KRISHNAGAR ACADEMY

Biology -

CHAPTER-2

Sexual Reproduction In Flowering Plants.

Brief Résumé

1. **Sexual Reproduction:** In angiosperms or flowering plants, sexual reproduction involves the fusion of two gametes, the male and the female which are produced in special organs called **flowers.**
2. **Flower:** The flower has a stalk called **pedicel** and an upper swollen region called **thalamus** or **receptacle.** On this are borne the four whorls [Fig. 2.1].

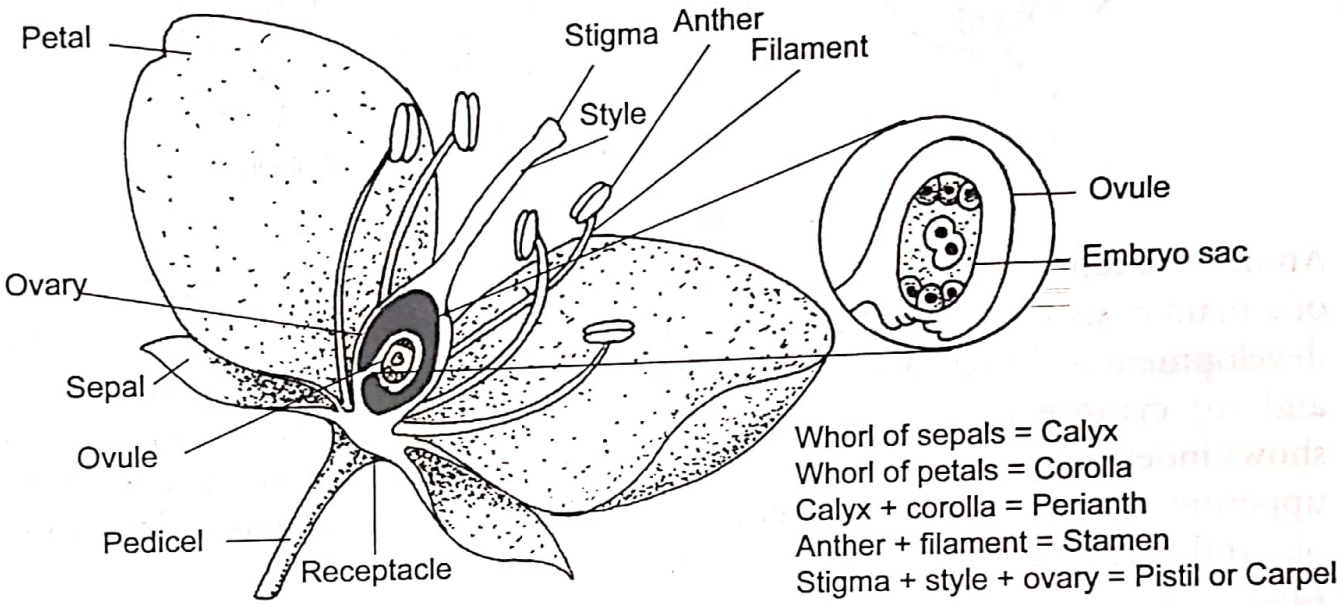


Fig. 2.1: *A typical flower*

(*i*) *Calyx:* It is made up of leaf-like green sepals.

(*ii*) *Corolla:* It consists of a number of petals, which may be brightly coloured and/or scented to attract insects for pollination.

(*iii*) *Androecium:* It consists of stamens. Each stamen has three parts: filament, anther and connective. The anther contains the pollen grains.

(*iv*) *Gynoecium:* It is also known as the **pistil.** It is composed of the ovary, style and stigma. The ovary contains the ovules.

The androecium and gynoecium are reproductive whorls, whereas calyx and corolla are accessory whorls.

