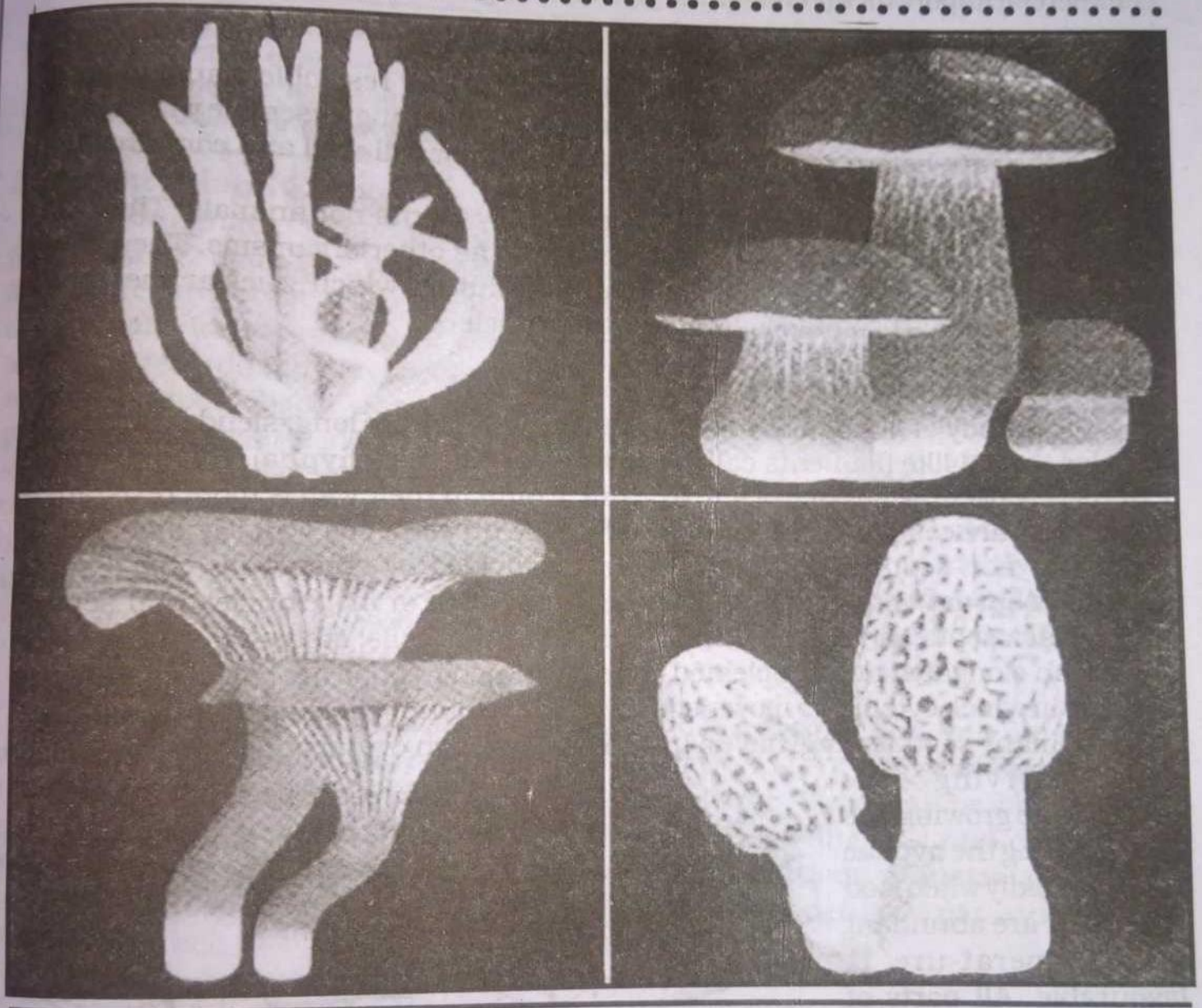
CHAPTER 8

THE KINGDOM FUNGI



The words fungus and mold may evoke some unpleasant images. Fungi rot timbers, attack plants, spoil food and afflict humans with athlete's foot and worse maladies. However, ecosystem would collapse without fungi to decompose dead organisms, fallen leaves, feces and other organic materials, thus recycling vital chemical elements back to the environment in forms other organisms can assimilate.

It includes non-chlorophyllus, multicellular (except yeast) organisms having chitinous cell wall and coenocytic body called mycelium. e.g. Agaricus (mushroom) yeast, etc. They are absorptive hetrotrophs.

More than hundred thousands species are found. This group includes pathogens such as harmful rusts, smuts (on wheat and corn), molds growing on food-stuff and crops; edible as well as poisonous mushrooms and fungi of commercial importance (Penicillium, yeasts). Fungi are best decomposers alongwith bacteria.

Previously fungi were regarded as plants as they resemble plants in having cell-wall, lacking centrioles and being non-motile. But fungi resemble with animals also as they are heterotrophic, lack cellulose in their cell-wall and contain chitin.

It means that fungi are neither completely plants nor animals. Their DNA studies also confirm that they are different from all other organisms. They have a characteristic mitosis called **nuclear-mitosis** during which nuclear membrane does not break and spindle is formed within nucleus.

8.1 THE BODY OF FUNGUS

The body of a fungus, called **mycelium**, consists of long, slender, branched tubular thread like filaments called the **hyphae** (singular **hypha**). Hyphae spread extensively over the surface of substratum. Chitin in their wall is more resistant to decay than are cellulose and lignin which make up plant cell wall. Hyphae may be septate or non-septate. **Septate** hyphae are divided by cross-walls called **septa** (singular **septum**) into individual cells containing one or more nuclei. Non-septate hyphae lack septa and are not divided into individual cells; instead these are in the form of an elongated multinucleated large cell. Such hyphae are called **coenocytic** hyphae, in which cytoplasm moves effectively, distributing the materials throughout. Septa of many septate fungi have a pore through which cytoplasm flows from cell to cell, carrying the materials to growing tips and enabling the hyphae to grow rapidly when food and water are abundant and temperat-ure is favourable. All parts of fungus growing through the substrate are metabolically active. Extensive spreading system of hyphae provides enormous surface area for absorption.

