Structure of Anther and Pollen

Introduction

Androecium is the collective name for the male reproductive organ- the stamens. Stamens are the male reproductive organs of flowering plants. A typical stamen has a large elongated sterile filament bearing at its distal end a fertile bilobed anther. The anther filament transmits water and nutrients to the anther and also positions it to aid pollen dispersal.

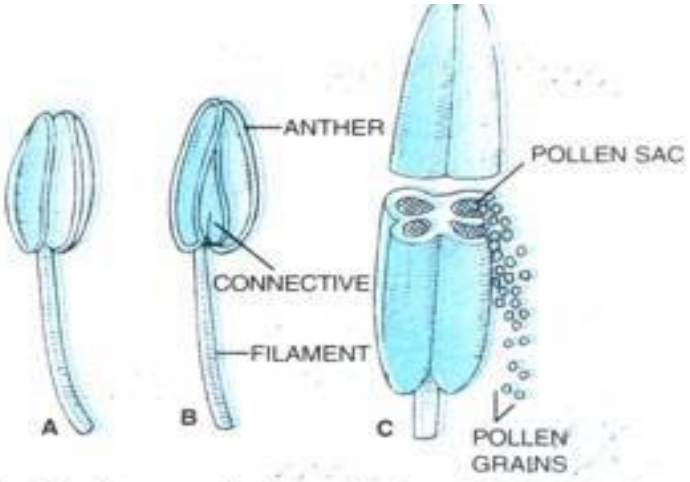
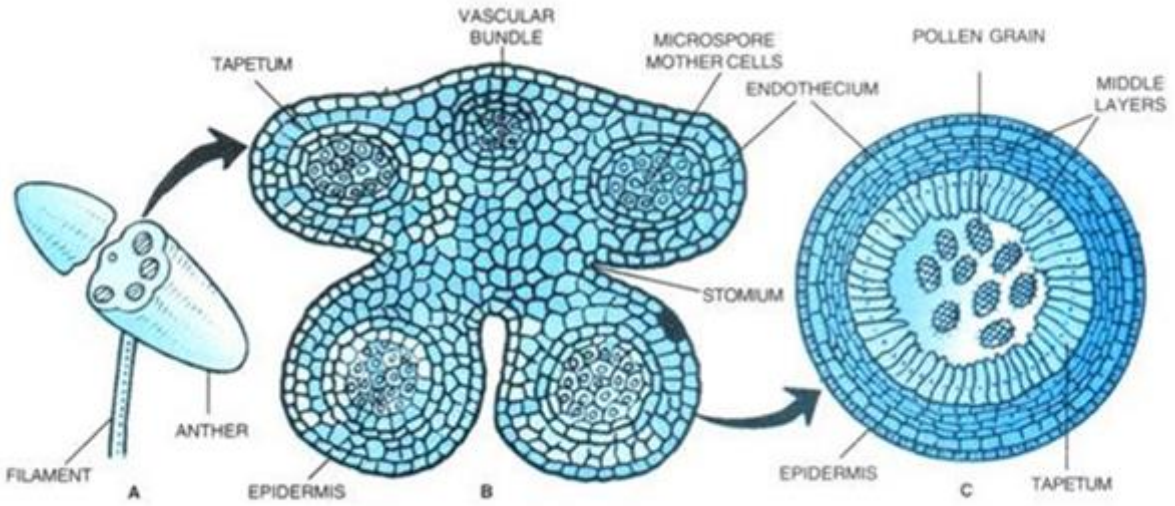


Fig. 2.3. Stamen. **A.** Ventral view; **B.** Dorsal view; **C.** Three dimensional cut section of Anther (Enlarged).

Structure

A typical anther is a bilobed, dithecous structure with two microsporangia in each lobe. Therefore, an anther is a tetrasporangiate structure with four microsporangia. The non-sporangial tissue that joins the two anther lobes is known as the connective. A single vascular strand is embedded in the connective. In each lobe the two microsporangia are separated by a strip of sterile tissue, the intersporangial septum. In a mature anther, the two sporangia in an anther lobe become confluent due to the enzymatic lysis of the septum to form a single locule or theca. In some plants such as Hibiscus rosa-sinensis, the anther is one lobed consisting of two microsporangia which are fused at maturity to form a single theca (monothecous).



T.S. anther, showing stomium and pollen grains.