3. A flower having all four whorls is said to be *complete* and if one or more whorls are missing, it is *incomplete.*
4. Flowers bearing both stamens and carpels are called **hermaphrodite** or **bisexual** flowers and flowers in which only either stamen or carpel is found are called **unisexual flowers.** Such flowers may either be **staminate** (having stamens) or **pistillate** (having carpels). If a plant has unisexual, bisexual as well as neuter flowers, it is called **polygamous.**

Structure of Microsporangium

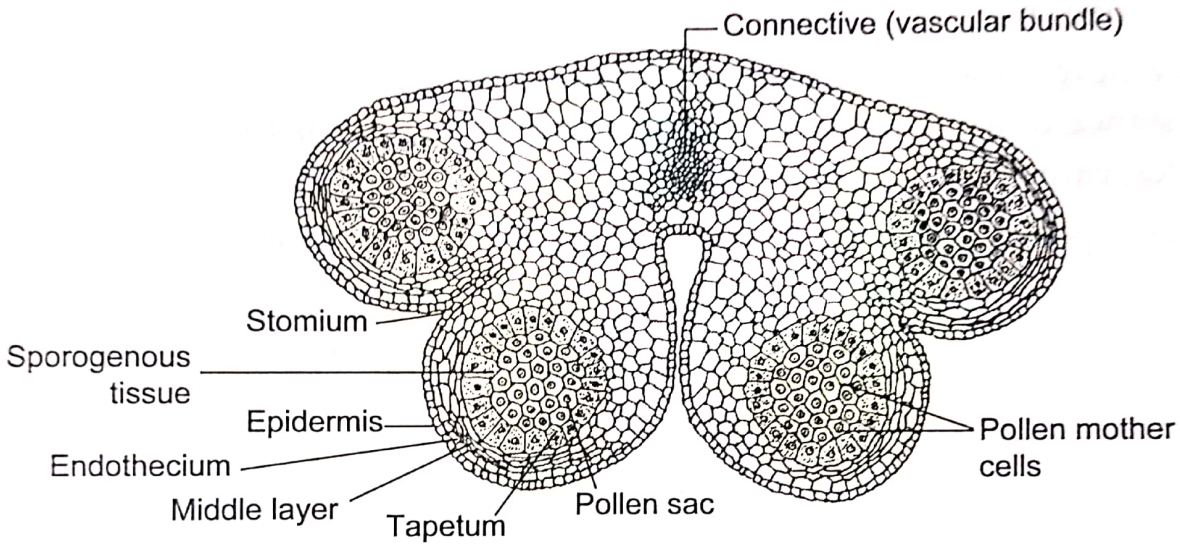


Fig. 2.4: *T.S of anther lobe*

- It appears more or less circular in outline in transverse section and is surrounded by four walls:
  - (*i*) Outermost is epidermis made up of a single layer of cells.
  - (*ii*) Second layer is endothecium.
  - (*iii*) Middle layer is made of 2–4 layers of cells.
  - (*iv*) Intermost tapetum is made up of large diploid/polyploid, binucleate/ multinucleate cells.

(d) **Structure of microspore (Pollen grain).** As already discussed, 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 25-50 micrometeres in diameter. The outer surface of microspores may have