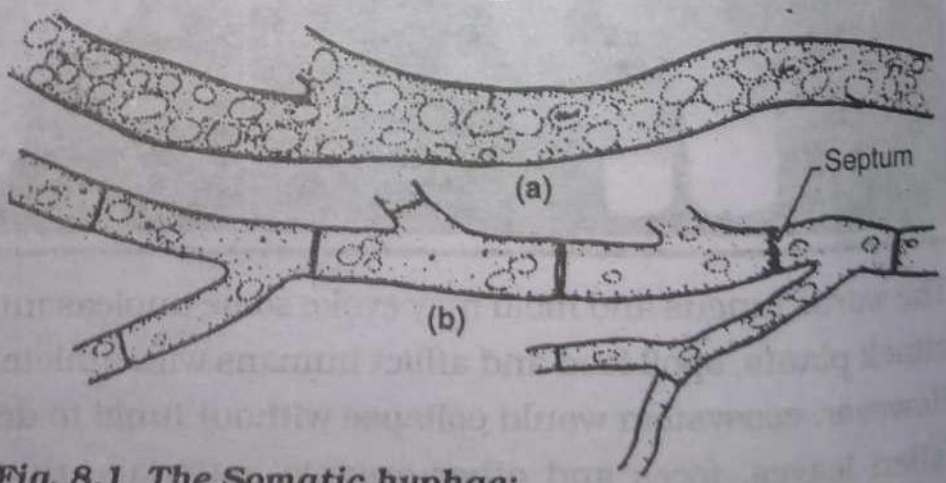


Fig. 8.1 The Somatic hyphae:
(a) Portion of a coenocytic (nonseptate) hyphae
(b) Portion of a septate hypha

Hyphae may be packed together and organized to form complex reproductive structures such as mushrooms, puff balls, morels etc. which can expand rapidly. Yeast are non-hyphal unicellular fungi.

All fungal nuclei are **haploid** except for transient **diploid zygote** that forms during sexual reproduction.

> A single mycelium may produce upto a kilometre of new hyphae in only one day. A circular clone of *Armillaria*, a pathogenic fungus afflicting conifers, growing out from a central focus, has been measured upto 15 hectares (1 hectare = 10000 m^2). Could it be the world's largest organism?

8.1.1 Nutrition in Fungi:

All fungi lack chlorophyll and are heterotrophs (obtaining carbon and energy from organic matter). They obtain their food by direct absorption from the immediate environment and are thus **absorptive heterotrophs**. Most fungi are **saprotrophs** (or **saprobes**), **decomposers** that obtain their food (energy, carbon and nitrogen) directly from dead organic matter. They secrete out digestive **enzymes** which digest dead organic matter, and the organic molecules thus produced are absorbed back into the fungus. Saprobic fungi anchor to the substrate by modified hyphae, the **rhizoid**. Fungi are the principal decomposers of cellulose and lignin, the main components of plant cell walls (most bacteria cannot break them). Extensive system of fast growing hyphae provides enormous surface for absorptive mode of nutrition. Saprobic fungi, alongwith bacteria, are the major decomposers of the biosphere, contributing to the recycling of the elements (C, N, P, O, H etc.) used by living things.

Some fungi are **parasites**, some are even **predators**, and still others are **mutualists**. **Parasitic** fungi absorb nutrients directly from the living host cytoplasm with the help of special hyphal tips called **haustoria**. They may be obligate or facultative. **Obligate** parasites can grow only on their living host and cannot be grown on available defined growth culture medium. Various **mildews** and most rust species are obligate parasites. **Facultative parasites** can grow parasitically on their host as well as by themselves on artificial growth media.

Some fungi are active **predators**. The oyster mushroom (*Pleurotus ostreatus*) is a carnivorous (predatory) fungus. It paralyses the nematodes (that feed on this fungus), penetrate them, and absorb their nutritional contents, primarily to fulfil its nitrogen requirements. It fulfils its glucose requirements by breaking the wood. Some species of *Arthrobotrys* trap soil nematodes by forming **constricting ring**, their hyphae invading and digesting the unlucky victim. Other predators have other adaptations, such as secretion of sticky substances.

Fungi form two key mutualistic symbiotic associations (associations of benefit to both partners). These are **lichens** and **mycorrhizae**.

Fig. 8.2 (a) Pleurotus sapidus

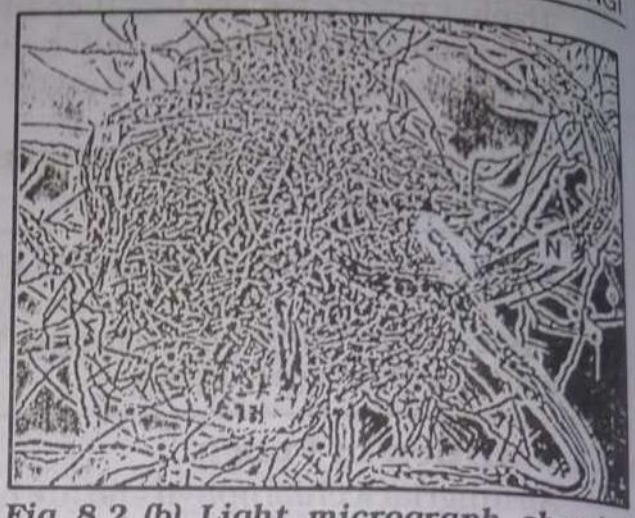


Fig. 8.2 (b) Light micrograph showing several nematodes (N) enmeshed by the mycelium of Dactylaria candida.

