ASCOMYCOTA : TAPHRINA, PHYLLACTINIA, ERYSIPHAE, NEUROSPORA, PEZIZA

Dr. Basudha Sharma

ASCOMYCOTA/SAC FUNGI

- These fungi form a sac like structure (ascus) which contains haploid ascospores
- Ascomycetes are of great importance- in baking industry (yeast), in wine and brewing industry in food industry. They also produce secondary metabolites which make the food unfit for human consumption. Some ascomycetes also act as parasites
- Filamentous ascomycetes produce hyphae with have perforated hyphae, allowing streaming of cytoplasm.
- Asexual reproduction result in the formation of conidia while sexual reproduction results in formation of asci. Sexual reproduction starts with the development of special hyphae, "male" strain which produces an antheridium or the "female" strain which produces an ascogonium. On fertilization, the antheridium and the ascogonium combine in plasmogamy without nuclear fusion. The asci vary in shape from cylindrical to spherical. The asci fill the fruiting body called the ascocarp
- There are different types of ascocarp in the ascomycetes Cleitothecia, Perithecia, Apothecia, Pseudothecia

REPRODUCTION

Teleomorphs-Produce both sexual and asexual spores

Anamorphs- lost ability to reproduce sexually

-Belonged to Deuteromycota

-Now classified as anmorphs of other phyla

-Most are Ascomycetes

Heterokaryosis-existence of different kind of nuclei in the same individual

Sexual spores are formed in three phases of development

-Plasmogamy-Union of two protoplast bringing together different nuclei in same cell. Haploid nuclei of donor cell (+) penetrates the nuclei of recipient cell (-)

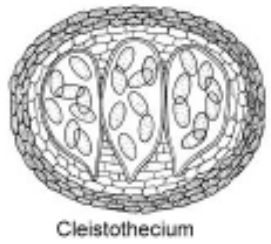
-Karyogamy- Fusion of two nuclei forming a dikaryon (binucleate cell containing nuclei from each parent. 2 nuclei fuse to form a diploid nucleus

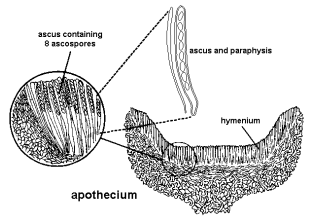
-Meoisis- Diploid nucleus give rise to haploid nuclei. Sexual spores are formed, some (+), some (-) and some recombinant

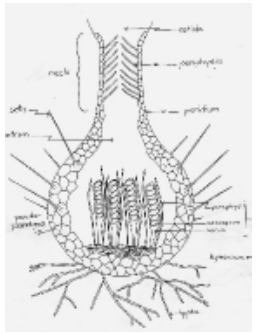
Sexual spores are used to classify fungi into different divisions

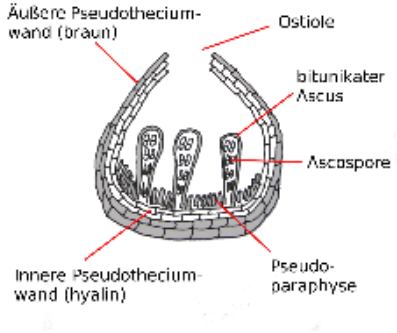
ASCOMYCE

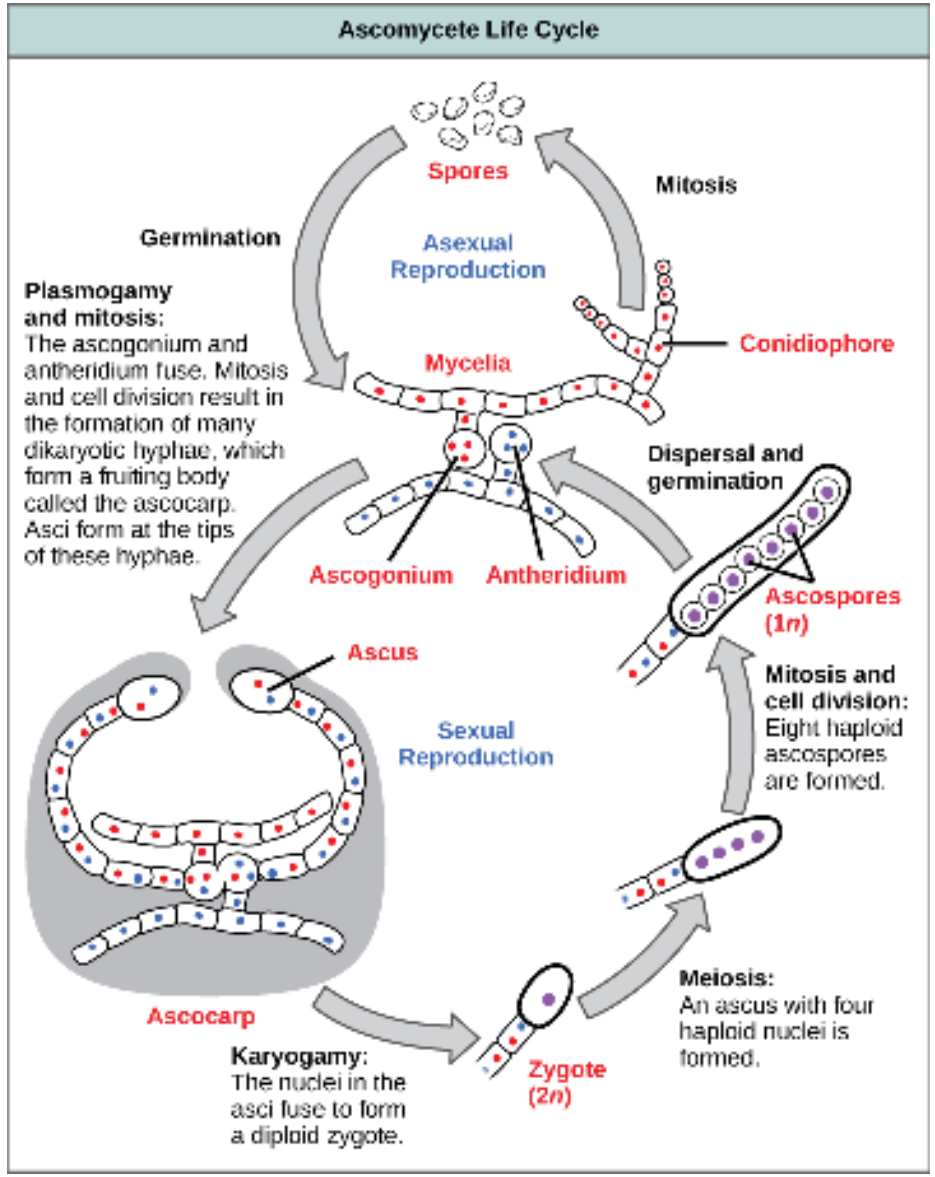
- Cleistothecium-These are globose fruitification with no specialized opening. Eg. Erysiphales
- Apothecium-Asci are born on cup shaped ascocarp, and at maturity the asci are freely exposed. E.g.. Pizizales
- Perithicium- These are the flask shaped fruiting body with an opening at the tip called, ostiole. Eg. Neurospora
- Pseudothecium-These are similar to perithicium but diifer only in the arrangement of the asci, which are bitunicate


Cleistothecium









TAPHRINA (PEACH LEAF CURL/WITHCES BROOM)

- These are members of Taphrinomycotina and include Taphrina (causing Peach leaf curl) and Protomyces (causing stem gall of coriander)
- These are yeast-like taxa(ie. Show dimorphism) Dimorphic fungi is the ability of fungi to grow in form of budding yeast or mycelia, depending on the environmental conditions
- The disease is now widely distributed in Europe and in the United States, in parts of Asia, China and Japan. The optimal temperature for the growth of the fungus is 20°C
- Symptoms: They cause malformations of buds, leaves, twigs, flowers and fruits producing diseases known as leaf curl. The symptoms are most conspicuous in leaves. In some cases woody twigs sometimes cause profuse branching called witches broom. Taphrina also produces auxins resulting in hyperplastic effect (cell proliferation)
- The infected host shows the presence of intercellular septate mycelium. The mycelium is dikaryotic and it establishes itself between the epidermis and the mesophyll. The fungus does not produce any ascocarp. . Karyogamy occurs, apparently between the paired nuclei present within each ascogenous cell, and the cell begins to elongate. The asci are formed beneath the epidermis, and ascospores are expelled through an apical slit, which may accumulate on the surface of the leaf, giving a white or greyish powdery condition. The infected host cells increases in size and changes in form and structure. The affected cells suffer almost a complete loss of chlorophyll accompanied with puckering of the midrib.

