et al* (2003) and Rajeswari (2004).

Mean performance of the 40 CMS lines were evaluated for yield and yield contributing characters along with two checks, CMS 7-1 and CMS 234 in Table4.

Among the forty diverse CMS lines, the lines DCMS 7 and DCMS 22 showed best mean performance in desirable condition for Plant height, days to 50 per cent flowering, head diameter, filled seeds per plant, seed yield, leaf area index and total dry matter over cheks (CMS 7-1 and CMS 234). In addition, DCMS-22 showed superior mean performance over check (CMS 7-1) for the character 100-seed weight. the lines that showed highest mean performance over the checks (CMS 7-1 and CMS 234) for oil content and harvest and harvest index are DCMS 14 and DCMS 16, resepectively.

It can be concluded that more none of the CMS lines showed high values for all the economic traits, however DCMS 7 and DCMS 22 showed best mean performance for majority of the characters over checks (CMS 7-1 and CMS 234). So these lines with desirable characters could be used in population improvement or in development of hybrids.

LITERATURE CITED

Allard R W . 1960. Principles of Plant Breeding. John wiley and sons, INc., New york. pp 83-88.

Anuradha N 2003. Genetic divergence in Sunflower (*Helianthus annuus L.*) M.Sc (Ag.) Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad.

Burton G W 1952. Quantitative inheritance in grasses. Procedings of 6th International Grassland Congress: 277-283.

Gangappa E 1991. Evaluation of Sunflower Crop Science 15(1): 77-88.

Johnson H W , Robinson H F and Comstock R E 1995. Estimates of genetic and environmental variability in soybean. Agronomy Journal, 47: 314-318.

Lush J L 1949. Intra- sire correlation and regresssion of offspring on dams as a method of estimating heritability of characters. Proceedings of American society of Animal Production 33: 293-301.

Panse V G and Sukhatme P V 1985. Statistical methods for Agricultural workers, Indian council of Agricultural Research, New Delhi pp.361.

Rajendra Prasad S, Shankar A N, Raut N D, Khare D and Srivastava 2003. Morphological chemical and electro phoretic descriptors of sunflower varieties / hybrids (*Helianthus annuus L.*), National Seed Project (Crops), IARI, New Delhi. Technical Bulletin No. 22:1-33.

Table 1: Characterization of the CMS lines of sunglower based on morphological descriptors.

Genotypes	Hypocotyl anthocyanin colouration	Leaf shape	Leaf colour	Leaf fineness of serration	Ray flower colour	Disk flower colour	Plant branching	Head attitude (at maturity)	Head shape of grain side	Seed shape	Seed base colour
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DCMS-1	M	C	MG	M	Y	Y	A	TD	CON	OE	BL
DCMS-2	S	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-3	S	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-4	S	C	DG	M	Y	Y	A	HT	F	R	BL
DCMS-5	A	C	DG	CO	Y	Y	A	HT	F	OW	G
DCMS-6	A	C	DG	CO	Y	Y	A	HT	F	OW	BL
DCMS-7	A	C	DG	CO	Y	Y	A	TD	CON	OE	BL
DCMS-8	M	C	MG	M	Y	Y	A	HT	F	OE	BR
DCMS-9	M	C	MG	M	Y	Y	A	HT	CONC	OW	G
DCMS-10	M	C	MG	CO	Y	Y	A	TD	F	OE	BL
DCMS-11	M	C	MG	CO	Y	Y	A	HT	F	OW	G
DCMS-12	S	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-13	S	C	DG	CO	Y	Y	A	TD	CONC	OW	BL
DCMS-14	S	C	DG	CO	Y	Y	A	TD	F	E	BL
DCMS-15	S	C	DG	CO	Y	Y	A	HT	CONC	OW	BL
DCMS-16	M	T	DG	CO	Y	Y	A	HT	F	OW	BL
DCMS-17	S	C	DG	CO	Y	Y	A	V	F	E	BL
DCMS-18	S	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-19	A	C	MG	M	Y	Y	A	TD	F	OW	BL
DCMS-20	S	C	DG	CO	Y	Y	A	HT	F	OE	BL

(Contd.....)

