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NAAC ACCREDITED 'A' GRADE



Topic: PALEOBOTANY AND PALYNOLOGY
Course Title: PLANT DIVERSITY II
Paper: BOT-G-CC-2-2-TH
Unit: 3.4
Semester: II
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Name of the Department: Botany (Morning)

Palynology

Definition:

Palynology is the study of plant pollen, spores and certain microscopic planktonic organisms (collectively termed palynomorphs) like chitinozoans, coccoliths, dinoflagellates, acritarchs etc in both living and fossil form. It does not include organisms with siliceous or calcareous exoskeleton (diatoms, foraminiferans).

Botanists use living pollen and spores (actuopalynology) in the study of plant relationships and evolution, while geologists (palynologists) may use fossil pollen and spores (paleopalynology) to study past environmental stratigraphy (the analysis of strata or layered rock), historical geology and paleontology.

The term originates from greek word “palynein”. Hyde and Williams (1845) first used the term.

A classic palynologist analyses “ particulate” samples collected from air, from water, or from deposits including sediments of any age. The condition and identification of these particles, organic or inorganic, give the palynologist clues to the life environment and energetic conditions that produced them.

Difference Between Pollen and Spore:

Pollen grain:

- Pollen refers to the powdery product (dust) synthesized by the seed plants (gymnosperm and angiosperm) responsible for the production of male gametes of the plant.
- Pollen grains are termed microspores or microgametophytes & consists of sporopollenin coating which serves to protect the gametophytes as they are transported from the stamen or male cone

to the pistil or female cone in flowering and coniferous plant respectively.

- In flowering plants, microspores are formed inside the pollen sac or the microsporangium.
- Each microspore is a minute body of varying shape and structure and transported by various means (wind, water, insect) to the female structure where fertilization occurs. Microspores have one cell and 2 coats- 1. exine and 2. intine
 - Exine - tough, cutinized thick outer layer with spinous outgrowth or sometimes it can be smooth
 - Intine- inner thin layer made up of cellulose.
- Exine contains germ pore (thin) through which intine grows out to form the pollen tube. Pollen tube elongates through the gynoecium tissue, carrying two male gametes in it.
- Pollen tube grows down and enters into the micropyle of the ovule.
- The apex of the pollen tube degrades and 2 male nuclei are released in the ovule.
- Double fertilization takes place by the fusion of the one male nucleus with the egg cell nucleus, giving rise to the diploid zygote, and fusion of the other male nucleus with the diploid secondary nucleus giving rise to the triploid primary endosperm nucleus.

Spores:

Spores are unicellular or multicellular haploid reproductive units. They are important for reproduction as well as for survival in the unfavourable condition.

- In gymnosperm and angiosperms spores germinates to produce gametophytic plant body.
- Fungi produces spore to complete asexual reproduction.
- Algae and bacteria also produce spores in different stages of their life cycle according to their requirement.

- Plants may be homosporous or heterosporous. Almost all seed bearing plants are heterosporous and possess large spores i.e megaspores in megasporangium and small spores which are called microspores in microsporangium.
- Microspores and megaspores are germinate to produce male gametophytes and female gametophytes respectively.
- Unlike in primitive plants, in seed bearing plants, the gametophytes are never released from the spore. This can be considered as an evolutionary advance. Due to this nature the gametophytes are well protected from desiccation.
- But the male sperms produced from the male gametophyte needs to reach the female egg. This is done through the dispersal of spores. Spores can be dispersed by wind, water or insects .

MICROSPORES	POLLEN GRAIN
1. Any of the spores in heterosporous plants that give rise to male gametophytes, which are generally smaller than megaspores.	1. 1111A microscopic body that contains male reproductive cell of a plant, produced from a microspore mother cell.
2. Occurs in seedless vascular plants such as ferns and spike mosses.	2. Occurs in seed plants.
3. A unicellular structure, found inside the ovule.	3. A multicellular structure, found inside the pollen sac.
4. Process of formation is known as microsporogenesis.	4. Undergoes both microsporogenesis and microgametogenesis.
5. Develops into the male gametophyte later.	5. Has already developed into the male gametophyte.

