SPECIES OF HELIANTHUS AND TITHONIA SOURCES OF Rf GENES FOR CMS IN SUNFLOWER

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ABSTRACT

The study is conducted with the aim to reveal new sources of Rf genes for CMS in sunflower and to develop forms with a complete restoring ability. It was found out that 58 samples of 6 annual and 21 perennial species of Helianthus and Tithonia rotundifolia from the collection of IWS "Dobroudja", General Toshevo, are sources of Rf genes for CMS Pet-1, AN-67, ARG-1, ARG-2 and ARG-3. Sunflower forms with a complete restoring ability and some other useful qualities, a part of which represent new R lines, are developed through self-pollination, backcrossing and check of the restoring ability of materials possessing Rf genes.

INTRODUCTION

A great number of sources of Rf genes /Kinman, 1970; Fick and Zimmer, 1974; Skoric et al., 1978; etc./ are found till now from the discovery of the first stable source of cytoplasmic male sterility (CMS) in sunflower /Leclercq, 1969/.
Christov and Petrov /1988/ report for carriers of restoring genes from wild species of sunflower. Skoric et al. /1988/ found that the wild species possess restoring genes for different types of CMS in sunflower.
The aim of this study is to discover new sources of Rf genes from species of Helianthus and T.rotundifolia for CMS Pet-1 (F) and some new sources of CMS produced at Dobroudja IWS,as well as developing of sunflower forms with a complete restoring ability.

MATERIAL AND METHODS

Sixty five samples from 27 species of genus Helianthus, one species of genus Tithonia and five sources of CMS in sunflower - Pet-1, AN-67, ARG-1, ARG-2 and ARG-3 are involved in the study. Sterile plants from the different CMS sources are crossed with wild species of sunflower and Tithonia rotundifolia species.

The pollen from the male parent is laid two times on each sterile plant. Fertility restoration in the F_1 interspecific hybrids was checked in all plants at the stage of full flower. The fertile plants are isolated and self-pollinated. Together with the selfpollination a pollen is collected separately and is laid on sterile plants for producing of BC_1 generation and for the confirmation of the restoring ability. Double backcrossing is conducted in some of the cases when the interspecific hybrids are produced with participation of perennial species. Examination of the restoring ability is carried out in F_3 and F_4.

RESULTS AND DISCUSSION

Genes restoring the fertility of the five sources of CMS are discovered in 58 entries of the studied ones /Table 1/. It is found for CMS Pet-1 that fertile plants in F_1 are not produced in the crosses with seven samples. A part of the samples including H.annuus E-004, H.annuus E-039, H.annuus E-070, H.annuus E-092, H.praecox E-028, H.divaricatus M-044, H.glaucophyllus M-012, H.mollis M-020, H.smithii M-008 and H.hirsutus M-007 in crossing with sterile plants give a generation with a very high percent of fertile plants. The response of the samples H.eggertii M-001, H.resinosus M-046, and H.hirsutus M-029 is reverse. In the rest samples the percent of the fertile plants produced in F_1 is about 40 - 50%.

Genes are discovered in different samples of wild species in the genus Helianthus also for the newly produced sources of CMS. The data in Table 1 show that their Rf genes sources are considerable less compared to these for Pet-1. It is so because a large part of the samples are not studied and crosses with sterile plants on the basis of new CMS are not made. The results of the species investigated till now show that there is a difference between Rf genes depending on the CMS source. Probably, such difference will be observed also in the study of rest species.

In crossing of sterile plants from CMS Pet-1, ARG-1 and ARG-3 with T.rotundifolia F_1 fertile plants are produced only by the crosses with the materials of Pet-1 and ARG-3. A seed-set is produced after self-pollination and backcrossing with sterile plants. Ttis fact indicates that T.rotundifolia possesses Rf genes for CMS Pet-1 and ARG-3.

