

CYTOPLASMIC MALE STERILITY OF PLANTS – BIOLOGICAL AND MOLECULAR MECHANISMS

S u m m a r y

Cytoplasmic male sterility (CMS), the trait resulting in the formation of non-functional microspores or pollen grains, is commonly used by plant breeders for hybrid seeds production. Numerous studies aimed at the explanation of both biological and molecular mechanisms leading to the pollen abortion have been carried out in the past thirty years. Among the cytological events accompanying CMS, the most pronounced one concerns the tapetum – tissue surrounding differentiating pollen mother cells (PMC) – and involves its abnormal vacuolization, fusion of cells into multinuclear syncytia, and disturbances in the time of the programmed tapetum death. Development of PMC, depending upon the species, is arrested either during meiosis or in postmeiotic phase, and is usually related to the failure in the deposition of the microspore (pollen) wall. Ultrastructural and morphometric analysis clearly showed that mitochondria in both tapetum and PMC are seriously affected in CMS plants, which is reflected in changes of their number, size and structure.

Molecular analyses indicated that several structural features of mitochondrial DNA (mtDNA) might be related to CMS expression. The results of RFLP studies and of hybridizations with specific mitochondrial probes revealed, that the organization of several genes such as *atpA*, *atp6*, *atp9*, *coxI*, *coxII*, *coxIII* and *cob* is different in sterile plants in comparison with their fertile counterparts. Despite that the altered mitochondrial organization typifies all plant tissues, the disturbances in development could only be detected in anthers. This probably results from exceptionally high energetic demand of anther tissues due to the numerous subsequent cell divisions accompanied by several cycles of DNA replication.

The wide interest of breeders in the application of CMS plants led to the development of several techniques of male sterility induction, including the production of transgenic plants with altered expression of either nuclear or mitochondrial genes, the transfer of mitochondria from sterile to fertile plants, and formation of new “cybrid” plants with rearranged mtDNA.