TAPHRINA- DISEASE CYCLE

- Ascospores produce small, round or ovoid spores by budding. This process may begin before the ascospores are released from the asci and continue after the spores have been released to the substrate. These spores, like the ascospores, are uninucleate and haploid. On the surface of the host, the spores continue to bud, then at some point they initiate the mycelial stage, by fusing in pairs after which they form the infective mycelium.
- Disease control
- Bordeaux mixture-just before the buds begin to expand
- cutting out infected shoots and removing and burning of all infected leaves adequately control the disease incidence.

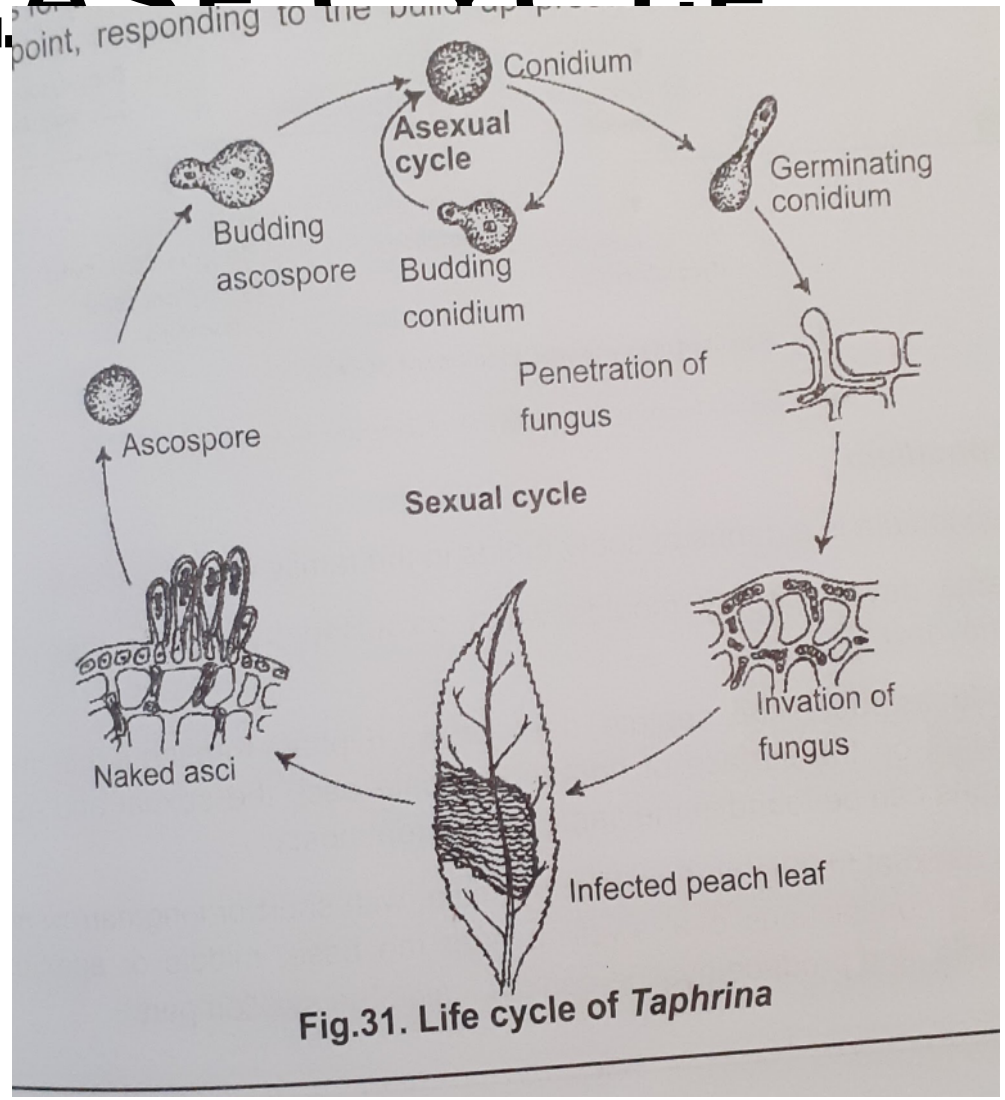
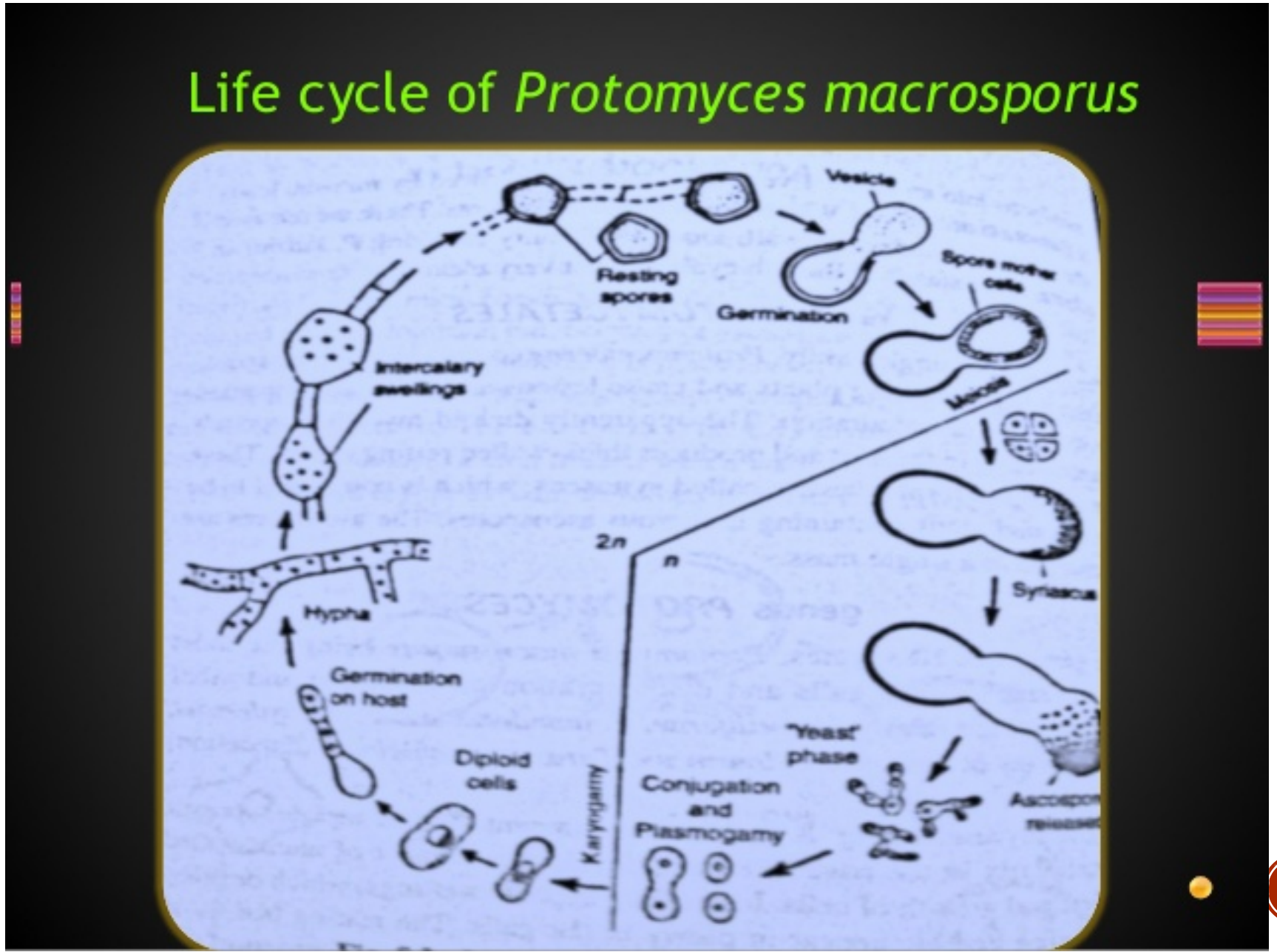