Table 1. Samples from the species of the genera Helianthus and Tithonia carriers of Rf genes for some sources of CMS in sunflower

Species	Sources of CMS				
	Pet-1	AN-67	ARG-1	ARG-2	ARG-3
1	2	3	4	5	6
H.annuus E-002	+				
H.annuus E-003	+				
H.annuus E-004	+		+		
H.annuus E-039	+	+	+	+	
H.annuus E-041	+				
H.annuus E-044	+				
H.annuus E-045	+				
H.annuus E-046	+		+		
H.annuus E-062	+		+		
H.annuus E-070	+	+	+		
H.annuus E-092	+	+	+	+	
H.argophyllus E-006	+				
H.argophyllus E-007	+				
H.argophyllus E-008	+				
H.argophyllus E-091	+		+		+
H.debilis E-010	+				
H.debilis E-011	+				
H.debilis E-012	+				
H.debilis E-014	+				
H.debilis E-082	+				
H.debilis E-089	+				
H.debilis E-104	+		+		
H.neglectus E-017	+				
H.petiolaris E-020					
H.petiolaris E-021					
H.petiolaris E-022	+				
H.petiolaris E-034					
H.petiolaris E-036	+				
H.petiolaris E-037					
H.praecox E-027					

Table 1. (Continued)

1	2	3	4	5	6
H.praecox E-028	+	+	+		
H.praecox E-029					
H.divaricatus M-044	+				+
H.giganteus M-011	+		+		
H.giganteus M-030	+	+	+		
H.glaucophyllus M-012	+				
H.grosseserratus M-014	+				
H.maximiliani M-081	+				
H.maximiliani M-087	+	+	+		
H.mollis M-020	+				
H.mollis M-033	+				
H.mollis M-082	+				+
H.nuttallii M-021	+				
H.nuttallii M-088	+				
H.salicifolius M-045	+	+	+		
H.salicifolius M-078	+				
H.smithii M-008	+				
H.decapetalus M-043	+	+	+		+
H.hirsutus M-007	+				
H.hirsutus M-029	+				
H.laevigatus M-016	+				
H.scaberimus M-042	+				
H.scaberimus M-054	+	+	+		
H.tomentosus M-041	+				
H.ciliaris M-092	+				+
H.eggertii M-001	+				+
H.x.laetiflorus M-005	+		+		
H.rigidus M-028	+				
H.rigidus M-097	+	+	+		
H.resinosus M-046	+		+		
H.strumosus M-059	+				
H.tuberosus M-004	+				
H.tuberosus M-039	+		+		
T.rotundifolia T-119	+				+

Table 2. Sunflower forms with restoring genes for CMS Pet-1 and genes for resistance to downy mildew produced by hybridization of sunflower male sterile lines with species of Helianthus and Tithonia

№	Donors of Rf genes	Plant height /cm/	Head diameter /cm/	1000-seed weight /g/	Oil content /%/	Generation	Type of plant
591	H.annuus E-003	115	18	39	43,2	F_7	unbranched
605	H.annuus E-004	130	10	41	48,2	F_7	branched
609	H.annuus E-039	170	12	43	45,4	F_6	branched
628	H.argophyllus E-006	170	11	43	43,6	F_6	branched
661	H.debilis E-011	170	19	50	47,0	F_5	unbranched
459	H.petiolaris E-036	155	19	51	43,9	F_6	unbranched
655	H.praecox E-028	160	15	41	45,6	F_7	branched
580	H.divaricatus M-044	150	18	39	44,7	F_5	unbranched
2091	T.rotundifolia T-119	155	13	40	49,6	F_5	branched

A backcrossing with sterile plants is carried out in many of the interspecific hybrids for producing of forms closer to these of sunflower. This approach contributed for preserving of some useful characters transferred by sunflower to eliminate some features not desired by the wild species, as well as the perennial character of F_1 materials produced by the participation of some perennial species.

The selected materials produced in F_1 or BC_1 and BC_2 carriers of Rf genes are selfpollinated several times. After crossing with sterile plants it is found that R forms are developed with a complete restoring ability and some other useful qualities /Table 2/.

CONCLUSION

Restoring genes are discovered in 58 samples of 6 annual and 21 perennial Helianthus and T.rotundifolia species for five CMS sources in sunflower. Through application of some of the classical breeding methods sunflower forms are developed from the interspecific hybrids with a complete restoring ability and some other useful qualities a part of which are ready R lines.

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