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Research Article

New male sterile lines in sunflower

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Abstract:
Two sunflower inbreds viz., TNHSF 239 and 852 B were selected for high oil content and vigour respectively. These inbreds were converted into cytoplasmic genic male sterile (cms) lines using two cms lines viz., 17 A and 234 A (PET 1 source of cytoplasm). A total of 30 cms lines were developed through back cross. These newly converted cms lines were tested for their heterotic potential for oil yield, seed yield, oil content and other yield components. Among these converted cms lines, four lines performed superior for oil yield and its component traits. These cms lines were designated as COSF 2A, 3A, 4A and COSF 5 A and recommended for utilization in heterosis breeding programme.

Keywords: Sunflower, cms lines, combining ability

Introduction

Sunflower (*Helinathus annuus* L.) is an important oilseed crop in India. The identification of cytoplasmic genic male sterile (cms) source from *Helianthus petiolaris* (PET 1) (Leclercq, 1969) and their restoration gene (Kinman, 1970) led the sunflower breeders to evolve high yielding hybrids. The hybrids are being cultivated in 80-85 per cent area in India due to its high yield potential and the role played by the private companies. So far, more than 70 cms sources were identified from wild and cultivated sources of sunflower. However, most of the hybrids were developed from PET 1 cytoplasm and released for commercial cultivation (Friedt, 1992). A promising hybrid should have high seed yield and also high oil yield for the commercial acceptance. Hence development of good combining cms lines for high oil yield is one of the important objectives in heterosis breeding programme of sunflower. In the present study, an attempt has been made to convert high oil content and promising inbreds into cms lines through backcross approach.

Materials and Methods

A high oil content (40-42% oil content) inbred from the population TNHSF 239, maintainer inbred 852 B, cms lines 17 A and cms 234 A were utilized in this study. The inbreds were crossed with 17 A and 234 A repeatedly for 6 times from 2005-09 at Dept. of Oilseeds, Tamil Nadu Agricultural University, Coimbatore. A total of 30 cms lines were shortlisted in BC_6F_1 generation. Lines 31 to 40 belong to 17 A x TNHSF 239 combination, lines 41 to 44 belong to 17 Ax 852 B and lines 45 to 60 belong to cms 234 A x TNHSF 239 combination. These 30 cms lines, 17 A and 234 A were crossed with a restorer line CSFI 99 during Summer 2009. All the 32 F1s were evaluated in Randomized Block Design replicated twice with a plot size of 5.4 m^2 with recommended cultural practices. Observations were recorded for plant height (cm), head diameter (cm), days to flowering, 100-seed weight (g), volume weight (g /100 ml), oil content (%), seed yield per plant (g) and oil yield per plant (g).

Results and Discussion

Parental lines 17A and 234 A, maintainer inbred 852 B and a high oil content inbred from the population TNHSF 239 were selected for their potentials for heterosis breeding. The line 17 A is a good combining cms line for late flowering, head diameter, volume weight and seed yield. A high yielding hybrid KBSH 44 has been developed using 17 A and used as national check in All India Coordinated Research Programme in Sunflower. However, this cms line has low oil content (33-35%) and stripes on seeds. Hence most of the hybrids developed from this cms line has low oil content and stripes on seed which fetches low price in the market. The 234 A is also a good combining cms line for oil

content, oil yield and seed yield. Many public hybrids namely BSH 1, KBSH 1, KBSH 41, NDSH 1, LSFH 35, TCSH 1 and PSFH 67 were developed using this cms line. However, it has early flowering with weak plant architecture. The inbred TNHSF 239 has high oil content (40-42%) and high volume weight. The maintainer inbred 852 B is with short plant structure. A promising cms line should have high oil content, seed yield, oil yield and less prominent or no stripes on seed surface. In addition to these characters, it should have good vigour and combining ability for oil yield and component traits. Hence, in order to develop good combining cms lines with high oil content, these lines were utilized in the back cross programme.