6. Female spores are retained within the ovary.	6. Dispersed by various mechanisms (wind, water, insect).
7. Contains a lesser amount of nutrients.	7. Contains a larger amount of nutrients.
8. Divides meiotically	8. Divides both meiotically and mitotically.
9. Apertures occur on a proximal pole, shows proximal germination.	9. Apertures occur on distal poles, shows distal gemination.
10. Aperturate spores are monolete or trilete.	10. Aperturate pollen grains are colpate/porate etc.
11. Division of exine into sexine and nexine is indistinct.	11. Division of exine into sexine and nexine is prominent.
12. Spores can develop into gametophytes or adult organisms without finding a partner.	12. Pollen can not produce a new organism until it matches with a female egg to produce a seed.

Sporoderm Stratification:

The pollen wall, the sporoderm is generally stratified i.e. layered (Fig. 4.14).

The walls of the mature pollen, at least in angiosperms, consists of two fundamentally different layers, these are as follows:-

1. Inner intine and

2. an outer acetolysis resistant layer exine composed of sporopollenin.

Exine:

The exine covers the entire pollen surface except germinal apertures where it is absent or greatly reduced.

➤ The exine of pollen grains can be divided into

1. an outer sculptured **sexine** and

2. an inner unsculptured **nexine** (Fig. 4.14).

➤ **Sexine** again consists of two layers:

a. the outer, ectosexine and

b. inner, endosexine.

➤ The sexine is generally constituted of a set of radially-directed rods supporting a **roof-like structure (tectum or tegillum)**, which may be partially perforated or completely absent.

➤ **Rods supporting the tectum are known as columella**, and **rods not supporting** anything but standing vertically on the nexine are called **bacula**.

➤ Columella are usually simple, but may be branched. In Compositae the columellae are either distally branched (digitate) or proximally

branched (conjunctate) or sometimes the columella hangs down from the tectum, e.g., Caryophyllaceae (Fig.4.15).

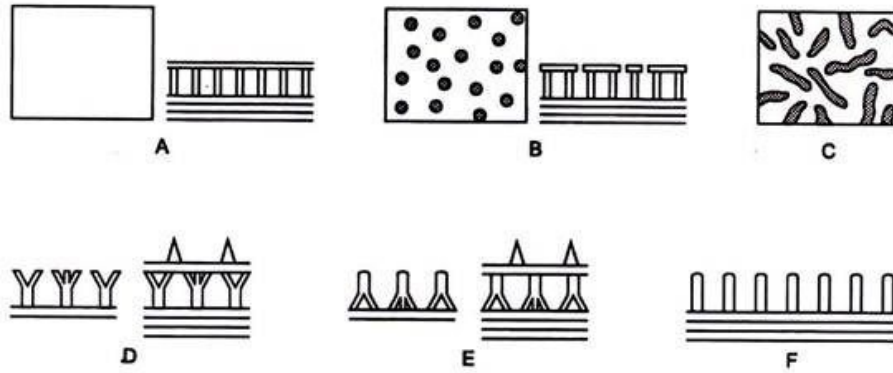


Fig. 4.15 : Nature of tectum (A=Tectum imperforatum/solidum (Tectate/eutectate), B=Tectum perforatum (Semi-tectate), C=Tectum perfossulatum, D=Digitate columella, E=Conjunctate, F=Intectate)

➤ The **nexine** has been divided into two layers namely **nexine I**, and **nexine II**.