Table 1: (Contd.....)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DCMS-21	M	C	DG	M	Y	Y	A	HT	F	OW	BL
DCMS-22	A	C	MG	CO	Y	Y	A	HT	MIS	OW	BL
DCMS-23	S	C	DG	CO	Y	Y	A	HT	F	OE	G
DCMS-24	M	C	DG	CO	Y	Y	A	HT	F	E	BL
DCMS-25	S	C	DG	CO	Y	Y	A	TD	F	OW	BR
DCMS-26	A	C	DG	CO	Y	Y	A	HT	F	OE	G
DCMS-27	M	C	DG	CO	Y	Y	A	HT	F	OW	BL
DCMS-28	S	C	DG	CO	Y	Y	A	TD	F	E	BL
DCMS-29	S	C	DG	CO	Y	Y	A	TD	CONC	OE	BL
DCMS-30	S	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-31	S	C	DG	CO	Y	Y	A	TD	F	OE	BR
DCMS-32	S	C	DG	CO	Y	Y	A	HT	F	E	BL
DCMS-33	S	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-34	S	C	DG	CO	Y	Y	A	TD	F	OE	BL
DCMS-35	M	C	DG	CO	Y	Y	A	TD	F	OE	BL
DCMS-36	A	C	MG	M	Y	Y	A	HT	F	OE	BL
DCMS-37	A	C	DG	CO	Y	Y	A	HT	F	OE	BL
DCMS-38	S	C	DG	M	Y	Y	A	HT	F	OW	BL
DCMS-39	S	C	DG	CO	Y	Y	A	V	F	OW	BL
DCMS-40	A	C	DG	CO	Y	Y	A	HT	F	R	BL
CMS 7-1	A	C	DG	CO	Y	Y	A	TD	CON	OE	BL
CMS 234	M	C	MG	M	Y	Y	A	TD	CON	OE	BL

M= Medium; C= Cordate; MG= Medium green; CO= Coarse; TD= Turned down; F = Flat; E = Elongated; BL = Black; S = Strong;
T = Triangular; DG = Dark green; Y = Yellow; HT = Half turned; Con + Convex; R = Rounded; CONC = Concave
OE = Ovoid elongated; G = Grey; A = Absent; MIS = Misshapen; OW = Ovoid wide

Table 2 : Analysis of variance for yield and yield contributing characters of the CMS lines used for characterization

Source	d.f.	Plant height (cm)	Days to 50 per cent flowering	Days to maturity	Head diameter (cm)	Filled seed/plant	100-seed weight (g)	Seed yield (g/plant)	Oil content (%)	Leaf area index	Total dry matter (g/plant)	Harvest index (%)
Replications	2	10.9702	0.6420	0.452	0.072	2341.61	0.0249	0.493	8.703	0.011	11.768	9.193
Treatments	41	1082.4573	50.434**	40.135**	10.945**	69831.22	1.6694**	393.412**	80.256**	0.4168**	1220.20**	245.34**
Error	82	113.829	3.985	6.305	1.889	4114.046	0.203	7.576	11.009	0.006	65.82	8.363
SEm±		6.159	1.153	1.449	0.794	37.032	0.319	1.589	1.916	0.002	4.68	7.77
CD (P=0.05)		17.072	3.196	4.016	2.201	102.647	0.884	4.404	5.310	0.005	12.97	21.537
CD (P=0.01)		22.437	4.200	5.279	2.886	134.908	1.159	5.789	6.98	0.007	17.009	28.306
CV (%)		9.42	3.220	2.70	10.25	11.05	9.80	10.43	9.25	2.92	8.50	10.41

** Significant at 1 per cent level

Table 3 : Estimates of variability, heritability, genetic advance as per cent of mean for yield and yield contributing characters of CMS lines used for characterization and evaluation in sunflower.