Lichens are mutualistic and have symbiotic associations between certain fungi (mostly Ascomycetes and imperfect fungi, and few Basidiomycetes (about 20 out of 15000 species of lichens) and certain photo autotroph either green algae or a cyanobacterium, or some times both. Most of the visible part of lichen consists of fungus, and algal components are present within the hyphae (Fig. 8.3). Fungus protects the algal partner from strong light and desiccation and itself gets food through the courtesy of alga. Lichens can grow at such places where neither of the components alone can, even at harsh places such as bare rocks etc. Lichens vary in

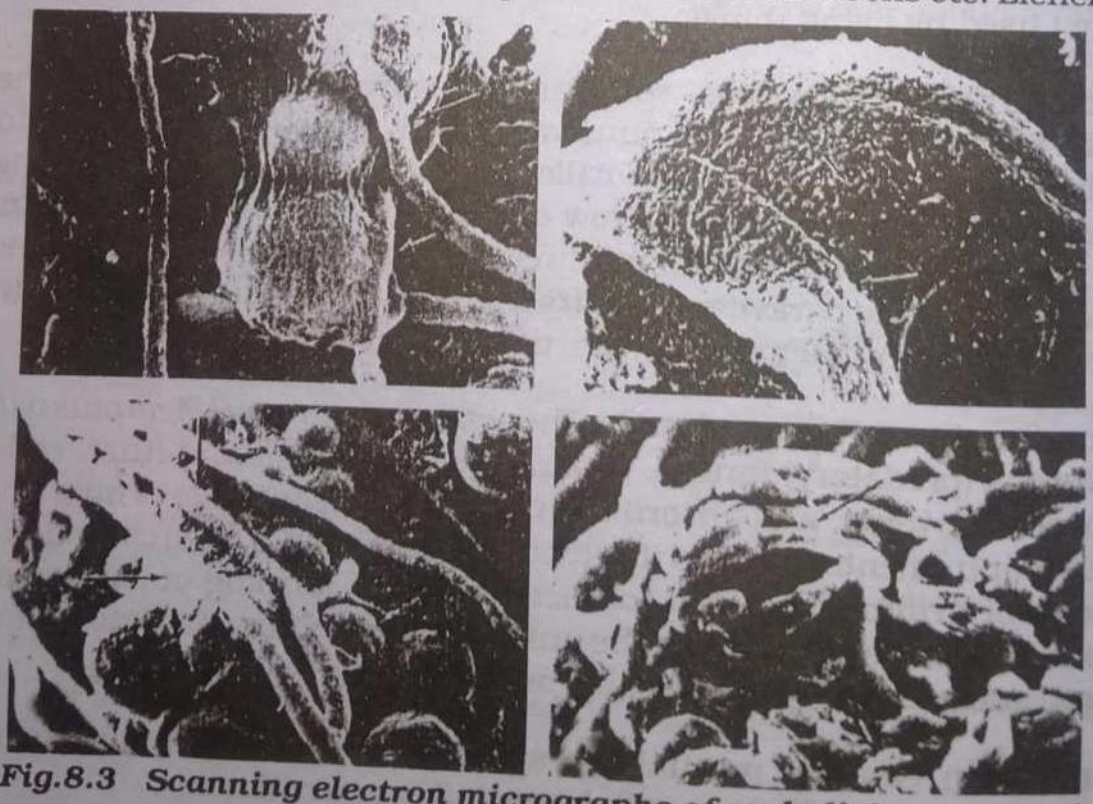
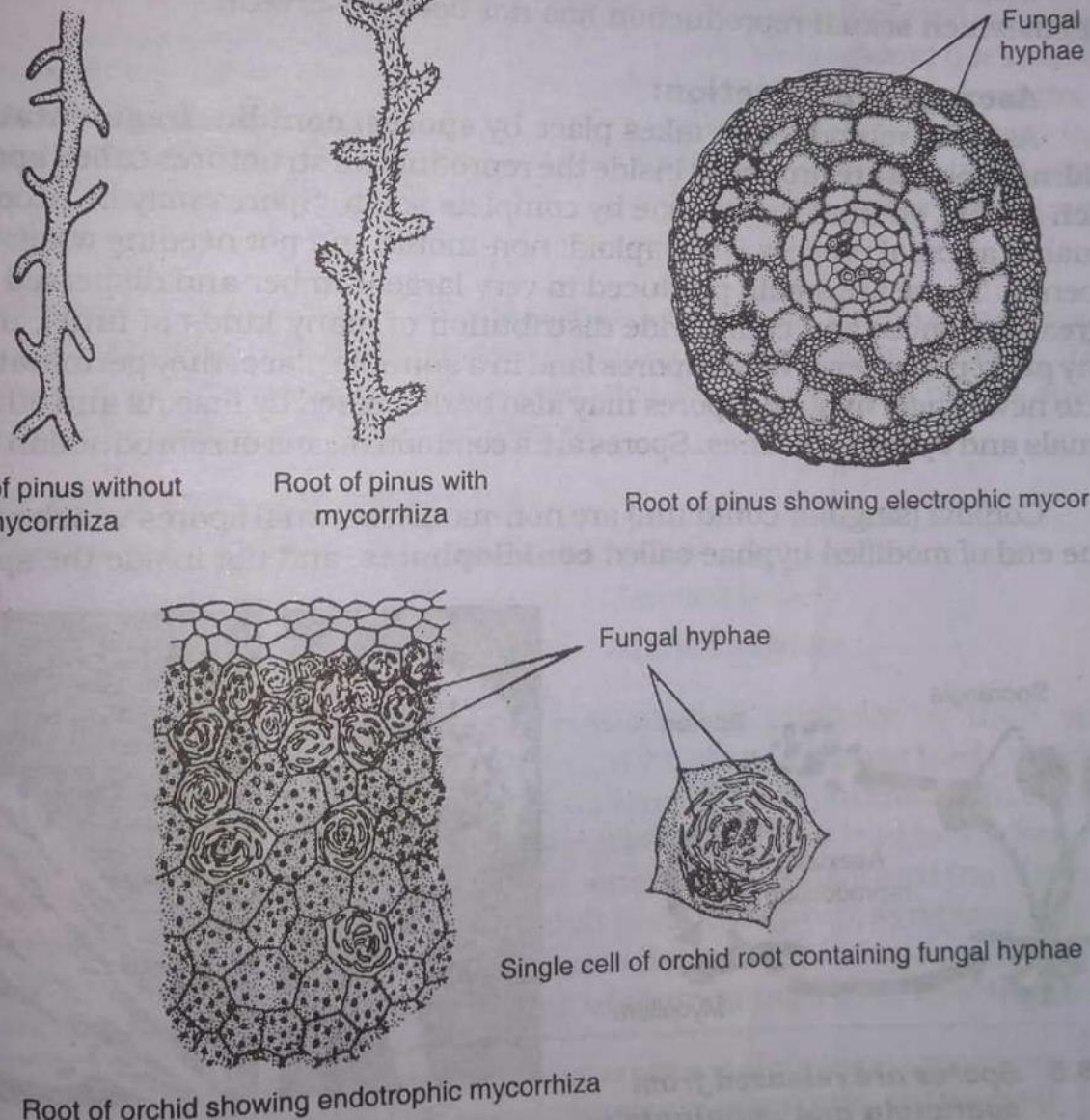