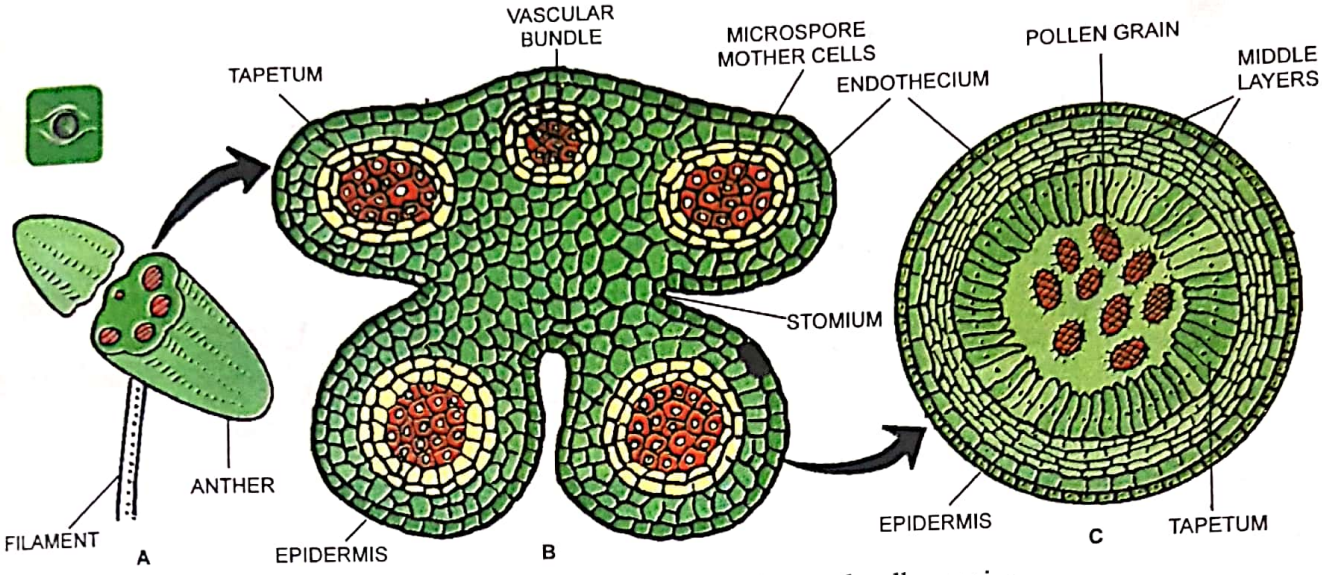


Fig. 2.4. T.S. anther, showing stomium and pollen grains.

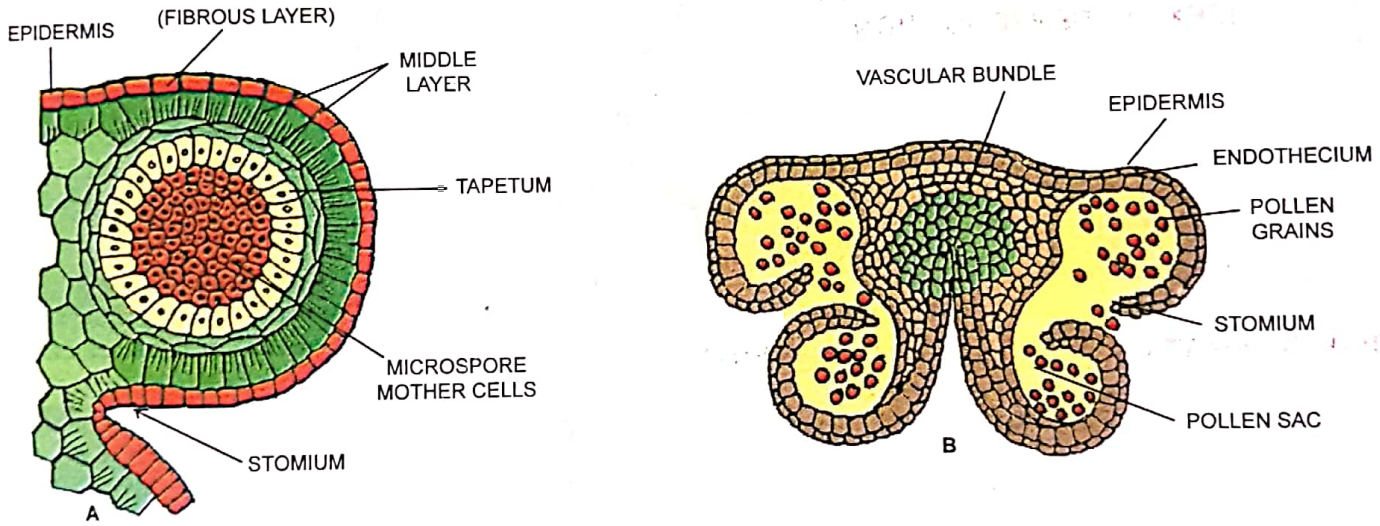


Fig. 2.5. A. Detailed structure of one young pollen sac; **B.** T.S. mature anther.

spines, ridges or furrows which may vary in other ways in different species. 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 of fatty substance, called **sporopollenin,** which is resistant to high temperature, strong acids and alkalies 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. At certain places the exine remains thin. 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. Uninucleated 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 grains of each anther lobe form a characteristic mass called **pollinium**. Each pollinium is provided with a stalk called **caudicle** and a sticky base called **disc** or **corpusculum**.

