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CHARACTERISTICS OF SOME NEW CMS SOURCES OF THE GENUS *Helianthus*

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SUMMARY

Three new CMS sources, ANT–1, Pet–2, ANN–1, are studied. B and R lines for CMS of Pet–1 type are included in the investigation. The results show that the three new sources are different from the French type Pet–1. Differences are also present between the new CMS types.

In ANT–1 and ANN–1 one and the same line appears as the maintainer of the two types. Restorers for CMS of ANT–1 and ANN–1 types from the lines used in the study are not found. In CMS of Pet–2 type the fertility is restored only by line RCMG–1.

It is supposed that the complementary performance of two nonallelic genes controls the fertility restoring in CMS of Pet–2 type.

Key words: *Heliantus annuus*, CMS sources, restoring fertility

INTRODUCTION

The French source of CMS (Pet–1) discovered by Leclercq (1969) is used most widely for production of sunflower hybrid seeds in all countries growing this crop. The use however, of one source of CMS limits the diversity of the parent lines and is a great risk if this source appears to be susceptible to some new diseases. Because of these reasons plant breeders have to find and study new sources.

During the period 1974–1990 a large number of CMS sources were discovered which are in process of investigation (Anaschenko, 1974; Leclercq, 1980; Heiser, 1982; Whelan, 1980, 1981; Whelan et al., 1986; Serieys, Vincourt, 1987; Christov, 1990).

The aim of this study is to describe the genetic nature of three CMS sources (ANT–1, Pet–2, ANN–1), the comparison of these with the French source Pet–1 by crossing with samples of B and R lines, and to suggest a model explaining the genetics of restoring fertility of the CMS sources studied.

MATERIAL AND METHODS

The study was conducted at IWS "Dobroudja", General Toshevo, Bulgaria in 1988–1990. Three new CMS sources were used – ANT–1, Pet–2 and ANN–1, together with the French source Pet–1, supplied by Dr. Serieys from the FAO Coordination Centre to whom we express our gratitude.

Except these CMS sources he gave us also the lines (B and R) HA–89, HA–291, RCMG–1, RCMG–2, RCMG–3.

The sterility is determinated according to the scale (0–3) of the FAO Centre. The method of fertility restoring is conducted according to the segregation in F_2 and BC_1 progenies.

RESULTS AND DISCUSSION

1. Study of the stability the CMS sources Pet–1, ANT–1, Pet–2 and ANN–1 under the conditions of Bulgaria.

During the flowering in 1988 the inflorescences of the sterile sources Pet–1, ANT–1 and Pet–2 were checked. Only three plants germinated from the sterile source ANN–1 during the same year and because of that the control of the sterility of this source was done in 1989. From Pet–1 162 plants were checked, from ANT–1 147, and from Pet–2 138 plants.

All inflorescences of the Pet–1 CMS source were completely sterile. These had empty and degenerated anthers (0 to scale). Changes were not observed in sterility expression in the next two years (1989, 1990) which differed essentially in climatic conditions.

The inflorescences of the ANT–1 CMS source belong to the group of scale 1. In 1988 flowers with anthers occured in 62 plants of the total of 147 ones, containing a certain pollen quantity which after colouring proved to be sterile. The anthers with some pollen occured only in flowers located in the middle of the inflorescence. That phenomenon was observed also in the next two years.

In 1989, 117 plants checked from the ANN–1 CMS source showed that the sterility refers to the second type (scale 1). Flowers with anthers in which there was a small quantity of sterile pollen were seen in 23 plants. That expression was similar also in 1990.

2. Characteristics of the nuclear–cytoplasmic nature of the CMS sources: Pet–1, ANT–1, Pet–2 and ANN–1.

The restoring and maintaining ability of 18 B and R lines with 18 hybrids produced between these lines and the CMS sources studied was checked in 1989.

The results obtained during observations are presented in Table 1.

2.1. Pet–1 is maintained by HA–89, HA–99, HA–291, RCMG–1, RCMG–2, RCMG–3 and ANT–1B, and is restored by PAH–2, RHA–265, RHA–266, RHA–271, RHA–274, RHA–276, RHA–278, RHA–279, RHA–298, RHA–299, RHA–801.

2.2. ANT–1 is maintained by ANT–1B and the other 17 lines which were tested. Restorers among these were not found.

2.3. In Pet–2 the fertility restoring is observed only in a crossing with the line RCMG–1. The other tested lines maintained the sterility.

2.4. The control of the maintaining and restoring ability of ANN–1 CMS was conducted in 1990. Because of a small number of plants germinated, of this CMS type it was made only seven hybrids. On the basis of the results obtained it appeared that the sterility in ANN–1 was maintained by the lines HA–89, HA–99, RCMG–1, RCMG–2, RCMG–3, RHA–265 and ANT–1B.

3. Comparison of the new CMS sources ANT–1, Pet–2 and ANN–1 with the French source Pet–1.

After the a series of B and R lines was investigated for breeding aspect with CMS–Pet–1 type, we studied the breeding aspect for the crossings with the new sources.

3.1. CMS–ANT–1 differed genetically from CMS Pet–1. The line RHA–265 and the other R lines of Pet–1 maintained sterility in CMS–ANT–1.

3.2. CMS–Pet–2 differed from CMS Pet–1 and ANT–1. The line RCMG–1 which restored CMS Pet–2 was a maintainer of CMS Pet–1 and ANT–1.