Fig.31. Life cycle of *Taphrina*

PROTOMYCES (STEM GALL OF CORIANDER)

- *Protomyces* species are plant parasitic and cause galls on stems, leaves and fruits of Apiaceae, Compositiae and Umbelliferae The species has been recorded in Scotland, Ireland, Norway, Denmark, Sweden, Nepal, Germany,North America, North Africa and South Asia
- It causes tumor like swelling on all the aerial parts of the plant. The galls are soft and fleshy when young and become hard and woody on maturity
- The peduncle becomes abnormal with hypertrophied fruits and flowers
- The mycelium is endophytic, intercellular, septate (diploid) and remains confined inside the gall region. On maturity, some of the hyphal cells swell, become globose, and thick walled, these are called the chlamydospores. The chlamydospores germinate by rupturing their outer wall and producing a cylindrical sac, which is generally called vesicle /spore sac. The multinucleate protoplast of the chlamydospore migrates into the vesicle. A large vacuole develops in the centre of the vesicle displacing protoplasm to the peripheral region where it undergoes cleavage resulting in its many pieces. These naked cells undergo reduction division that finally results in the formation of four spores inside each naked cell, these are also equated as asci. A large number of such asci present in the vesicle makes the latter to be called as compound ascus or synascus.
- On maturity, these ascospores collect in the centre of the vesicle which, bursts and releases them. Upon liberation, the ascospores may reproduce by budding in yeast-like manner or they may conjugate in pairs with one member of each pair continuing to bud

- Pathogen perennates as resting spores or chlamydospores
- Resting spores give rise to ascospores, which give rise to the mycelium.
- Disease Control
- Field sanitation practices, crop rotation, use of clean healthy seeds help reduce the source of inoculum.
- Seed and soil treatment with thiram



PHYLLACTINIA

- *Physlactinia sp.* is a member of Erysiphaceae. It is an obligate parasite distributed in the temperate regions and causes **powdery mildew** on leaves and stems.
- The mycelium grows on the surface of leaves forming a whitish mat on the surface. The hyphae send their branches through stomata of host in the epidermal cells. These hypha may give rise to haustoria which are saccate.
- Under favorable conditions, the fungus starts reproducing asexually. The asexual reproduction takes place by the formation of conidia produced exogenously in chains at the tip of conidial apparatus. The conidia are formed singly but in large numbers forming a white powdery mass on the leaf surface.
- Under unfavourable conditions, sexual reproduction occurs. The fungus is heterothallic and the gametangia are formed on two closely lying hyphae. The male gametangium is antheridium and the female gametangium is ascogonium. On maturity, plasmogamy occurs, forming dikaryotic cells which later fuse inside the fruiting body known as cleistothecium. The cleistothecium is usually black or brown in colour, several layered thick and with two types of appendages as agroup of radiating appendages with bulbous swollen bases or as a crown of repeatedly branched mucilage secreting appendages which help in adhesion of cleistothecium to the substratum.

PHYLLACTINIA

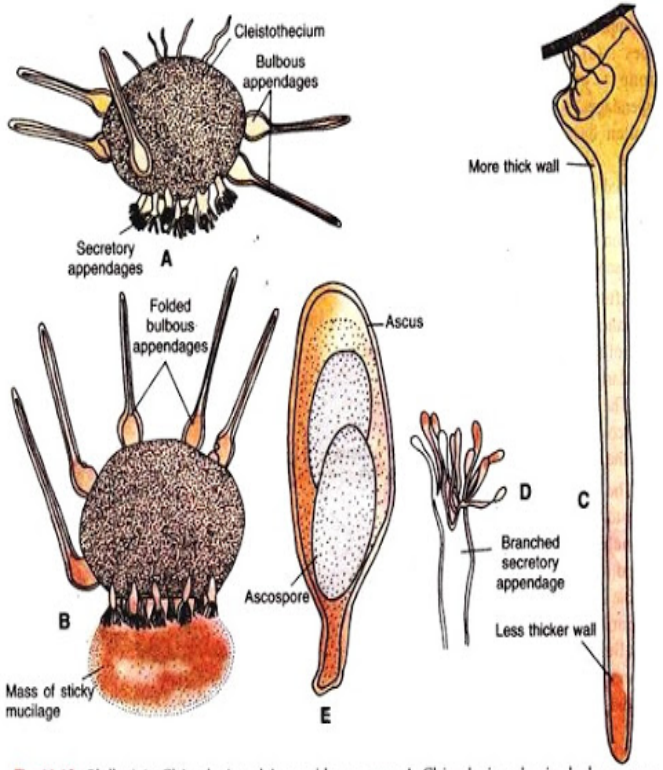


Fig. 11.12. *Phyllactinia*. Cleistothecia and Ascus with ascospores; A, Cleistothecium showing both secretory and bulbous appendages; B, Cleistothecium with appendages showing mucilage; C, A bulbous—appendage; D, Branched secretory appendage; E, An ascus with two ascospores.

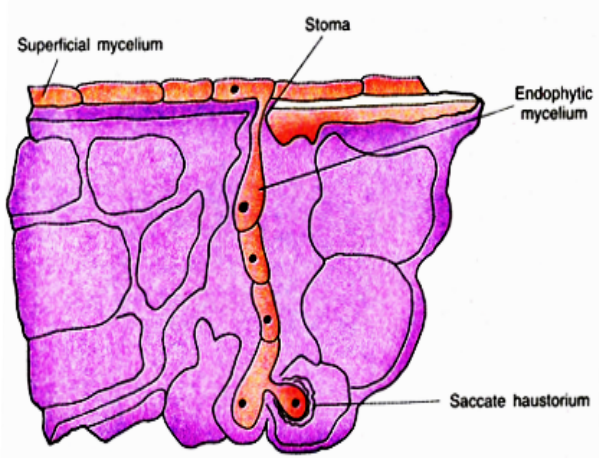


Fig. 11.9. *Phyllactinia*. Hemiendophytic mycelium showing haustorium.