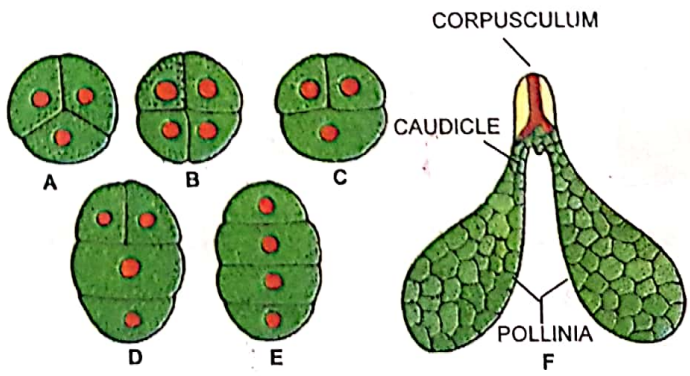
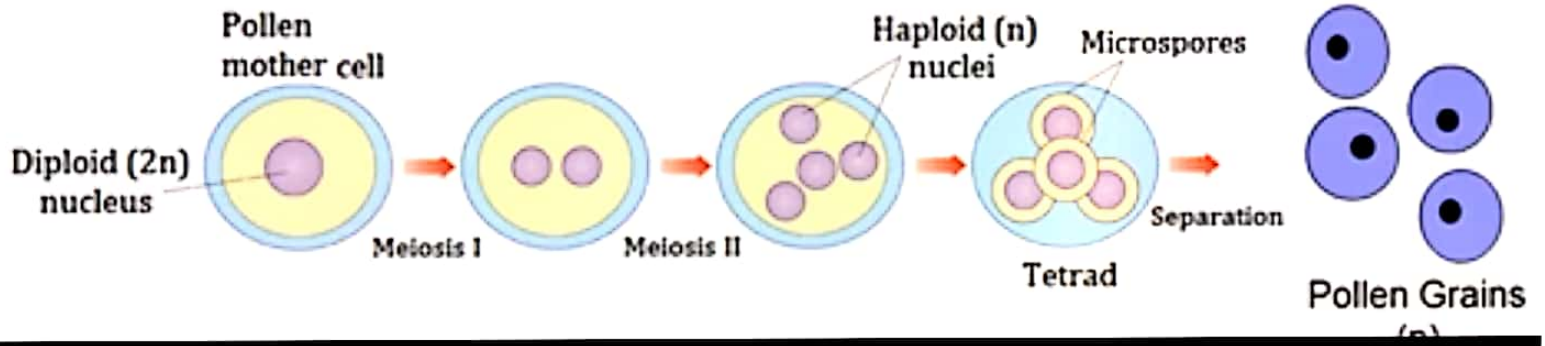


Fig. 2.6. Kinds of Microspore tetrads in angiosperms. **A**—Tetrahedral tetrad; **B**—Isobilateral tetrad; **C**—Decussate tetrad; **D**—**T** shaped tetrad; **E**—Linear tetrad; **F**—Pollinium of Ak or *Calotropis*.

Microsporogenesis



Process of formation of microspores or pollens from PMC through meiosis is called microsporogenesis.