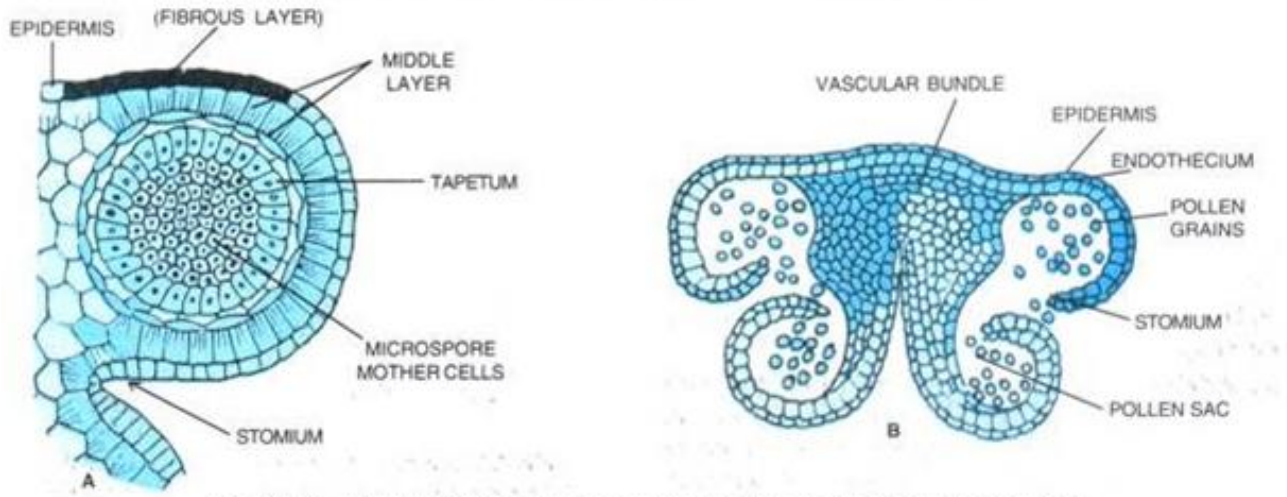
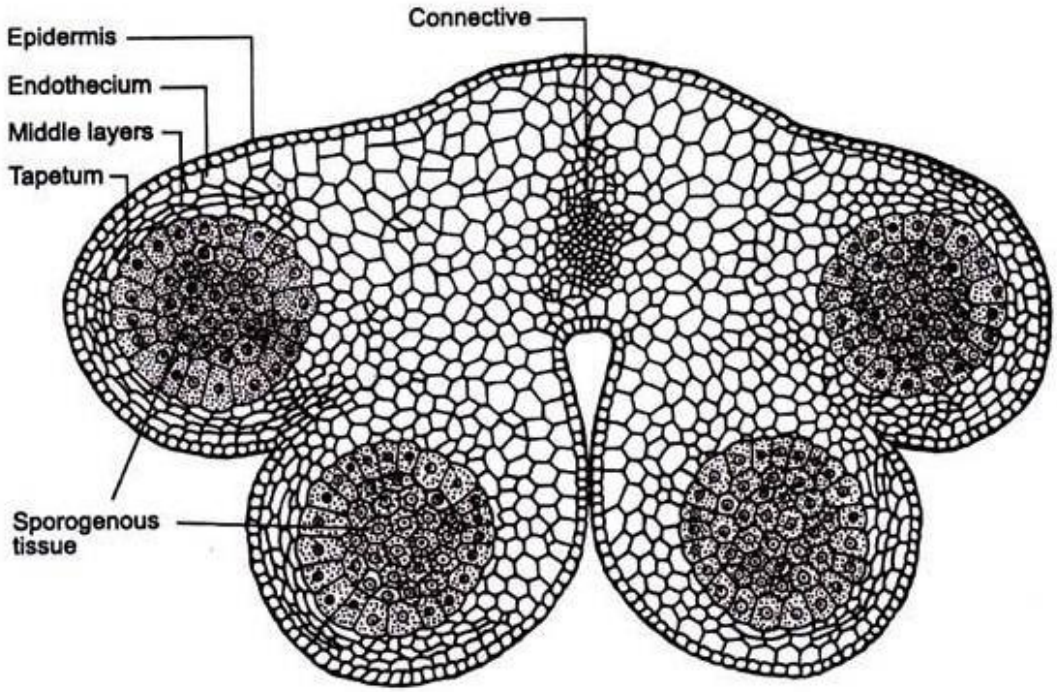


Fig. 2.5. A. Detailed structure of one young pollen sac; **B.** T.S. mature anther.

Structure of microsporangium (pollen sac):

Young anther while it is still in flower bud reveals the presence of outermost epidermis. The outermost wall layer lying just below the epidermis is called endothecium or fibrous layer, because wall (two radial and inner) develop fibrous thickenings on them except at the junctions of two pollen sacs. Below the endothecium, there are 1-3 middle layers of parenchyma cells.



The cells of innermost wall layer are radially elongated and rich in protoplasmic contents. This layer is called tapetum. The tapetum forms the nutritive tissue nourishing the developing microspores. The cells of tapetum may be multinucleate or may have large polyploid nucleus. The tapetal cells provide nourishment to young microspore mother cells either by forming a plasmodium (amoeboid or invasive type) or through diffusion (parietal or secretory type).

The pollen sac wall encloses a number of archesporial cells that further forms microspore mother cells (microsporocytes). In the beginning microspore mother cells are polygonal and closely packed, but as the anther enlarges, the pollen sac becomes spacious and gets loosely arranged. A few microspore mother cells become non- functional and are finally absorbed by developing microspores.