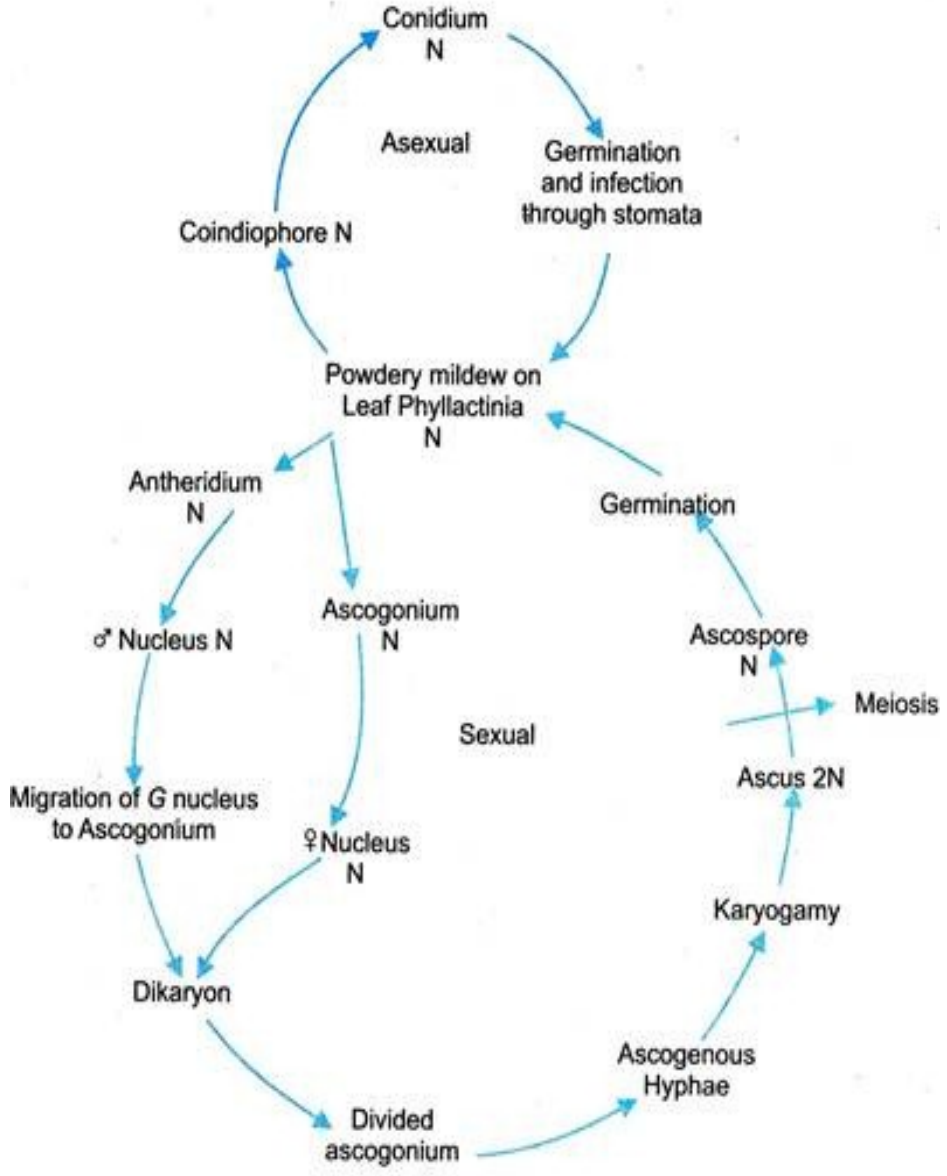


Fig. 11.13. Diagrammatic Life Cycle of *Phyllactinia*.

ERYSIPHAE

- These are also know as powdery mildews because the conidia produced in abundance on the shoots of infected host plants give them a whitish powdery appearance. All of them are obligate ectophytic parasites which infect a large number of species of angiosperms and some grains.
- They perpetuate themselves by means of conidia. The conidia falls on the leaf and germinates to form infection peg. The mycelium is formed which give rise to haustoria. The haustorium is the only structure which enters the cell. The haustoria may be simple or complex in structure.
- After the establishment of ectomycelium the fungi reproduces asexually by conidia. The conidia are formed exogenously in chains at the tip of the conidial apparatus.
- Sexual Reproduction: the hyphae produces sexual branches, which lie closely parallel to and more or less twisted about each other. The antheridium makes contact with the ascogonium at its apex and closely presses against it.The male nucleus passes into the ascogonium through the pore. A dikaryon is thus established in the ascogonium. It then undergoes meiosis followed by mitosis, forming eight haploid nuclei. They are present inside the fruiting body known as cleistothecia. The cleistothecia are globose and black structures without an opening.
- The mature cleistothecia remain dormant during winter. The thick peridium remains intact and enables them to resist adverse (winter) conditions

LIFE CYCLE OF ERYSIPHAE

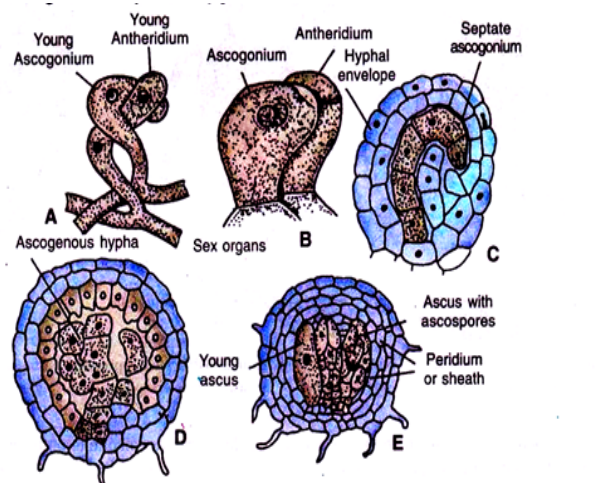


Fig. 11.6 (A-E). *Erysiphe*. A, young sexual branches interwined; B, Ascogonium with male and female nuclei forming a dikaryon; C, dikaryotised ascogonium becoming septate; D, Young, cleistothecium with the ascogenous hyphae arising from the binucleate penultimate cell; E, Section of mature cleistothecium.

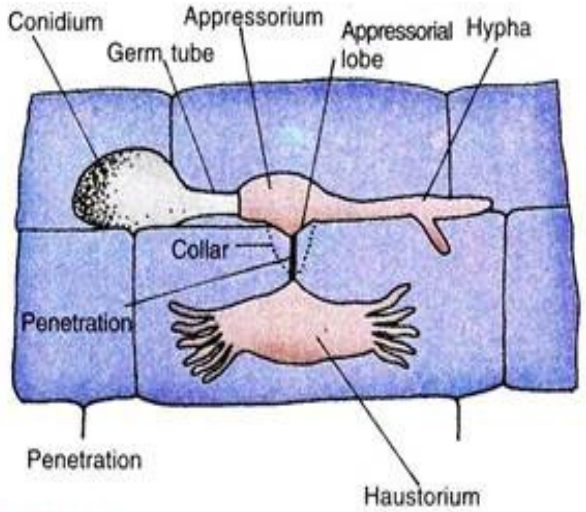


Fig. 11.2. *Powdery mildew*. Germination of conidium and infection of the host (After Johnson, Bashnell and Zeyen).

