S. S. Sindagi, India

PRODUCTIVITY OF SUNFLOWER HYBRIDS

The presently grown open pollinated sunflower varieties in India are highly heterogeneous. This lack of uniformity has imposed certain practical limitations in the spread of this crop. Moreover, the productivity of these varieties has varied over seasons and locations. Since hybrid sunflowers ensure homogeneity besides giving higher seed and oil yield per unit of time, water and input spent, they are preferable over populations. The value of such breeding programmes aimed at obtaining hybrid sunflowers has already been recognised in other countries, particularly in France, Romania and the USA.

The production of sunflower hybrids on large scale is possible only by using male sterility and fertility restorers. Four CMS lines, viz., CMS-2, CMS-124, CMS-204 and CMS-234 and two fertility restorers, RHA-266 and RHA-274 are used in the present study. All these lines are highly homogenous and stable in their performance as they have been selfed for a number of generations. One of the fertility restorers, RHA-266 is immune to rust, which is inherited as a dominant character. The salient morphological features of these lines are presented in Table 1.

Hybrid seeds were produced by growing CMS lines and restorers together on isolated plots. Hand pollination was also taken in addition to natural pollination.

Observations on seed characters in the hybrid seeds (F_o) revealed that the crossed seeds in general have higher grain weight, kernel and oil content (Table 2). The 1000 grain weight expressed as percentage of female parent ranged from 104.95 in CMS 124 x RHA 266 to 128.08 in CMS 204 x RHA 266. The oil content was sig-

Table 1

Salient Morphological-Features of Male Sterile Lines and Restorers

Culture	No. of days to flower	No. of leaves	Height (cm)	Stem girth (cm)	Head diameter size (cm)	1000 grain wt.	% of Hull	Reaction to rust
RHA-2 66	56	29.90	79.40	1.55	11.80	53.6	21.64	0
RHA-274	54	31.00	66.30	1.47	7.85	30.0	32.00	2
CMS-2	63	27.2	61.9	1.55	11.20	63.7	44.59	0
CMS-124	56	22.9	81.0	1.68	17.0	64.6	35.40	2
CMS-204	61	18.6	97.4	1.74	17.15	56.4	27.66	3
CMS 234	56	28.7	144.7	2.07	15.60	60.7	32.45	2

Rust score grades: 0 - immune, 1 - Resistant, 2 - Moderately susceptible, 3 - Susceptible, 4 - Highly susceptible

Table 2

1000 Grain Weight, Percent Kernel and Oil in Female Parent and in Different Crosses of Sunflower

Culture	1000 grain wet.	% kernel	% oil
CMS 2	63.2	54.2	28.9
CMS 124	66.7	74.4	39.3
CMS 204	55.2	75.0	32.8
CMS 234	53.4	75.5	43.9
CMS 2 x RHA 266	69.0	63.1	32.2
CMS 2 x RHA 274	68.3	58.4	30.2
CMS 124 x 266	70.0	79.6	46.2
CMS 124 x RHA 274	61.0	78.2	51.1
CMS 204 x RHA 266	70.7	79.0	33.9
CMS 204 x RHA 274	58.4	80.5	42.0
CMS 234 x RHA 266	59.5	80.0	52.4
CMS 234 x RHA 274	59.3	79.7	46.0

nificantly higher in all crosses compared to female parent.

It is to be noted that traits such as weight of seed, and kernel and oil content in seed are to a great extent influenced by the type of pollen parent involved in fertilization. The xenia effect which was here manifest as increased seed weight, kernel and oil content appears to be of great practical significance, since this can be exploited in sunflower for increasing oil output by careful selection of genotypes while developing new varieties. Besides it is interesting to find out whether any relationship exists between oil content in F_0 seeds and F_1 seeds, so that early prediction might be possible.

All the eight hybrids and their parents together with two check varieties, EC-68414 and EC-68415 were grown in replicated yield trial. Observations on eight characters were recorded. But here it is given only for four characters, i.e., head diameter, 1000 seed weight, oil per cent and yield. Heterosis over better parent and mid parent were computed for each character.

The analysis of variance revealed significant differences for these characters (Table 3).

Heterosis for yield and other economic characters over better parent and mid parent along with the means is given in Tables 3 and 4.

Heterosis was observed in all the hybrids for head diameter except CMS 124 x RHA 274. But significant differences could be seen only in two hybrids, and over the better parent heterosis was 44.25 and 73.40% respectively.

Four hybrids showed higher seed weight and in two, CMS 124 x RHA 266 and CMS 204 x RHA 274, it was significant over better parent.

Six out of eight hybrids showed significant increase in oil content over better parent (from 17.25% to 38.51%) and all the hybrids had significantly higher oil content over mid parent.