Fig.8.3 Scanning electron micrographs of early lichen synthesis.

colour, shape, overall appearance, growth form (Fig.8.3). They are ecologically very important as **bioindicators** of air pollution.

Mycorrhizae are mutualistic association between certain fungi and roots of vascular plants (about 95% of all kinds of vascular plants). The fungal hyphae dramatically increase the soil contact, total surface area for absorption, help in the direct absorption of phosphorus, zinc, copper and other nutrients from the soil into the roots. Such plants show better growth than those without this association. The plant on the other hand, supplies organic carbon to fungal hyphae.

There are two main types of mycorrhizae (Fig.8.4). **Endomycorrhizae**, in which the fungal hyphae penetrate the outer cells of the plant root, forming coils, swellings and minute branches, and also extend out into surrounding soil; and



Root of pinus without mycorrhiza

Root of pinus with mycorrhiza

Root of pinus showing electrophic mycorrhiza

Single cell of orchid root containing fungal hyphae

Root of orchid showing endotrophic mycorrhiza

Fig. 8.4 Types of mycorrhiza

ectomycorrhizae, in which the hyphae surround and extend between the cells but do not penetrate the cell walls of the roots. These are mostly formed with pines, firs etc. However, the mycelium extends far out into the soil in both kinds of mycorrhizae.

Fungi grow best in moist habitats, but are found wherever organic matter is present. They survive dry conditions in some resting stage or by producing resistant spores. They can also tolerate a wide range of pH from 2 – 9, a wide temperature range, and high osmotic pressure such as in concentrated salt/sugar solutions as in jelly, jam etc. These features also help them in their survival on land. Fungi store surplus food usually as lipid droplets or glycogen in the mycelium.

8.1.2 Reproduction:

Most fungi can reproduce asexually as well as sexually (except imperfect fungi in which sexual reproduction has not been observed).

1. Asexual reproduction:

Asexual reproduction takes place by **spores**, **conidia**, **fragmentation** and **budding**. **Spores** are produced inside the reproductive structures called **sporangia**, which are cut off from the hyphae by complete septa. Spores may be produced by sexual or asexual process, are haploid, non-motile and not needing water for their dispersal. These are small, produced in very large number and dispersed by wind to great distances and cause wide distribution of many kinds of fungi, including many plant pathogens. When spores land in a suitable place, they germinate, giving rise to new fungal hyphae. Spores may also be dispersed by insects and other small animals and by rain splashes. Spores are a common means of reproduction in fungi.

Conidia (singular conidium) are non-motile, asexual spores which are cut off at the end of modified hyphae called **conidiophores**, and not inside the sporangia,

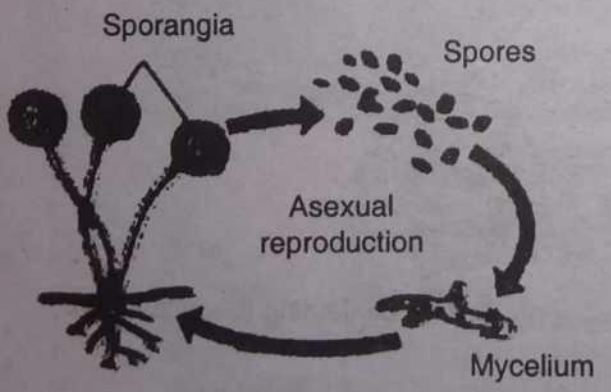


Fig. 8.5 Spores are released from sporangia and germinate to produce new hyphae.

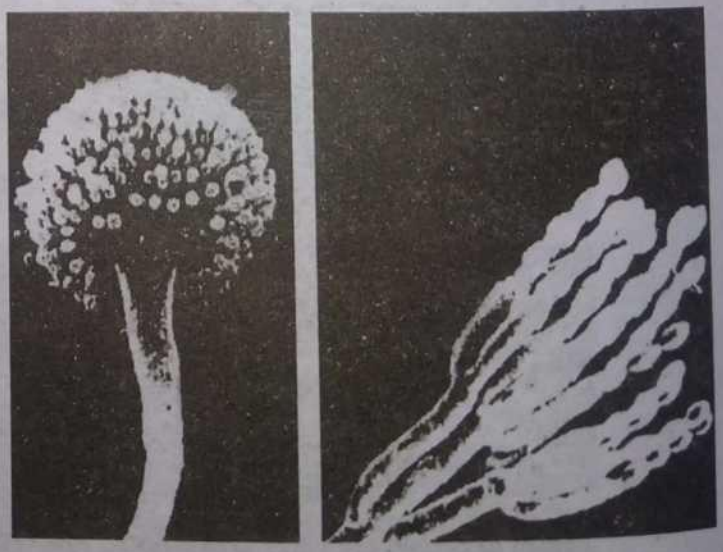


Fig.8.6 Conidia cut off at the tip of conidiophores in chains.

usually in chains or clusters. These may be produced in a very large number, can survive for weeks and cause rapid colonization on new food.

Fragmentation is simple breaking of mycelium of some hyphal fungi, each broken fragment giving rise to a new mycelium.