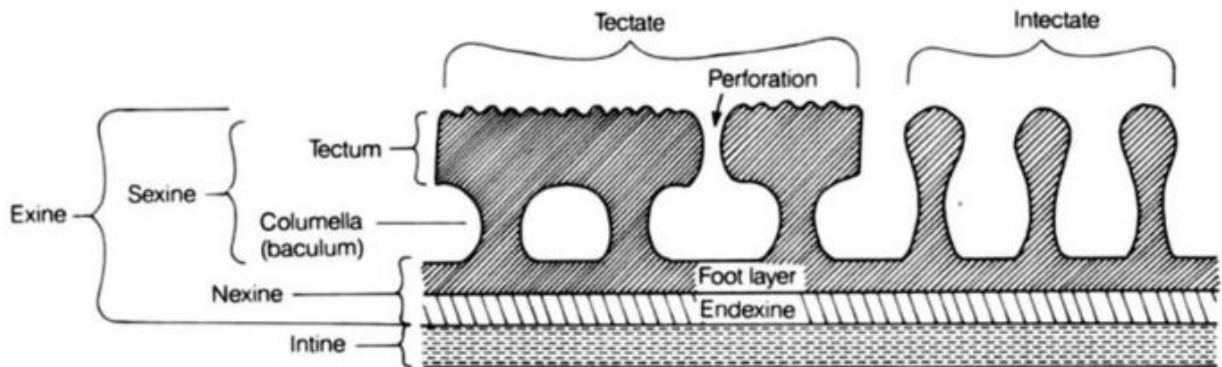
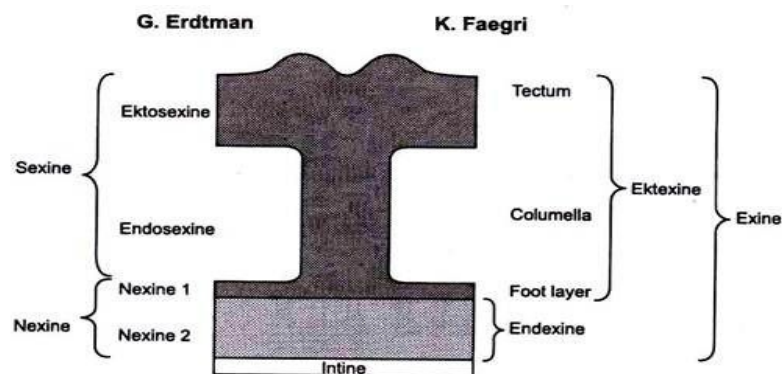


Fig: sporoderm stratification of pollen

Knut Faegri (1964) proposed an alternative terminology for exine stratification (Fig. 4.14).

He recognized two layers of exine,

- the outer **ektexine (including sexine and nexine I)** and **endexine (nexine II)**.
- He designated nexine I as **foot layer** and considered it to be the basal part of ektexine for its identical chemical composition and staining property as that of sexine.
- Faegri's **ektexine** is quite different from the endexine because the former contains more dense sporopollenin and stains more deeply. The ektexine may be regarded as a three-layered structure in which the granules form small columns, columella, thus dividing an outer tectum and an inner foot layer strata.
- The **endexine** is often well developed in dicots, but is virtually absent or has it only in the apertural region in monocots.



Structure of Pollen Wall

Fig. 4.14 : Sporoderm stratification

- In some pteridophyte spores (e.g. Polypodiaceae) and a few gymnosperms pollen (e.g., *Taxodium*) there is a hyaline loosely organized sporopolleninuous envelope called **Perine** covering the exine(Fig. 4.16). The perine may be continuous or sometimes folded in various ways. In some gymnosperms, especially among conifers, the ectexine enlarges to form bladderly wings (Saccus, Pl.Sacci) generally two (*Pinus, Cedrus, Abies, Picea* etc.) or one (*Tsuga*) in number.

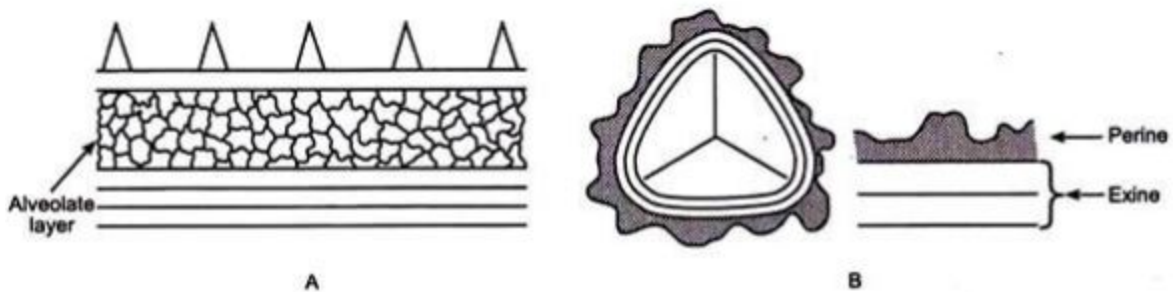


Fig. 4.16 : Gymnosperm and Pteridophyte sporoderm (A=Alveolate layer of Gymnosperm pollen, B=Perine and exine of Pteridophyte spore)