3.3. The lines HA–89, HA–99, RCMG–1, RCMG–2, RCMG–3, RHA–265 and ANT–1B maintained sterility in the CMS types ANT–1 and ANN–1. Due to that a similarity

probably exist in the genetic nature of the two sources.

3.4. CMS–ANN–1 differed from CMS Pet–2. The line RCMG–1 was a restorer of fertility in Pet–2, while in ANN–1 it maintained the sterility.

3.5. CMS–ANN–1 also differed from CMS Pet–1. The lines HA–89, HA–99 maintained sterility in CMS of Pet–1 type; the lines RHA–265, RCMG–1, RCMG–2 and RCMG–2 restored pollen fertility in this type, while all these lines maintained sterility in CMS of ANN–1 type.

4. Restoring of fertility in different CMS sources.

The genetics of restoring was studied only in two CMS sources, Pet–1 and Pet–2. In the other two sources, tested in 1988 and 1989, such lines were not found.

In 1990 crossings were carried out with a larger group of lines for the same purpose.

The analysis of segregation of the progeny in F_2 and BC_1 shows that:

4.1. In CMS of Pet–1 type one dominant gene is responsible for the fertility restoring.

4.2. In CMS of Pet–2 type the correlation of segregation in F_2 is 92 fertile and 71 sterile plants (theoretical 9:7) of the total plant number of 163 crosses of CMS–Pet–2 and RCMG–1. Perhaps, the fertility restoring in this CMS type is due to the complementary performance of two non–allelic genes.

The correlation in BC_1 (97 fertile and 65 sterile plants of the total of 162 plants) also gives ground to suggest the hypothesis for two restoring genes.

Table 1 – Performance of some sunflower lines to different CMS sources

CMS sources	Maintainer genotypes	Restorer lines
Pet–1	HA–89, HA–99, HA–291, RCMG–1, RCMG–2, RCMG–3, ANT–1B	PAH–2, RHA–265, RHA–266, RHA–271, RHA–274, RHA–276, RHA–278, RHA–279, RHA–298, RHA–299, RHA–801
ANT–1	ANT–1B, HA–89, HA–99, HA–291, RCMG–1, RCMG–2, RCMG–3, PAH–2, RHA–265, RHA–266, RHA–271, RHA–274, RHA–276, RHA–278, RHA–279, RHA–298, RHA–299, RHA–801	None
Pet–2	HA–89, HA–99, HA–291, ANT–1B, RCMG–2, RCMG–3, PAH–2, RHA–265, RHA–266, RHA–271, RHA–274, RHA–276, RHA–278, RHA–279,RHA–298, RHA–801	RCMG–1
ANN–1	HA–89, HA–99, RCMG–1, RCMG–2, RCMG–3, RHA–265, ANT–1B	None

CONCLUSIONS

1. The three CMS sources studied–ANT–1, Pet–2, ANN–1, are different from the French CMS of Pet–1 type used in breeding.

2. Some lines appear to be maintainers of the two CMS types–ANT–1, ANN–1, which supposes a certain similarity between these.

3. CMS of ANN–1 type differs from CMS of Pet–2 type. The line restoring CMS–Pet–2 (RCMG–1) maintains the sterility of CMS of ANN–1 type.

4. The fertility restoring in CMS of Pet–2 type is maybe controlled by the complementary action of two non–allelic genes.

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CARACTERISTICAS DE ALGUNAS NUEVAS FUENTES DE CMS DEL GENERO *Helianthus*

RESUMEN

Tres nuevas fuentes de CMS, ANT–1, Pet–2, ANN–1 fueron estudiadas. Las lineas B y R para la CMS del tipo Pet–1 fueron incluidas en la investigaciónm. Los resultados muestran que las tres nuevas fuentes son diferentes del tipo francés Pet–1. Las diferencias están también presentes entre los nuevos tipos CMS. En ANT–1, ANN–1 las misma líneas aparecen como mantenedoras de los dos tipos. Las restauradoras para los tipos CMS, ANT–1 y ANN–1 de las líneas utilizadas en el estudio no fueron encontrados. En la CMS del tipo Pet–2, la fertilidad es restaurada solo por la línea RCMG–1. Se supone que la complementación de los tres genes no alélicos controla la restauración de la fertilidad en CMS del tipo Pet–2.

CARACTÉRISTIQUES DE NOUVELLES SOURCES DE CMS DU GENRE *Helianthus* .

RÉSUMÉ:

Trois nouvelles sources de CMS, ANT-1, Pet-2, ANN-1 sont étudiées. Les lignées B et R pour la CMS de type Pet-1 ont été incluses dans cette étude. Les résultats montrent que les trois nouvelles sources sont différentes du type français Pet-1. Des différences ont été également mises en évidence entre chacune des nouvelles sources de CMS. Chez les types ANT-1 et ANN-1 et chez les mêmes lignées sont apparues des mainteneurs pour les deux types. Aucun restaureur pour les CMS des types ANT-1 et ANN-1 n'a été trouvé à partir des lignées utilisées au cours de cette étude. Pour la CMS de type Pet-2 la fertilité est restaurée uniquement par la lignée RCMG-1. Il est supposé que l'action complémentaire de deux génes non alléliques contrôle la restauration de la fertilité dans la CMS de type Pet-2.