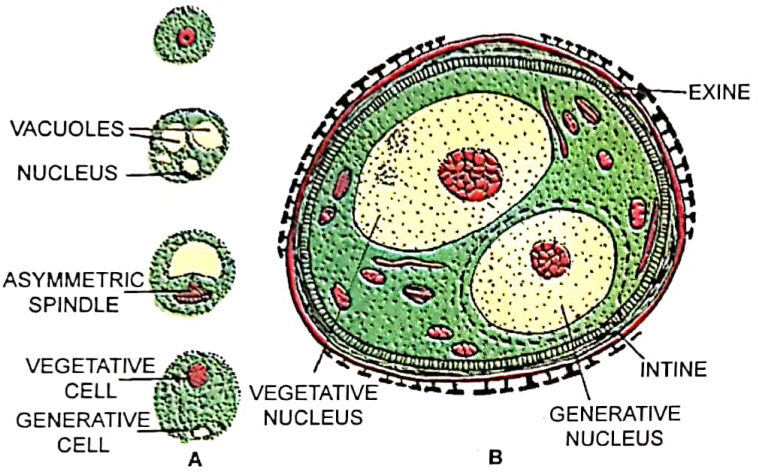


Fig. 2.7. A. Microspore forming a pollen grain; B. Structure of a pollen grain (enlarged view).

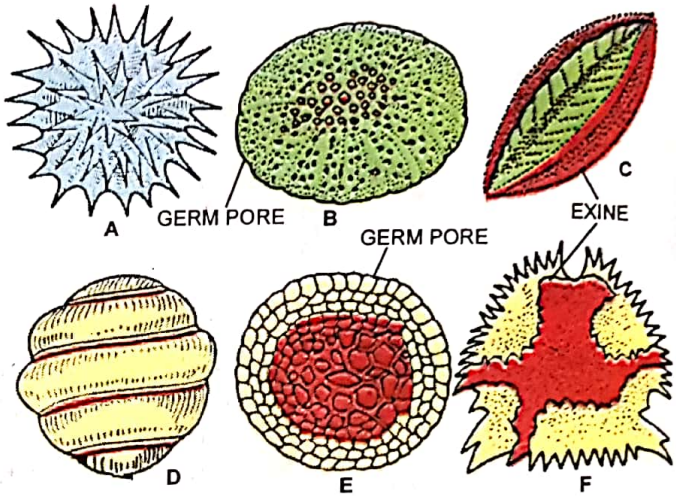


Fig. 2.8. Different pollens showing various types of sculpturing.

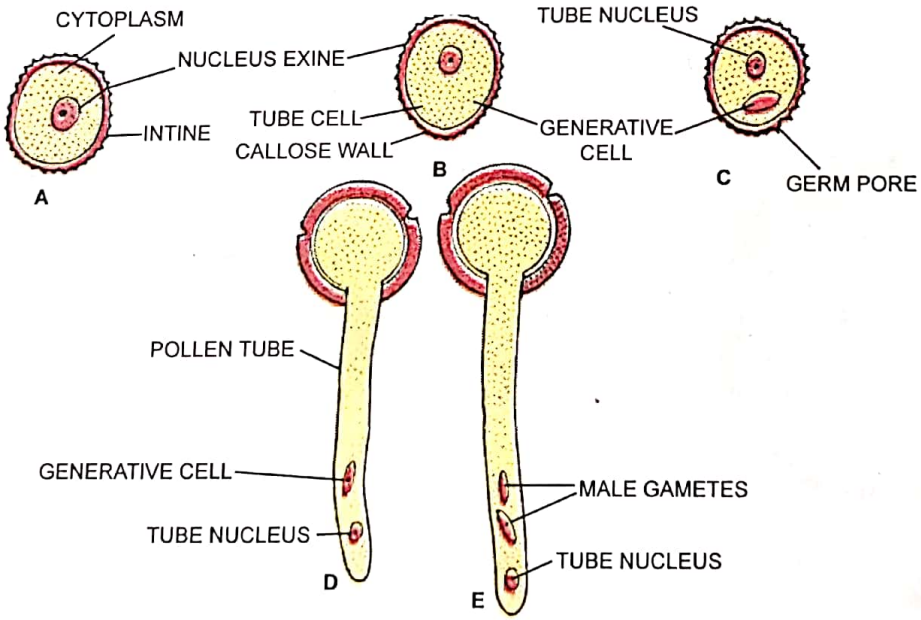


Fig. 2.9. Structure and germiantion of pollen grain in angiosperms. A—Uninucleate pollen grain; B—Pollen grain with generative cell and tube nucleus; C—Generative cell lies free in tube cell; D—Pollen tube has developed and the generative cell and tube nucleus hae migrated into it; E—Generative nucleus has divided into two male gametes.