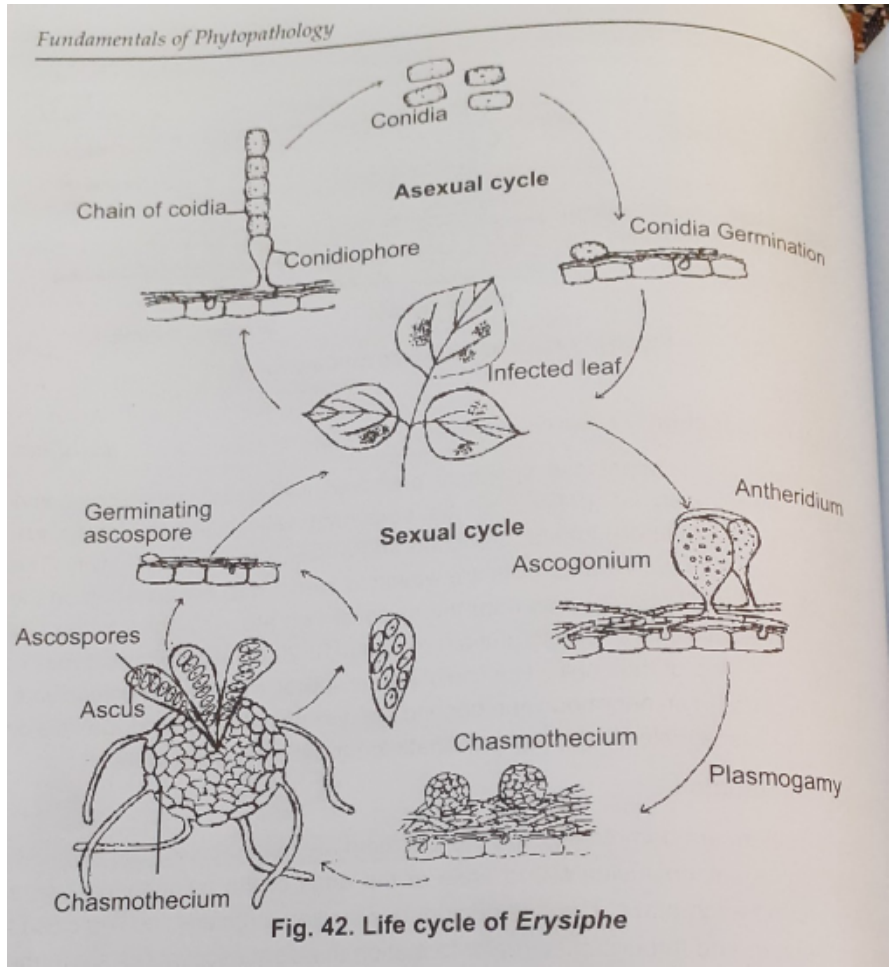


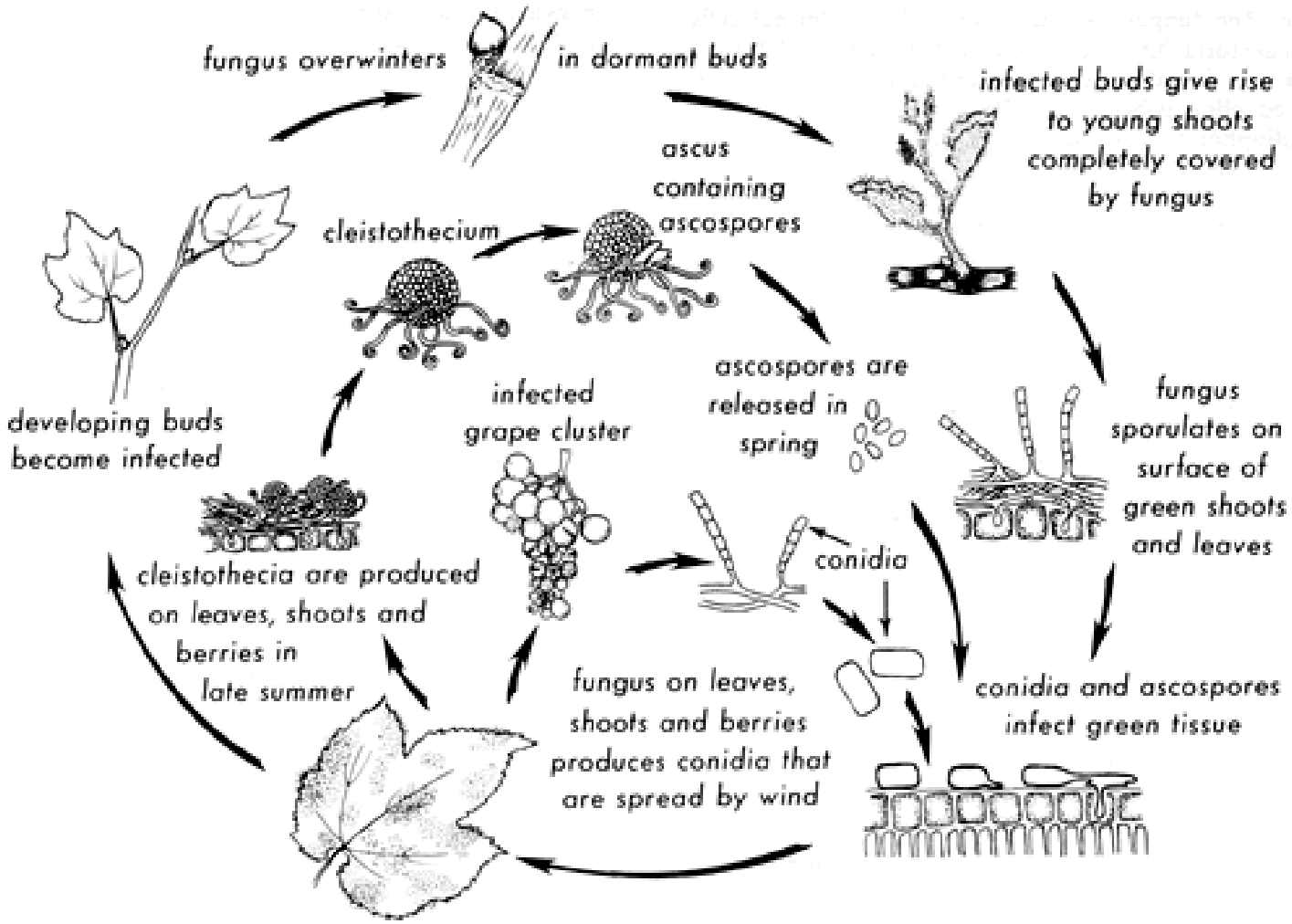
Fig. 42. Life cycle of *Erysiphe*

POWDERY MILDEW OF GRAPES (*UNCINULA NECATOR/ERYSIPHAE NECATOR*)

- Powdery mildew is an important disease of grapes worldwide. Unlike downy mildew, the powdery mildew fungus does not require free water on the plant tissue surface to infect. Powdery mildew can result in reduced vine growth, yield and fruit quality.. The disease does not kill the host plant but it is reduced in vigour owing to constant loss of food.
- The disease is favored by high humidity, cloudy weathers and warm temperature
- Symptoms: Small, white or grayish-white patches of fungal growth appear on the upper or lower leaf surface. These patches usually enlarge until the entire upper leaf surface has a powdery, white to gray coating. Leaves may curl upward during hot and dry weather. Flowers may wither and drop without setting fruit. Black specks may develop on the surface of infected areas. These are the sexual fruiting bodies (cleistothecia) of the fungus.
- Causal Organism The fungus overwinters as tiny black fruiting bodies (cleistothecia) in bark crevices or debris on the grapevine. The ascospores are released which cause the primary infection. The germinate to form myceclia. Later they form conida.
- Sexual reproduction result in the formation of cleistothecia which overwinters

LIFE CYCLE

- Disease Control
- Adoption of cultural practice that reduces humidity, enables good air circulation, and provide good light exposure
- Sanitation of the field
- Fungicides-determine the proper timing of fungicide application



BLAST OF PADDY (MAGNAPORTHE GRISEA(SEXUAL STAGE) PYRICULARIA ORYZAE)

