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The present study deals with the developmental, histochemical, biochemical and molecular aspects of cytoplasmic male sterility (CMS) in cotton (Gossypium hirsutum L.). The following aspects have been studied in order to understand the mechanism of CMS.

1. The time of male sterile gene action and its consequences;
2. Behaviour of callose during microsporogenesis in both fertile and sterile lines;
3. Histochemical changes that are seen in different anther tissues during microsporogenesis in fertile and sterile lines;
4. Identification of proteins as potential agents of degeneration of PMCs;
5. Identification of mitochondrialy synthesized polypeptides in normal and CMS lines.

Anther development in CMS and fertile lines was studied in order to understand the pollen abortion process and to identify the timing of male sterile gene action with the help of light microscopy and fluorescence microscopy. Light microscopic studies have revealed that the process of microsporogenesis in both fertile and CMS lines is similar up to the PMC stage. Before the onset of meiosis the PMCs of CMS anthers undergo degeneration. The tapetum, on the other hand, maintains a level of morphological integrity even after complete collapse of PMCs.

Fluorescence microscopic observations revealed normal deposition and dissolution of callose around meiocytes and microspore tetrads in fertile line. In CMS lines deposition of callose around meiocytes appears normal. However, precocious and faulty dissolution of callose around PMC's leads to sterility. The callose layer is degraded by
the activity of the enzyme callase synthesized by the tapetum, and abnormalities in the behaviour of tapetum may be reflected on irregular activity of callase.

Histochemical localization of polysaccharides, ascorbic acid (AA) and proteins reveals physiological differences between fertile and CMS anther tissues. In fertile anthers during PMC stage, tapetum and PMCs show larger amounts of polysaccharides, AA and proteins, whereas in sterile lines the contents of polysaccharides and protein are reduced. This may be indicative of the primary function of tapetum in the synthesis and transport of metabolites in the developing anther. Inability of tapetum to synthesize and supply of these substances leads to starvation of PMCs and thereby their degeneration.

SDS-PAGE of anther proteins from normal and CMS lines of cotton at different development stages was carried out. During sporogenous tissue stage, normal anthers show an additional band of 12 kd protein, which persists through later stages of development. This particular protein (12 kd) is not synthesized in the sterile line. Absence of 12 kd protein in CMS anthers has been correlated to cytological abnormalities like precocious degeneration of callose and abortion of pre-meiotic PMCs.

Mitochondria were isolated from leaves of CMS and normal lines of cotton and allowed to synthesize protein in the presence of $^{35}$S methionine. Fluorography revealed the synthesis of additional polypeptides of 36 kd and 48 kd in CMS plants.

These results suggest that mitochondria in CMS cotton like in other CMS systems synthesize additional proteins which may bring about pollen abortion. It is presumed that in sterile anthers the synthesis of 12 Kd protein is inhibited by additional polypeptides synthesized by sterile mitochondria.