Unicellular yeasts reproduce by **budding** (an asymmetric division in which tiny outgrowth or bud is produced which may separate and grow by simple relatively equal cell division.

2. Sexual reproduction:

Details of sexual reproduction vary in different groups of fungi but fusion of haploid nuclei and meiosis are common to all. When fungi reproduce sexually, hyphae of two genetically different but compatible mating types come together, their cytoplasm fuse followed by nuclear fusion. In two of the three main groups of fungi (Basidiomycetes, Ascomycetes), fusion of nuclei (**karyogamy**) does not take place immediately after the fusion of cytoplasm (**plasmogamy**); instead the two genetic types of **haploid** nuclei from two individuals may coexist and divide in the same hyphae for most of the life of the fungus. Such a fungalhypha/cell having 2 nuclei of different genetic types is called dikaryotic (also **heterokaryotic**) hypha/cell (Fig.8.1).

Different groups of fungi produce different types of haploid sexual spores, such as **basidiospore** and **ascospores**, subsequent upon meiosis in zygote. These spores may be produced by their characteristic structure/fruiting bodies such as **basidia/basidio carps** and **asci/ascocarps**.

8.2 CLASSIFICATION OF FUNGI

There are four major division/phyla of fungi.

1. Zygomycota
2. Ascomycota
3. Basidiomycota
4. Deuteromycota

The four divisions of fungi are distinguished primarily by their sexual reproductive structures. In the zygomycetes, the fusion of hyphae leads directly to the formation of a zygote, which divides by meiosis when it germinates. In the other three groups, an extensive growth of **dikaryotic** hyphae may lead to the formation of massive structures of interwoven hyphae within which areformed the distinctive kind of reproductive cell characteristic of that particular group, **syngamy**, followed immediately by meiosis, occurs within these cells, and haploid spores are formed. On release the spores are dispersed, some of them giving rise to new hyphae.

Fungi are saprotrophic heterotrophic eukaryotes composed of hyphae (a mycelium). Fungi produce spores during both sexual and asexual reproduction, and the major groups of fungi are distinguishable on the basis of sexual reprodiction.

(1) Zygomycota:

The zygomycetes lack septa in their hyphae except when they form sporangia or gametangia. Zygomycota are by far the smallest of the four groups of fungi, with only about 600 named species. Included among them are some of the more frequent bread molds (Fig. 8.7), as well as a variety of other microscopic fungi found on decaying organic material. The group is named after a characteristic feature of the life cycle of its member, the production of temporarily dormant structures called **zygospores.**

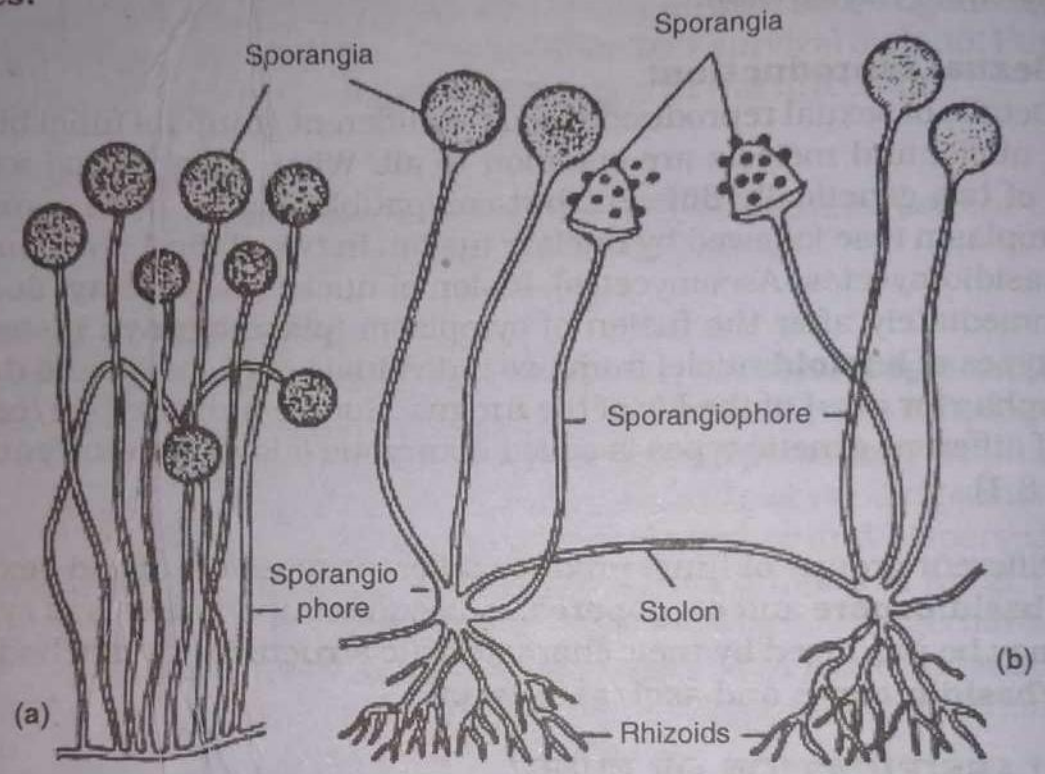


Fig. 8.7 Habit of Mucor and Rhizopus,
(a) Mucor sp. sporangiophores emerging from the prostrate hyphae;
(b) Rhizopus stolonifer — sporangiophores arising in groups from the nodes of stolon.

In the life cycle of the zygomycota (Fig. 8.8), sexual reproduction occurs by the fusion of gametangia, which contain numerous nuclei. The gametangia are cut off from the hyphae by complete septa. These gametangia may be formed on hyphae of different mating types or on a single hyphae. If different mating types are involved, fusion between the pairs of nuclei occurs immediately. Once the haploid nuclei have fused. They form diploid zygote nuclei, the fused portion of hyphae develops into a zygospores. Except for the zygote nuclei, all nuclei of the zygomycota are haploid. Meiosis occurs during the germination of the zygospore.