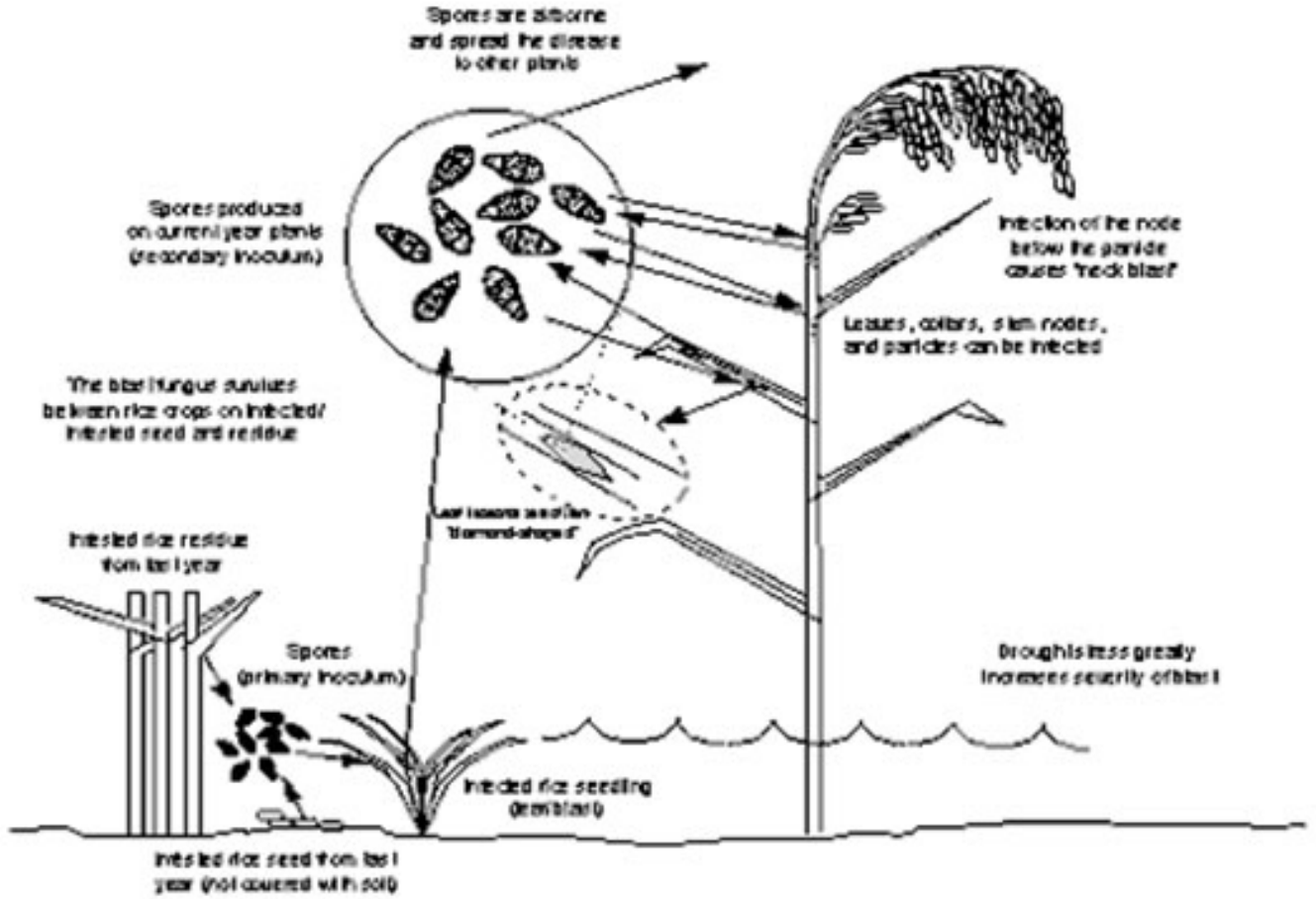
- It is a fungal disease present all over the world especially in Japan, Taiwan, India and USA. It is mainly prevalent in areas with high humidity and rainfall
- Symptoms: The symptoms are seen mainly in the leaves. In rice seedlings, small necrotic regions appear initially, which become larger and coalesce, and have chlorotic margins. In older rice plants, disease symptoms can occur in leaves, collar – junction of the leaf blade and leaf sheath, nodes, neck, and panicle
- Causal Orgainsm: The disease cycle begins when a conidium lands on a rice plant and becomes attached to the host surface.
- It starts the production of mycelium and undergoes conidation

DISEASE CYCLE

- The conidia are pear shaped with 2 septa.
- The fungi produces toxins pyricularin and α Pinolinic acid and pectinolytic enzymes

Disease control

- Use of healthy seeds
- Field sanitation
- Use of fungicides- Use of thiram seed treatment fungiscide

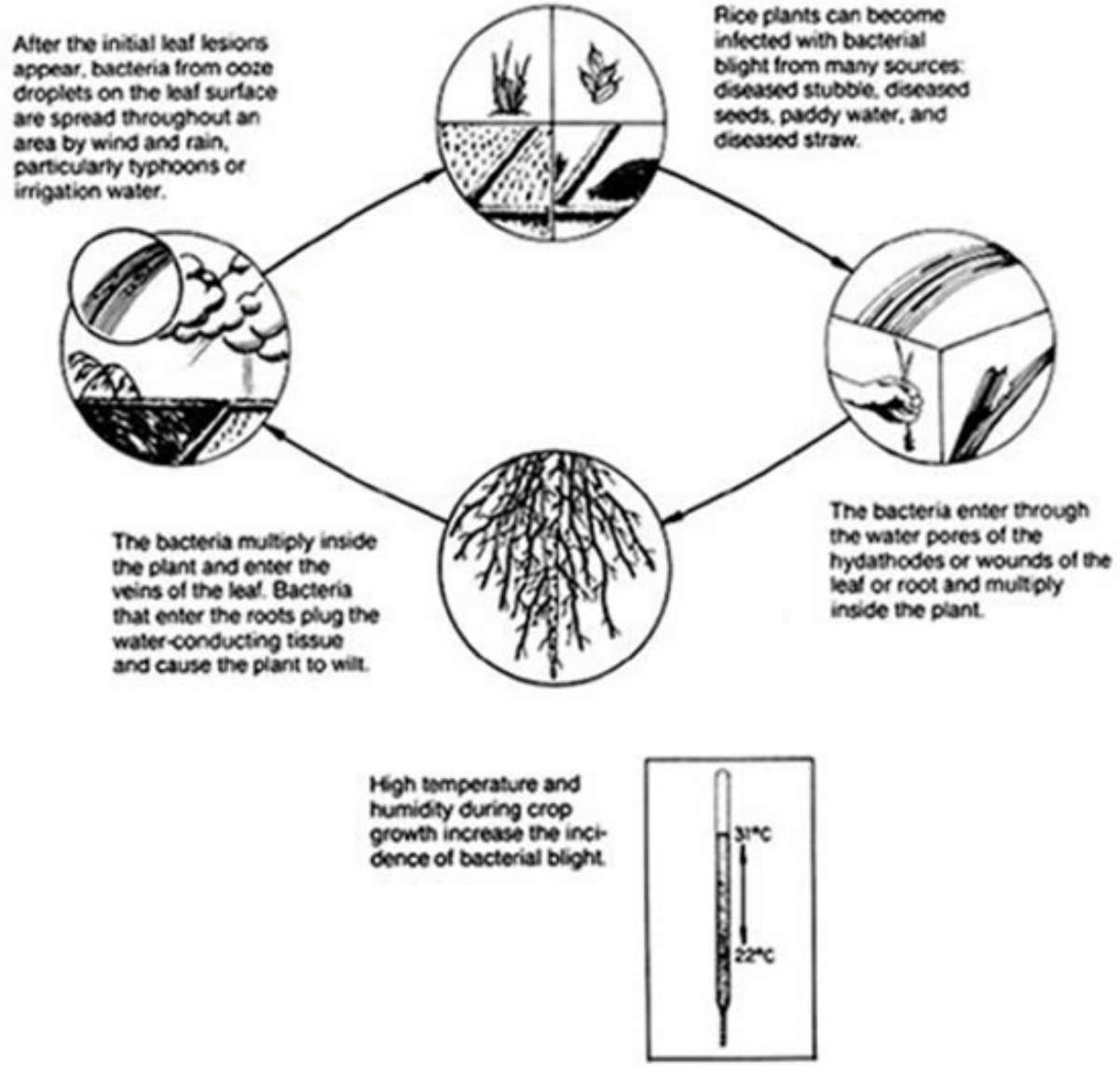


BACTERIAL LEAF BLAST (*XANTHOMONAS ORYZAE*)

- Seedling wilt
- Water-soaked to yellowish stripes on leaf blades or starting at leaf tips then later increase in length and width with a wavy margin
- **Leaves** with undulated yellowish white or golden yellow marginal necrosis, drying of **leaves** back from tip and curling, leaving mid rib intact Appearance of bacterial ooze that looks like a milky or opaque dewdrop on young lesions early in the morning
- Lesions turn yellow to white as the disease advances
- If the cuts end of leaf is kept in water it becomes turbid because of bacterial ooze

DISEASE CYCLE

- Spray fresh cowdung extract
- Neem oil



APPLE SCAB (*VENTURIA INAEQUALIS*)

- The disease apple scab is caused by *Venturia inaequalis.* This is a common disease in the region of world where apple is cultivated. Normally common areas having moist and humid atmospheres
- Symptoms: The first infections often occur on the leaves surrounding flower buds. As the lesions (infected areas) become older, they assume a definite outline as olive-green or brown circular spots.
- Fruit may become infected at any time in its development. Typical fruit lesions are distinct, almost circular, rough-surfaced, olive-green spots up to ¾ inch in diameter.
- The spots do not show at harvest time but develop slowly, .in storage. This phase of apple scab disease is termed storage scab.
- Disease cycle: Spores land on wet apple buds, leaves, germinate and penetrates, to grow and enlarge beneath the cuticle, producing conidia and visible scab lesion. When the lesions are wet, the spores are dislodged which cause secondary infection. Fruit symptoms are similar to those found on leaves. However, the margins of the spots are often more distinct on the fruit
- The spores/conidia are unequal, footprint shaped 2-celled spores
- During winter the fungi undergoes sexual reproduction and starts the production of antheridia and ascogonium. The ascospores mature in perithicia in spring and cause fresh infection

DISEASE CONTROL

Use of resistant varieties This reduces or eliminate the need for fungicide applications.