During microsporogenesis the nucleus of each microspore mother cell undergoes meiosis and gives rise to four haploid nuclei (microspore tetrad). These four nuclei are arranged in a tetrahedral manner forming tetrahedral tetrad. The four microspores separate from each other, and each develops a characteristic shape or form which differs in different species of plants.

Structure of microspore (Pollen grain):

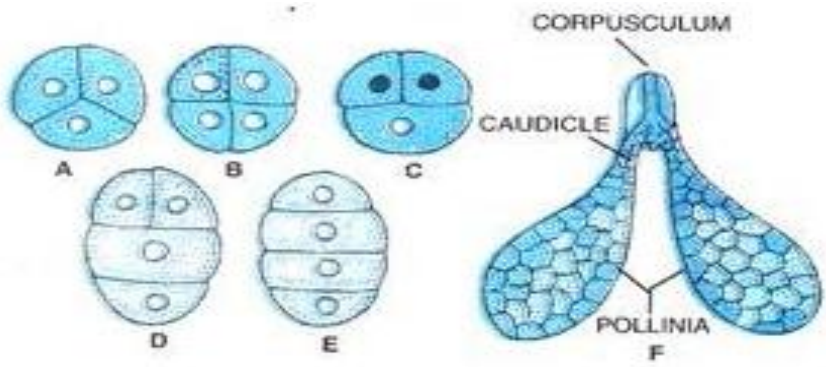
Pollen grains develop from the diploid microspore mother cells in pollen sacs of anthers. Typically, pollen grain is a haploid, unicellular body with a single nucleus. Pollen grains are generally spherical measuring about 25-30 micrometeres in diameter. The outer surface of microspores may have spines, ridges or furrows which may vary in other ways in different species. A mature pollen grain has a two-layered wall—the outer exine and inner

intine. The wall encloses a large vegetative cell containing vegetative nucleus and a lenticular generative cell. Their functions are as follows:

1. **Exine:** The outer thick exine layer is made up of sporopollenin which is resistant to physical and biological decomposition. It provides protection during the hazardous journey of pollen from the anther to stigma. There are one or many germ pores on the pollen surface which are directly or indirectly associated with its germination.
2. **Intine:** The intine is pecto-cellulosic in nature. It is associated with the formation of the pollen tube.
3. **Vegetative cell:** The vegetative cell is large and contains abundant food reserve. It has a large vegetative nucleus. The function of the vegetative cell is to provide the medium for the movement of male gametes inside the pollen tube.
4. **Generative cell:** The generative cell cytoplasm is highly reduced but it contains the usual cell organelles. It divides mitotically to produce two functional male gametes.

There may be oval, ellipsoidal, triangular, lobed or even crescent-shaped pollen grains. The cytoplasm is surrounded by a two layered wall. The outer layer exine is thick and sculptured or smooth. It is cuticularised and the cutin is of special type called sporopollenin which is resistant to chemical and biological decomposition. In insect pollinated pollen grains, the exine is covered by a yellowish, viscous and sticky substance called pollen kit.

Pollen grains are well preserved as fossils because of the presence of sporopollenin. The thin areas are known as germ pores, when they are circular in outline and germ furrows when they are elongated. The cytoplasm is rich in starch and unsaturated oils.



Kinds of Microspore tetrads in angiosperms. A—Tetrahedral tetrad; B—Isobilateral tetrad; C—Decussate tetrad; D—F shaped tetrad; E—Linear tetrad; F—Pollinium of Ak or *Calotropis*.

Uninucleate protoplast becomes 2-3 celled at the later stages of development. The branch of study of pollen grains is called palynology. In Calotropis and orchids, the pollen of each anther lobe forms a characteristic mass called pollinium. Each pollinium is provided with a stalk called caudicle and a sticky base called disc or corpusculum.

Table1.1 : Function of anther cell and tissue types

Cell or Tissue Types	Major Function
Connective	Join anther thecae together; connect anther to filament, provide structure, support and morphology.
Circular cell cluster	Dehiscence
Endothecium	Structure and support; dehiscence.
Epidermis	Structure and support; prevent water loss; gas exchange; and dehiscence.
Microspore	Pollen grain and sperm cell development.
Middle layer	Structure and support; dehiscence.
Stomium	Dehiscence
Tapetum	Pollen wall components; nutrients for pollen development; enzymes for microspore release from tetrads.
Vascular Bundle	Connection between anther, filament, and flower; nutrient and water supply.

The anther dehisces at maturity in most of the angiosperms by a longitudinal slit, the stomium to release the pollen grains. The pollen grains represent the highly reduced male gametophytes of flowering plants that are formed within the sporophytic tissues of the anther. These microgametophytes or pollen grains are the carriers of male gametes or sperm cells that play a central role in plant reproduction during the process of double fertilization.