Asexual reproduction occurs much more frequently than sexual reproduction in the zygomycetes. During asexual reproduction, haploid spores are produced within more or less specialized sporangia formed on specialized erect hyphae called

sporangiophores. Their spores are thus shed above the substrate, in a position where they may be picked up by the wind and blow about.

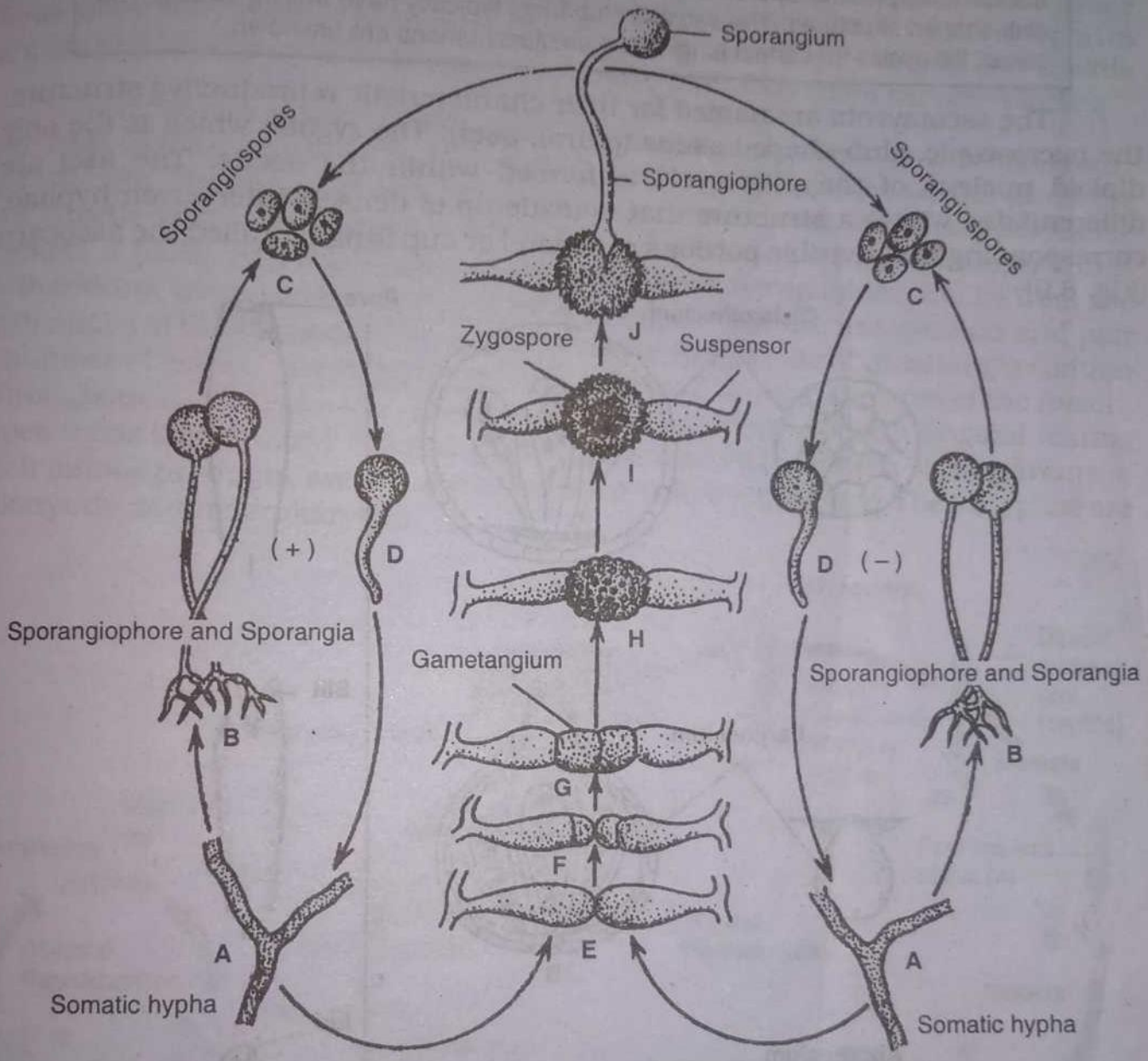


Fig. 8.8 ***Life-cycle in Mucor sp., A–D and A' D'—Asexual stage of + and – strains; E: progametangia coming closer; F: progametangia differentiated into gametangia and suspensors; G and H: gametangial copulation; I: mature zygospore; J: germination of zygospore.***

(2) Ascomycota:

The second division of fungi, the ascomycota is a very large group of about 30,000 named species with many more being discovered each year. Among them are such familiar and economically important fungi as yeasts, common molds, morels, and truffles. Also included in this division are many of the most serious plant pathogens e.g. powdery meldew etc.

During sexual reproduction, the black bread molds produce spores in sporangia, the sac fungi produce spores in sac like cells, and the club fungi produce spores in club-shaped structures. The sac and club fungi typically have fruiting bodies. The sexual life cycles for certain fungi that parasitize humans are unknown.

The ascomycota are named for their characteristic reproductive structure, the microscopic, club-shaped **ascus** (plural, **asci**). The zygote, which is the only diploid nucleus of their life cycle is formed within the ascus. The asci are differentiated within a structure that is made up of densely interwoven hyphae, corresponding to the visible portions of a morel or cup fungus, called the ascocarp (Fig. 8.9).