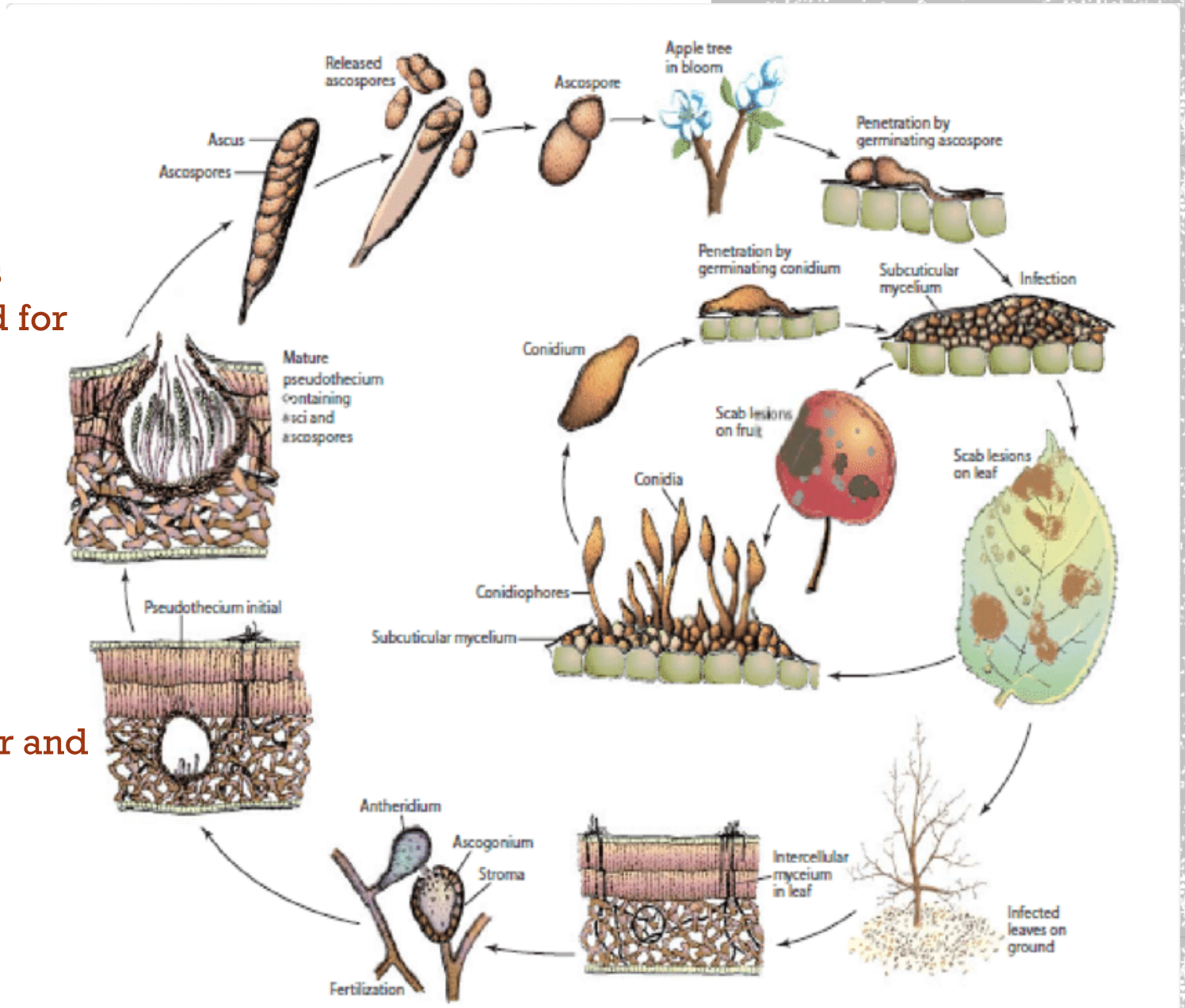
Cultural Practices

-Field Sanitation

-Proper distance between the plants

-Use of chemical control

-use of fungicides with copper and sulphur base

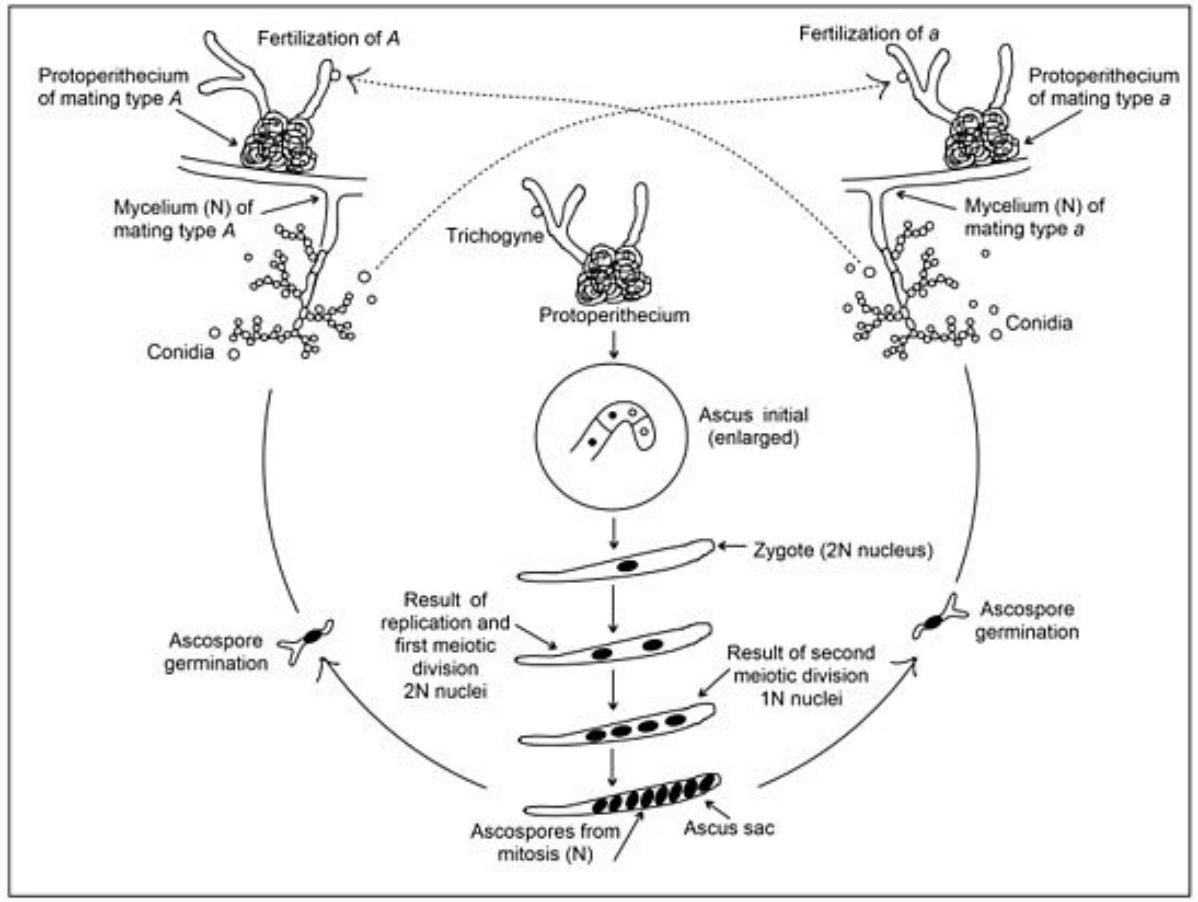


NEUROSPORA

- *Neurospora* crassa is an ascomycete fungus that has been used extensively in genetic research. Cultures of *Neurospora* are recognized by the orange color of the vegetative spores. The first genetic studies of *Neurospora* were carried out by Carl Lindegren in the 1930s
- Lindegren isolated several morphological mutant strains and constructed the first linkage maps. Beadle and Tatum exposed *N. crassa* to x-rays, causing mutations They then observed failures in metabolic pathways caused by errors in specific enzymes. This led them to propose the "one gene, one enzyme hypothesis. It has been involved in circadian rhythms, epigenetics and gene silencing, cell polarity, cell fusion, development, as well as many aspects of cell biology and biochemistry.
- Neurospora has haploid life cycle, with only a short diploid stage prior to meiosis. Reproduction of this organism occurs through spore formation resulting in the production of two kinds of spores:Conidia [asexual reproduction]Ascospores [sexual reproduction] confined to a narrow tube called the ascus

NEUROSPORA LIFE CYCLE

- Neurospora crassa life cycle. The haploid mycelium reproduces asexually by two processes: (1) simple proliferation of existing mycelium, and (2) formation of conidia (macro- and micro-) which can be dispersed and then germinate to produce new mycelium. In the sexual cycle, mating can only occur between individual strains of different mating type, A and a. Fertilization occurs by the passage of nuclei of conidia or mycelium of one mating type into the protoperithecia (female reproductive structure) of the opposite mating type through the trichogyne. Fusion of the nuclei of opposite mating types occurs within the protoperithecium to form a zygote (2N) nucleus.



PEZIZA

- **Peziza** is a large genus of saprophytic/coprophilous cup fungi that grow on the ground, rotting wood, or dung.
- Peziza produces above- ground heterokarkyotic reproductive structures that comes from an underground myceliumIt is characterized by having fleshy or brittle, sessile or feebly stalked cup or disc-shaped colored apothecia.