Character	Mean	Coefficient of variation (%)		Heritability (broad sense %)	Genetic advance	Genetic advance as per cent of mean
		Genotypic	Phenotypic			
Plantheight(cm)	113.26	15.87	16.77	89.49	35.01	30.91
Days of 50% flowering	62.38	6.31	6.57	92.10	7.78	12.47
Days to maturity	93.00	3.61	3.93	84.30	6.35	6.83
Head diameter (cm)	13.39	12.99	14.26	82.74	3.26	24.35
Filled seed per plant	595.93	24.84	25.60	94.11	295.78	49.63
100-seed weight (g)	4.60	15.20	16.22	87.79	1.35	29.35
Seed yield (g/plant)	26.39	42.97	43.39	98.07	23.13	87.65
Oil content (%)	35.87	13.39	14.22	86.28	9.19	25.62
Leaf area index	2.82	13.13	13.22	98.56	0.76	26.95
Total drymatter (g/plant)	95.45	20.55	21.13	94.61	38.35	40.18
Harvest index(%)	27.78	31.99	32.55	96.59	17.56	63.21

Table 4: Mean performance for yield and yield cotributing characters of the CMS lines and their respective checks of sunflower.

S.No.	Genotypes	Plant height (cm)	Days to 50% flowering	Days to maturity	Head diameter (cm)	Filled seeds/ Plant	100.seed weight (g)	Seed yield (g/plant)	Oil content (%)	Leaf area index	Total drymetter (g/plant)	Harvest index (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	CMS lines											
1.	DCMS-1	128.90	62.0	92.0	13.00	660.12	4.90	27.00	38.0	2.90	95.00	28.42
2.	DCMS-2	107.10	66.0	97.0	12.20	519.16	4.80	24.50	37.7	2.60	87.50	28.00
3.	DCMS-3	148.00	62.0	93.0	11.80	498.24	4.80	23.50	37.8	2.51	85.28	27.56
4.	DCMS-4	105.00	62.0	93.0	11.00	473.32	4.50	21.00	31.4	2.20	75.00	28.00
5.	DCMS-5	96.00	61.0	92.0	16.80	688.52	4.80	32.60	38.5	3.55	120.00	27.17
6.	DCMS-6	100.00	59.0	89.0	12.00	487.75	5.90	28.25	33.0	2.92	94.00	30.05
7.	DCMS-7	90.00	57.0	88.0	19.10	890.54	3.97	35.00	35.8	3.90	135.00	25.90
8.	DCMS-8	120.00	61.0	92.0	12.70	482.35	5.60	26.50	38.6	2.80	94.00	28.19
9.	DCMS-9	80.00	62.0	93.0	11.10	498.04	4.60	22.50	33.6	2.35	83.50	26.95
10.	DCMS-10	85.00	62.0	91.0	12.00	495.88	4.97	24.20	37.7	2.55	87.00	27.82
11.	DCMS-11	86.00	62.0	92.0	11.80	547.82	4.36	23.50	33.4	2.52	85.25	27.57
12.	DCMS-12	95.00	70.0	99.0	12.25	568.44	4.11	23.00	35.4	2.50	85.00	27.06
13.	DCMS-13	120.00	62.0	93.0	13.00	842.25	3.24	27.00	32.6	2.90	95.00	28.42
14.	DCMS-14	130.00	62.0	93.0	18.80	830.48	4.20	34.50	30.1	2.75	93.00	37.09
15.	DCMS-15	125.00	54.0	86.0	13.70	738.26	3.77	27.50	30.6	2.92	97.00	28.35
16.	DCMS-16	124.00	59.0	92.0	11.20	491.14	5.64	27.20	39.7	2.90	96.00	28.33
17.	DCMS-17	100.00	69.0	98.0	11.30	515.23	4.64	23.50	35.3	2.52	88.58	26.52
18.	DCMS-18	126.00	67.0	97.0	13.25	659.94	4.23	27.50	34.0	2.93	98.00	28.60
19.	DCMS-19	100.10	61.0	91.0	12.00	514.19	4.75	24.00	36.0	2.51	86.00	27.91
20.	DCMS-20	105.00	62.0	92.0	12.20	502.84	4.96	24.50	36.0	2.61.	87.60	27.97

(Contd.....)

