STUDY ON THE DEGREE OF STERILITY AND THE COURSE OF MICROSPOROGENESIS IN VARIOUS CMS SOURCES IN SUNFLOWER

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INTRODUCTION

Cytoplasmic pollen sterility was obtained for the first time in the year 1961 from a varietal population of the cultivated species H. annuus and was called after its discoverer Gundayev. Later on Anashtchenko obtained cytoplasmic pollen sterility combined with partial protogyny. Armenian ecotype of H. annuus was its source. Other cms sources were obtained by distant hybridization. Leclercq (1968) crossed H. petiolaris x H. annuus, Anashtchenko (1970) H. lenticularis x H. annuus and finally Georgieva-Todorova (1974) H. grosseserratus x H. annuus.

In the breeding practice three cms sources have been considered up to this time: Gundayev cms, Leclercq cms and Anashtchenko cms. Cytoplasmic pollen sterility obtained by Georgieva —Todorova has no sources of fertility restoring genes from varietal population of the cultural sunflower.

In general, Gundayev cms and Anashtchenko cms are considered as less stable, affected in their phenotypic realization by a modifying effect of climatic conditions and crossing with cultural genotypes. Usually Leclercq cms is stable in its phenotype, independent of climate or effect of the cultural genotype used to develop analogues.

Up to this time nothing substantial is known about the stability of Georgieva-Todorova cms under different climatic conditions.

RESULTS

In our experiments we evaluated all mentioned types of cms, i.e. Gundayev cms (cms from Armenian ecotype included), Anashtchenko

cms, Leclercq cms and Georgieva-Todorova cms under climatic conditions supporting the increase of pollen fertility, i.e. suitable conditions for testing instability of cms. Sterility was investigated on two levels, namely for the degree of final phenotypic realization of the trait, i.e. sterile pollen production and for the degree of phenotypic realization on histological level, i.e. in the course of microsporogenesis. Manifestation of pollen sterility was determined by vital staining of pollen with TTC and by staining polen nuclei with aceto-carmine.

Percentage of lines with phenotypic manifestation

Type of cytoplasm	Only Sterile	Sterile and partially fertile	Sterile and completely fertile	Partially fertile and completely fertile
H. petiolaris (Leclercq cms)	95%	5%	—	—
H. grosseserratus (Georgieva-Todorova cms)	40%	—	40%	20%
H. annus lenticularis (Anashtchenko cms)	—	100%	—	—
H. annuus annuus	20%	50%	30%	—
H. annuus with protogyny (Armenian ecotype)	—	—	—	100%

Our findings indicate that the presumption of stability of Leclercq cms was also confirmed under climatic conditions of CSSR. As a matter of fact line (HA 148) shows a decreased stability of cms in one case only.

Georgieva-Todorova cytoplasmic pollen sterility is less perfect. Most of the studied lines show a high proportion of fertile pollen, in percents over 90%.

Anashtchenko cms displayed full sterility when tested by means of TTC, whereas after aceto-carmine staining incomplete sterility

was found in most plants which reached at most 30% of fertility. Line derived from Armenian ecotype shows under our experimental conditions partial to complete fertility. Gundayev cms obtained from the cultivars of cultural sunflower has a characteristic deficiency consisting in the presence of some completely sterile lines among lines possessing a certain proportion of completely fertile individuals in addition to sterile plants.

It is possible to summarize that under climatic conditions of CSSR the most perfect source of cms is Leclercq cms where only a negligible proportion of plants produce fertile pollen. Anashtchenko cms manifests phenotypically by production of a certain proportion of fertile pollen (0-30%) in most plants. Gundayev cms and Georgieva-Todorova cms show phenotype of partial fertility in some plants and cms combined with protogyny is characterized by production of partially or completely fertile pollen in all plants. The given range indicates the value for breeding of all cms sources in sunflower studied by us.

In our experiments the course of microsporogenesis was studied in the plants coming from various cms sources and possessing complete sterility.

The results of evaluation showed that in all experimental plants with complete sterility only one type of the course of microspore degeneration connected with a malfunction of tapeta, as a source of microspore nutrition, occurred. Hence data on cms in sunflower on histological level can be summarized more accurately in the following way:

1. Beginning of the degeneration process before meiosis of pollen mother cells was not observed in any casi in cms sources included in the experiments. Therefore cms in sunflower is not a consequence of degeneration of sporogenous tissue.

2. Microspore degeneration begins in the phase limited by early prophase of meiosis of pollen mother cells on one side and by the phase of tetrade separation on the other side. The premature stop of the function and absortion of tapeta cells was always the cause of degeneration. In consequence microspores have unsufficient nutrition, slow down their development and degenerate. Hence the cause of cms is not an atypical course of meiosis of sex cells but changes in the development of nutritional tissue of anothers.

3. Only one type of the course of microspore degeneration common for all cms sources was found by us. Differences related to the beginning of the degeneration process in various stages of micro-

sporogenesis is impossible to classify. Differences in the beginning of microspore degeneration occur between individual plants of the same line, between flowers of the same plant, even between pollen sacs of the same anther. Hence these differences cannot characterize either a certain source of cms or a certain line. Obviously they are not of genetic origin and occur as modifications among individual plants and also on a single plant.

Therefore we can state that it is impossible to differentiate on histological level more genetically conditioned phenotypic manifestations between various sources of cms or various lines of the same source of cms. Small phenotypic differentiation consists in individual modificatory variability of individual plants showing cytoplasmic pollen sterility.

Our findings can be taken for a certain contribution to the knowledge on pollen sterility in sunflower. However, the cause of cms instability in some of its sources manifesting segregation of lines into completely sterile plants and plants with partial or complete fertility remains to be determined. This problem can hardly be solved on the level of histological studies of microsporogenesis.