DEVELOPMENT OF MALE GAMETOPHYTE

Development of male gametophyte starts in pollen grains, while still present in the microsporangium or pollen sac (**precocious germination**). Microspore undergoes only two mitotic divisions. First mitotic division leads to the formation of larger **vegetative cell** and smaller **generative cell**. Vegetative cell is also called **tube cell**. The vegetative cell is bigger has abundant food reserve and large irregular shaped nucleus. These cells do not possess any cell wall, hence represented only by cell membranes. A temporary **callose** wall is laid down between the two cells (Groska-Bry-Lass, 1967). The callose wall spreads between the generative cells and the intine to finally pinch it off. Soon, this callose wall dissolves and generative cell lies freely in the cytoplasm of vegetative cell. Generative cell may be elliptical, lenticular or even spindle shaped. The cytoplasm contents of generative cell are almost hyaline and do not possess much of stored food **material.** The larger vegetative cell contains fat, starch and some type of protein granules. **It is usually at this two celled (bicelled) stage that pollen grains are liberated from pollen sacs of anther lobes.** Rarely generative cell may further divide to form two male gametes. Other stages for the development of pollen tube etc. occur on the stigma after pollination. All these stages for the development of male gametophyte are grouped under **pre-pollination stages.**

After falling of pollen grains on stigma **post-pollination** changes occur. Pollen grain absorbs water and nutrients of the stigmatic secretion through its germ-pores. The intine protrudes out through one of the germ pores or through a germ furrow. The generative nucleus divides to form two male nuclei, which become surrounded by cytoplasmic masses and appear as distinct male gametes. Protruded intine forms pollen tube. Tube nucleus migrates to pollen tube. Formation of male gametes can occur in vegetative cell or pollen tube. Usually generative cell comes down into pollen tubes and then divides to form the male gametes. The hinder region of the pollen tube is highly vacuolated. This region plugged from anterior part by the development of callose. The pollen grain or male gametophyte in angiosperms is highly reduced.

Economic Importance of Pollen Grains

(*i*) Pollen grains are very rich in nutrients and hence are being taken as food supplements.

(*ii*) In Western countries pollen products are obtained as tablets and syrups.

(*iii*) Also available as creams, energy shakes (thought to increase performance of athletes).

Germination of Pollen Grain: The germination of pollen grain starts in the pollen sac where the cell divides into two cells—a small **generative cell** and a large **tube** cell. The pollen grain is liberated at this two-celled stage and further germination takes place on the stigma. The intine grows out of the germ pore as a short pollen tube. As the pollen tube grows, the tube nucleus and the generative nucleus grow more into it. As the pollen tube reaches the ovary, it enters either through the micropyle or chalaza or nucellus to reach the egg apparatus. By this time, the tube nucleus degenerates and the generative nucleus divides into two male gametes. The pollen tube bursts and the male gametes are liberated.