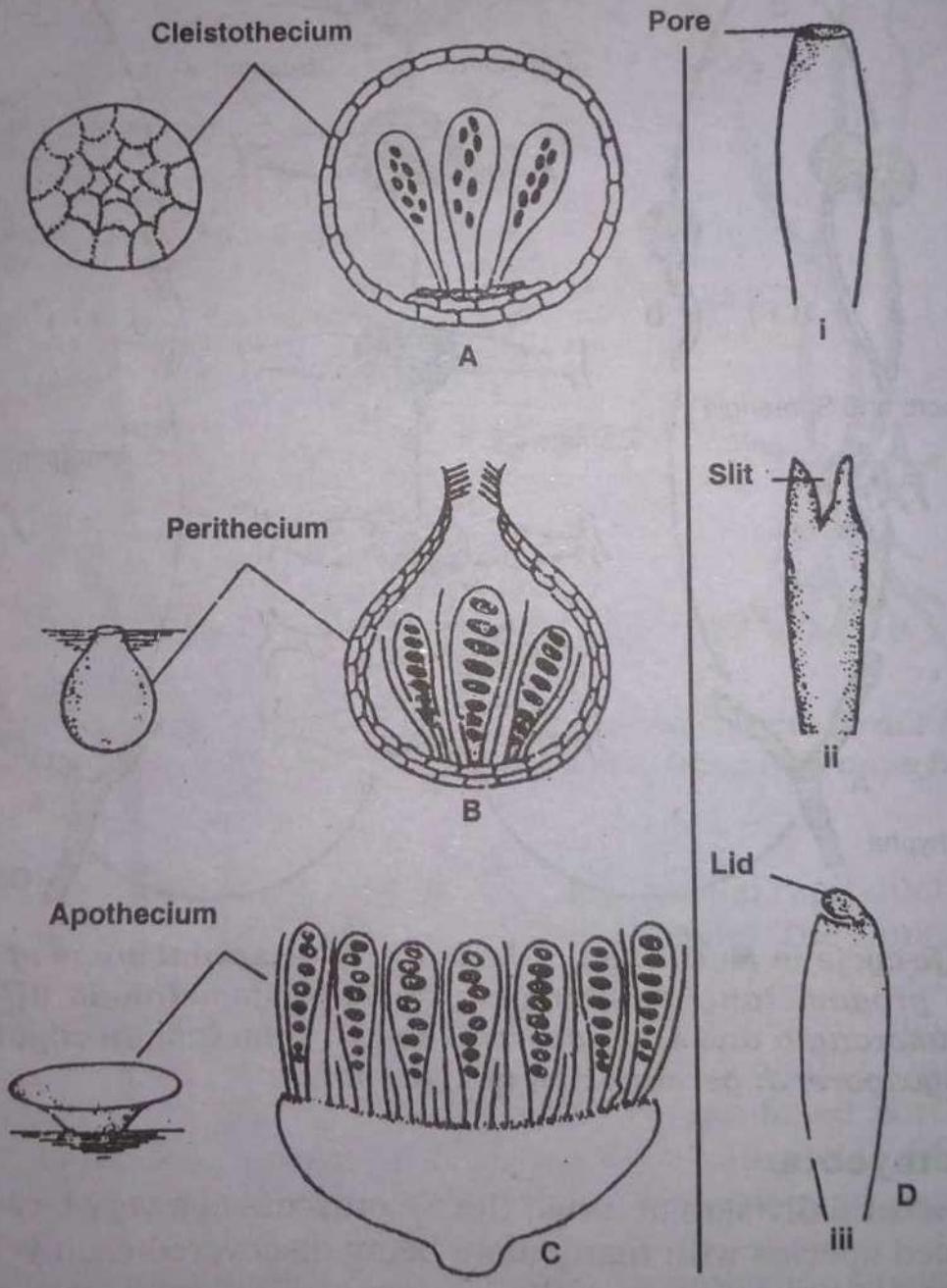


Fig. 8.9 Types of ascocarps in Ascomycetes, A: cleistothecium; B: perithecium; C: apothecium; D: ascus dehiscence; i: by pore; ii: by slit; iii: by lid.

Asexcual reproduction is very common in the ascomycota. It takes place by means of conidia (singular, conidium), spores cut off by septa at the ends of modified hyphae called conidiophores. Many condia are multinucleate. The hyphae of ascomycetes are divided by septa, but the septa are perforated and the cytoplasm flows along the length of each hyphae. The septa that cut off the asci and conidia are initially perforated like all other septa, but later they often become blocked.

The hyphae of ascomycetes may be either homokaryotic or heterokaryotic. The cells of these hyphae usually contain from several to many nuclei, as do the gametangia. The female gametangia, which are called ascogonia, having a beaklike out growth called a **trichogyne**. When the antheridium, or male gametangium is formed, it fuses with the trichogyne of an adjacent ascogonium; nuclei from the antheridium then migrate through the trichogyne into the ascogonium and pair with nuclei of the opposite mating type. Initially, both kinds of gametangia contain a number of nuclei. Heterokaryotic hyphae then arise from the area of the fusion. Throughout such hyphae, nuclei that represent the two different original mating types occur (dikaryoticy). Several nuclei, some derived from each of the parents of their mitotic products, are present within each cell of the hyphae. These hyphae are dikaryotic and heterokaryotic.