A high oil content inbred line developed from TNHSF 239 population and 852 B were crossed with 17 A and 234 A during January 2005. The F1s were evaluated during June 2005 and observed for their male sterility maintenance and back crossed with male parent. In each backcross generation, the F1s were evaluated for their male sterility maintenance and backcrossed with single plants of male parents. Backcrossing process was repeated for six times. In BC6F1 stage, 30 cms lines were shortlisted based on their homogeneity for various characters namely plant height, head diameter and flowering. Among these 30 newly converted lines, lines 31 to 40 belong to 17 A x TNHSF 239 combination, lines 41 to 44 belong to 17 Ax 852 B and lines 45 to 60 belong to cms 234 A x TNHSF 239 combination.

Thirty converted cms lines and the two parent cms lines 17A and 234 A were crossed with a single restorer line CSFI 99 to assess the hetrotic potential for oil yield and other yield components. The F1s were evaluated for various yield and yield components. The variance due to genotypes indicated that the presence of significant difference among the hybrids for all characters. Among various characters, positive heterosis is preferred for head diameter, volume weight, oil content, seed yield and oil yield. In case of 100-seed weight, positive heterosis is preferred in case of confectionary type of sunflower and there is no such preference for oil seed type. Positive and also negative heterosis are preferred for days to flowering depending upon the area in which the hybrids are grown. Early flowering is preferable for rainfed. Early hybrids are desirable in an area where the crop is being grown upon residual moisture. It is also most preferred in to the cropping sequence of the particular locality. In case of irrigated situation and summer crop, late maturing hybrids are most preferred. In case of plant height negative heterosis is preferred to have dwarf hybrids because tall hybrids may lead to lodging.

In the present study, hybrid of cms line 17 A recorded positive heterosis for flowering, plant height, head diameter, 100-seed weight and volume weight (data not shown). It recorded negative heterosis for oil content and non significant heterosis for seed yield and oil yield. Hybrid with cms line 234 A recorded positive heterosis for plant height, 100-seed weight, seed yield and oil yield. It has non significant heterosis for days to flowering, head diameter, volume weight and oil content. Among the converted cms lines, line 38, 39, 42 and 45 recorded positive heterosis for seed yield. In addition to positive heterosis for seed yield, these lines also recorded positive heterosis for other traits viz., the line 38 for 100-seed weight; line 39 for 100-seed weight and oil yield per plant; line 42 for early flowering and oil yield per plant and line 45 for volume weight and oil yield per plant. Hence, considering the heterosis for oil yield and component traits, four lines viz., 38, 39, 42 and 45 were considered as superior. These cms lines were named as COSF 2 A to COSF 5 A. The morphological characters of these cms lines were given in the Table 1. These cms lines were recommended for utilization in sunflower hybrid breeding programme.

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Table 1. Morphological features of new cms lines and parent cms lines of sunflower

Line #	Cms lines	Pedigree	Good combiner	Days to flowering	Plant height (cm)	Head Diameter (cm)	Flower colour	Pollen colour of maintainer line	Seed coat: Base Colour	Seed coat: Stripes on seed	Seed coat: colour of stripes
38	COSF 2A	17A x TNHSF 239	100-seed weight, Seed yield	62	163.6	22.4	Yellow	Yellow	Black	Nil	-
39	COSF 3A	17A x TNHSF 239	100-seed weight, Seed yield, Oil yield	56	165.6	18.9	Yellow	Yellow	Black	Nil	-
42	COSF 4A	17A x 852B	Early flowering, Seed yield, Oil yield	54	148.5	14.5	Yellow	Yellow	Black	Present	white
45	COSF 5A	234A x TNHSF 239	Volume weight, Seed yield, Oil yield	61	174.5	20.5	Yellow	Yellow	Black	Nil	-
	17 A	-	Late flowering, Head diameter, 100-seed weight, Volume weight	58	144.3	16.5	Yellow	White	Brown	Present	Brown
	234 A	-	100-seed weight, Seed yield, oil yield	54	155.9	14.7	Yellow	Yellow	Black	Nil	-

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Figure 1. Morphological features of seed of new cms line and parent lines