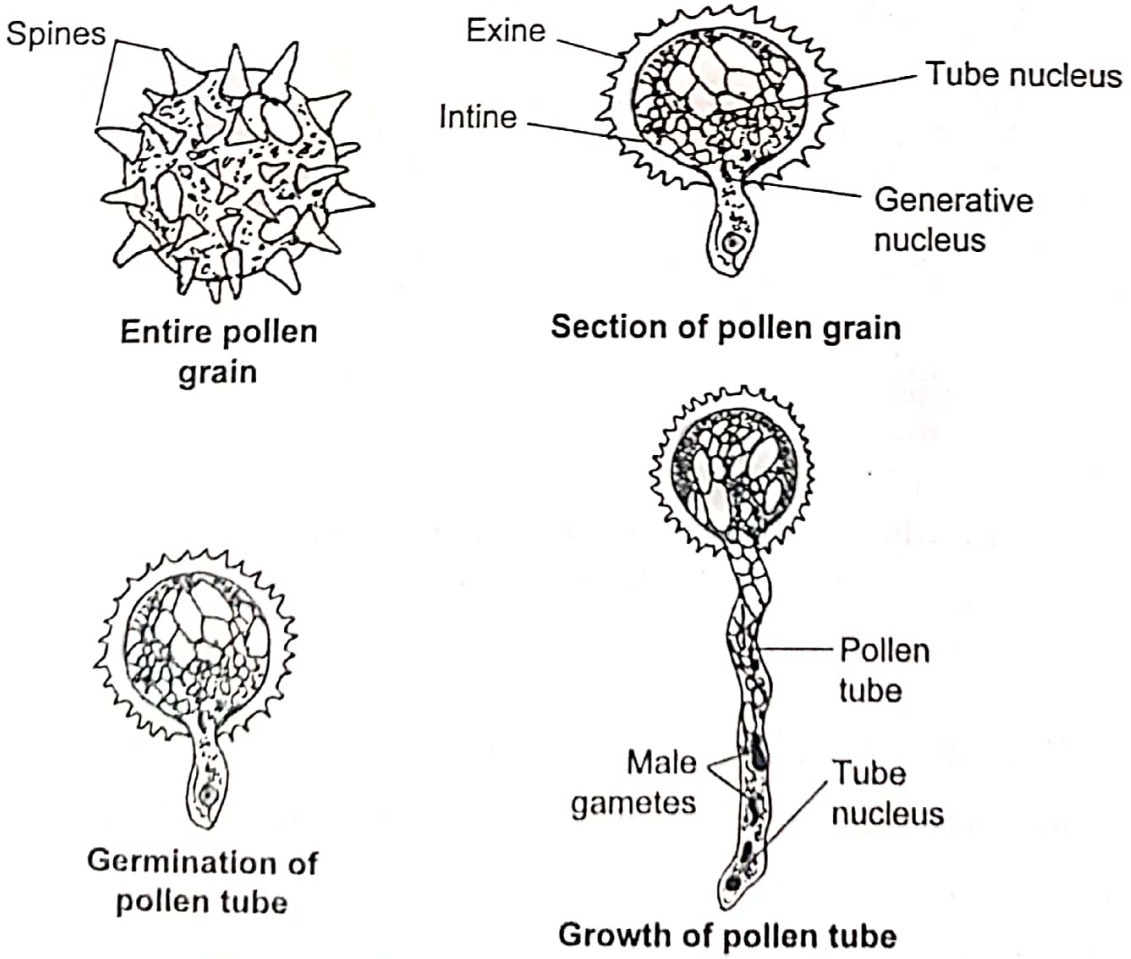


Fig. 2.7: *Germination of pollen grain*

Important points about Pollen

- ✓ **Pollen grains are well preserved as fossils because of presence of sporopollenin. Palyno fossils (fossil pollens) help in exploration of petroleum spots.**
- ✓ **Pollen grains of many species cause severe allergies leading to chronic respiratory disorders like asthma and bronchitis.**
- ✓ **Parthenium (carrot grass) came to India as a contaminant with imported wheat. It has become ubiquitous in occurrence and causes pollen allergy.**
- ✓ **Pollen grains are rich in nutrients. Thus they are consumed as food supplement.**
- ✓ **Pollen Bank: Storing pollen grains of large number of species for years in liquid nitrogen (-190° C). This process is known as cryopreservation.**

Home Task - Class XII.

1. Define :- Tapetum, microspore, sporopollenin, palynology, caudicle.

2. Briefly describe the process of microsporogenesis.

3. Mention 2 economic importance of pollen grains.

4. Write down the process of germination of pollen grain, with proper diagrams.