Table 4 : (Contd ....)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
21.	DCMS-21	108.20	59.0	89.0	12.50	700.48	3.64	25.50	39.0	2.72	92.00	27.72
22.	DCMS-22	86.80	56.0	88.0	19.00	659.27	4.64	30.20	35.1	3.30	114.00	26.49
23.	DCMS-23	105.20	63.0	94.0	13.25	715.46	3.27	23.40	38.0	2.51	85.24	27.45
24.	DCMS-24	112.00	66.0	96.0	12.90	474.39	5.80	27.00	37.0	2.91	96.00	28.13
25.	DCMS-25	100.20	63.0	94.0	12.20	528.19	4.67	24.25	36.0	2.56	88.00	27.56
26.	DCMS-26	120.00	61.0	91.0	14.20	589.19	4.91	28.50	38.0	2.99	100.00	28.50
27.	DCMS-27	135.00	62.0	93.0	11.20	549.48	4.16	22.50	36.6	2.40	82.00	27.44
28.	DCMS-28	120.00	64.0	94.0	13.80	781.41	3.65	28.20	37.6	2.98	99.00	28.48
29.	DCMS-29	125.00	65.0	96.0	13.20	555.76	5.60	30.60	38.0	3.40	118.00	25.93
30.	DCMS-30	120.00	67.0	98.0	12.50	494.65	5.25	25.50	37.0	2.73	92.50	27.57
31.	DCMS-31	123.00	64.0	96.0	12.60	530.21	4.99	26.00	39.0	2.76	93.50	27.81
32.	DCMS-32	127.00	64.0	95.0	12.40	489.68	5.20	25.00	37.5	2.65	89.00	28.09
33.	DCMS-33	138.00	61.0	91.0	15.00	655.84	4.56	29.50	38.0	3.25	118.00	25.00
34.	DCMS-34	130.00	68.0	98.0	14.50	765.47	3.78	28.60	39.0	3.00	101.00	28.32
35.	DCMS-35	95.00	66.0	94.0	12.60	628.39	4.26	26.40	38.6	2.78	93.40	28.26
36.	DCMS-36	118.00	61.0	92.0	11.20	482.11	4.82	22.80	31.5	2.45	83.00	27.47
37.	DCMS-37	140.40	61.0	91.0	16.40	691.66	4.76	32.50	37.5	3.60	124.00	26.21
38.	DCMS-38	78.00	59.0	90.0	11.00	659.48	3.23	21.15	30.0	2.75	93.00	22.74
39.	DCMS-39	135.00	68.0	99.0	15.60	557.14	5.80	31.80	32.3	3.50	112.00	28.39
40.	DCMS-40	90.00	57.0	90.0	12.40	543.87	4.58	24.50	32.9	2.61	87.60	27.97
	Mean	111.91	62.43	93.03	13.22	598.92	4.61	26.52	35.85	2.83	95.97	27.78
	Range	78.00-148.0	54.00-70.00	86.00-99.00	11.00-19.10	473.32-890.54	3.23-5.90	21.00-35.00	30.00-39.70	2.20-3.90	75.00-135.00	22.74-37.09
	Checks											
41.	CMS 7-1	152.60	62.0	94.0	18.00	588.27	4.20	24.60	35.90	2.62	87.40	28.15
42.	CMS 234	128.20	61.0	91.0	16.00	484.11	4.70	22.56	36.7	2.42	82.50	27.35
	Grand Mean	113.26	62.38	93.0	13.39	595.93	4.60	26.39	35.87	2.82	95.45	27.78

Rajeswari U 2004. Heterosis and Combining ability studies in the genotypes derived through Interspecific Hybridization in Sunflower(*Helianthus annuus L.*) M.Sc (Ag.)Thesis, Acharya N.G.Ranga Agricultural University, Hyderabad.

Suma, CM and Virupakshappa K 1994. Characterization and evaluation of Sunflower (*Helianthus annuus L.*) germplasm. Indian Journal of Genetics and Plant Breeding 54(4): 360-365.

(Received on 02.06.2007 and revised on 16.10.2007)