The hybrids matured 8-10 days earlier than the check variety EC-68415, besides possessing

Table 3

Mean Performance of Parents, F1 and % Heterosis Over Better Parent (BP) and Mid Parent (MP) in Sunflower Crosses

Crosses	Head diameter			1000 seed weight		
		Heterosis (%)			Heterosis (%)	
	Mean	BP	MP	Mean	BP	MP
1	2	3	4	5	6	7
EC 68414	16.2			57.1		
EC 68415	17.2			67.2		
RHA 266	11.3			37.4		
RHA 274	7.5			29.5		
CMS 2	13.2			62.9		
CMS 124	14.1			45.6		
CMS 204	9.4			24.5		
CMS 234	12.5			57.1		
CMS 2 x RHA 266	16.7	26.5	36.3	54.6	-13.2	8.9

Table 3 (cont.)

1	2	3	4	5	6	7
CMS 124 x RHA 266	16.1	14.2	26.8	60.2	32.0	45.1
CMS 204 x RHA 266	16.3	44.3	57.5	42.8	14.4	38.3
CMS 234 x RHA 266	15.3	22.8	29.0	55.8	-2.3	18.1
CMS 2 x RHA 274	16.0	21.2	54.6	57.3	-8.9	24.0
CMS 124 x RHA 274	13.4	-5.0	24.1	50.1	9.9	33.4
CMS 204 x RHA 274	16.3	73.4	92.9	45.5	54.2	68.5
CMS 234 x RHA 274	13.7	9.6	37.0	44.9	-21.4	3.7
CD (5%)	4.6			17.49		
CD (1%)				24.22		

Table 4

Mean Performance of Parents, F1 and % Heterosis Over Better Parent (BP) and Mid Parent (MP) in Sunflower Crosses

Crosses	Oil percentage			Yield/ha		
	Mean	Heterosis (%)		Mean	Heterosis (%)	
		BP	MP		BP	MP
1	2	3	4	5	6	7
EC 68414	48.2			1181.4		
EC 68415	47.4			2104.7		
RHA 266	33.9			1171.1		
RHA 274	35.4			324.4		
CMS 2	38.2			870.2		
CMS 124	42.0			760.0		
CMS 204	33.2			289.3		
CMS 234	51.7			1112.9		
CMS 2 x RHA 266	46.0	20.3	27.5	2612.5	123.1	156.0

Table 4 (cont.)

1	2	3	4	5	6	7
CMS 124 x RHA 266	49.3	17.3	29.7	2360.4	101.6	144.5
CMS 204 x RHA 266	47.0	38.5	40.0	2123.5	81.3	190.8
CMS 234 x RHA 266	52.0	0.5	21.3	2759.9	135.7	152.7
CMS 2 x RHA 274	50.6	32.3	37.4	1832.5	110.6	206.8
CMS 124 x RHA 274	51.2	21.8	32.3	2505.9	203.4	325.3
CMS 204 x RHA 274	47.4	33.8	38.1	2605.8	703.4	749.3
CMS 234 x RHA 274	50.9	-1.8	16.7	2563.4	153.0	283.4
CD (5%)	5.6			588.3		
CD (1%)	7.7			814.8		

Table 5

Performance of Promising Hybrids of Sunflower

Hybrids	Yield (kg/ha)		Oil content (%)		Oil yield/ha (kg)	
	Summer irrigated	Kharif rainfed	Summer	Kharif	Summer	Kharif
CMS 234 x RHA 266	2750.9	1208.0	52.0	46.9	1434.3	566.1
CMS 2 x RHA 266	2612.5	1581.9	46.0	44.3	1201.5	700.1
CMS 234 x RHA 274	2563.4	1106.6	50.9	44.4	1303.5	490.8
CMS 204 x RHA 274	2605.8	1251.3	47.4	43.6	1234.1	545.2
E.C. 68415 (check)	2104.7	643.4	47.4	45.7	998.5	294.2

100% resistance to rust caused by Puccinia helianthi, a character transferred from pollen parent.

All the hybrids except one CMS 204 x RHA 274 showed significantly higher seed set than EC 68415. This is probably due to the fact that the inbreds which are used in the synthesis of hybrids will have naturally more self fertile genes which in turn might be responsible for higher seed set under natural conditions. The studies conducted on the problem of seed filling in sunflower have clearly indicated that the poor seed set in certain localities and seasons is mainly due to limitations of pollinators.

Development of hybrids using self fertile lines (inbreds) may help to a large extent in alleviating this problem. So, it may be necessary to use highly self fertile lines in the synthesis of hybrids.