- The mycelium is frequently perennial and consists of a dense network of branched, septate hyphae. The apothecia (sporocarps) are aerial extensions of the subterranean mycelial network. Both the asci and paraphyses are phototropic. Asexual reproduction is rare and occurs by production of conidia/chlamydospores. Sexual reproduction occurs by somatogamous coplulation (antheridia and ascogonium are absent, and there is fusion of two vegetative cells).
- The adult mycelium consists of a tangled mass of hyphae. Somatogamy results in the formation of a dikaryon/dikaryotic cell. The dikaryotic cell produces ascogenous hypahe. The pair of nuclei migarate into the ascognenous hypae with becomes multinuclear due to the formation of septa. The terminal cell of the ascogenous hypahe forms the hook or crozier. The croxier forms 3 celled structure in which the penultimate cell is dikaryotic. This cells functions as ascus mother cell and lit elongates to form a cylindrical or club-shaped ascus. It then undergoes meiosis and then mitosis. Numerous small sterile braches called paraphysis develop between the asci. During the development of an ascus, the surrounding mono- karyotic hyphae organize a thick protective coat around the developing ascus, collectively called ascocarp.
- The asci are arranged in parallel rows differentiating into a cup shaped ascocarp known as the apothecium.

LIFE CYCLE P

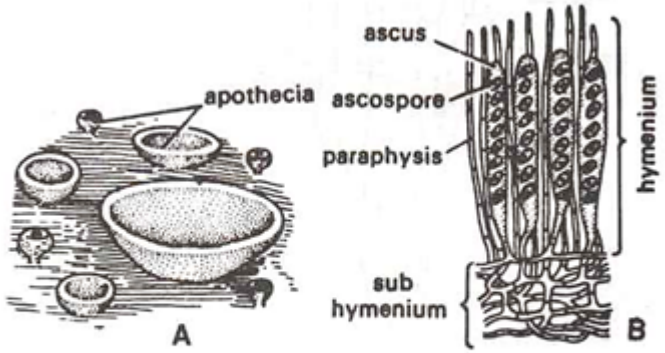


Fig. 89. Peziza. A, Some fruiting bodies; B, A few asci, ascospores and paraphyses.

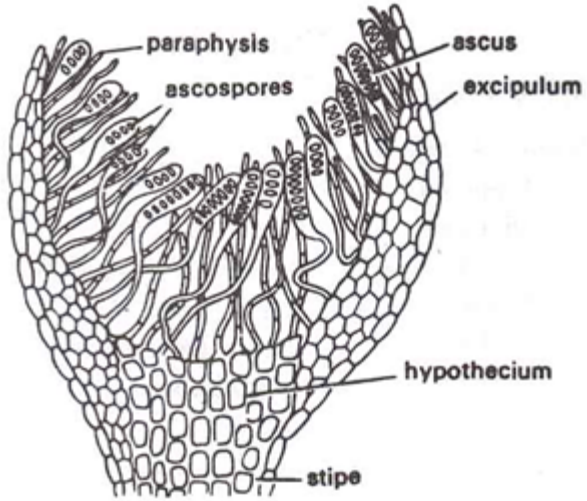
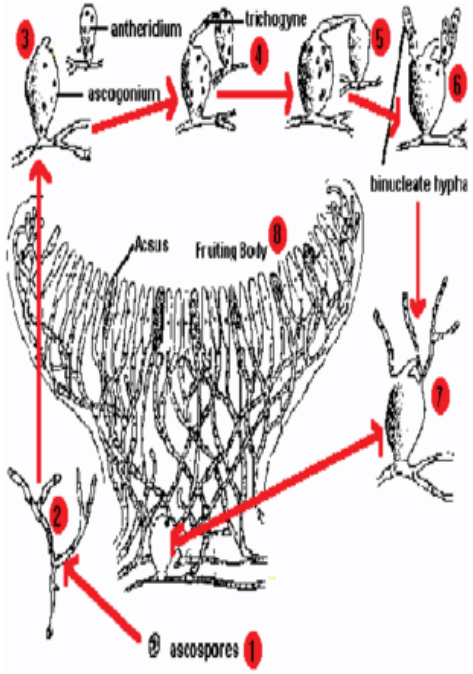
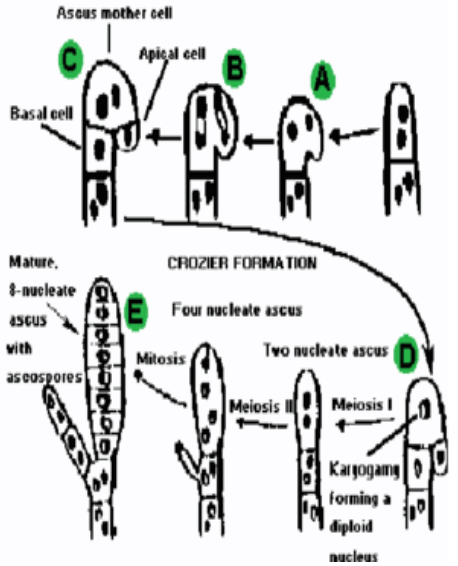


Fig. 90. Peziza. V.S. of an apothecium.





CROZIER

- A **crozier** is an anatomical feature of many fungi in the phylum Ascomycota that form at the base of asci and look like hook type of structure.
- The crozier helps to maintain a dikaryotic state in the ascus initial. The tips of developing asci on these ascogenous hyphae curl over. One haploid nucleus migrates into the curved tip while the other compatible haploid nucleus remains in the penultimate space below the hook.
- A minority of Ascomycota lack crosiers, hence the presence or absence of croziers is an important taxonomic character. Croziers resemble and function similarly to clamp connections on the dikaryotic hyphae of Basidiomycota.

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Thank You