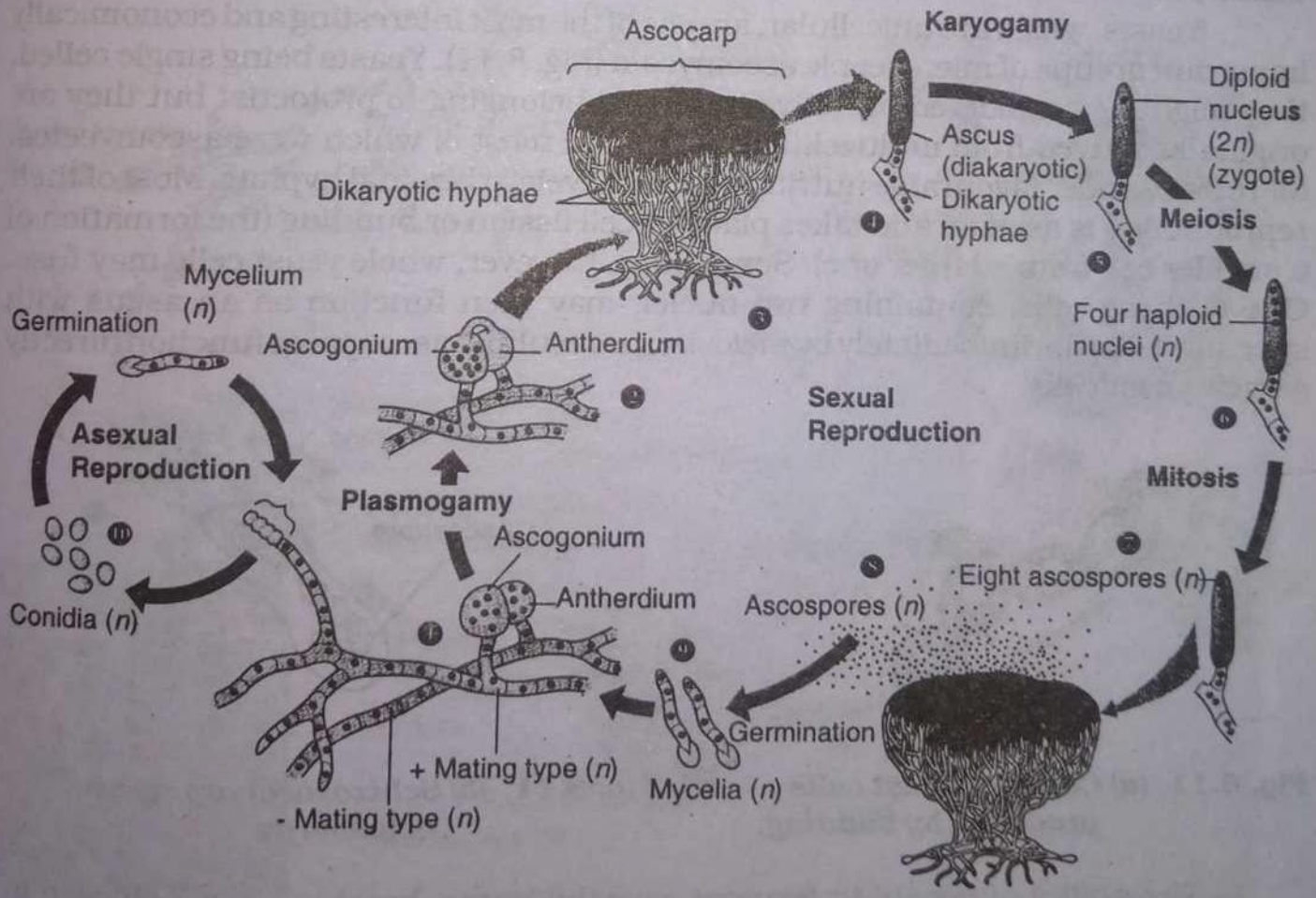


Fig. 8.10 The Life-cycle of an ascomycete

The asci are cut off by the formation of septa at the tips of the heterokaryotic hyphae. There are two haploid nuclei within each ascus, one of each of the two mating types represented in the dikaryotic hyphae. Fusion of these two nuclei occurs within each ascus, forming a zygote, each zygote divides immediately by meiosis, forming four haploid daughter nuclei; these usually divide again by mitosis, producing eight haploid nuclei that become walled ascospores. In most ascomycetes the ascus becomes highly turgid at maturity and ultimately bursts, often at a perforated area. When this occurs, the ascospores may be thrown as far as 30 centimetres, an amazing distance considering that most ascospores are only about 10 micrometers long (Fig: 8.10).

Ascocarps or fruity bodies (Fig: 8.9), are made up of tightly interwoven monokaryotic and dikaryotic hyphae. Within an ascocarp, on special fertile layers of dikaryotic hyphae, the asci are formed. The ascocarps of the cup fungi and the morels are open, with the asci lining the open cups called **opothecium**. Other ascocarps are closed or have a small opening at the apex called **cleistothecium** and **perithecium** respectively; the ascocarps of ***neurospora***, an important organism in genetic research, are of this latter kind.

YEASTS:

Yeasts, which are unicellular, are one of the most interesting and economically important groups of microscopic ascomycota (Fig. 8.11). Yeasts being single celled, they might be considered primitive fungi and belonging to protoctist but they are originally derived from multicellular ancestors, most of which were ascomycetes. More over, under favourable nutrition it may develop rhizoidal hyphae. Most of their reproduction is asexual and takes place by cell fission or budding (the formation of a smaller cell from a larger one). Sometimes, however, whole yeast cells may fuse. One of these cells, containing two nuclei, may then function as an ascus with syngamy followed immediately by meiosis; the resulting ascospores function directly as new yeast cells.

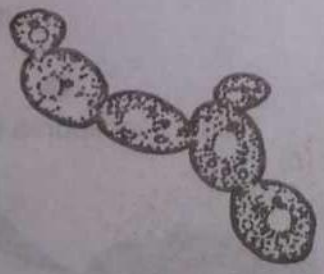


Fig. 8.11 (a) Chain of yeast cells produced by budding.

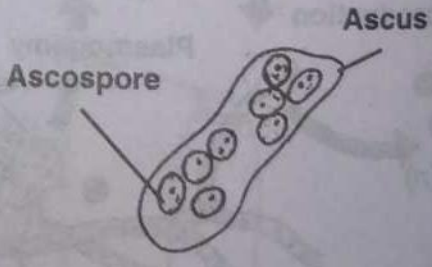


Fig. 8.11 (b) Schizosaccharomyces octosporus

The ability of yeasts to ferment carbohydrates, breaking down glucose to produce ethanol and carbon dioxide in the process, is fundamental in the production

of bread, beer and wine. Through the millennia, many different strains of yeast have been domesticated and selected for these processes. Wild yeast—ones that occur naturally in the areas where wine is made were important in wine making historically, but domesticated yeasts are normally used now. The most important in all these processes is ***saccharomyces cerevisiae***. This yeast has been used by humans throughout recorded history. Other yeasts are important pathogens and cause diseases such as thrush and cryptococcosis; one of them, ***candida***, causes a common vaginal infection.

Over the past few decades yeasts have become increasingly important in genetic research.

(3) Basidiomycota:

The basidiomycetes, have about 16,000 named species. More is known about some members of this group than about any other fungi. Among the basidiomycetes are not only the mushrooms, toadstools, puffballs, jelly fungi, and shelf fungi, but also many important plant pathogens among the groups called rusts and smuts. Many mushrooms are used as food, but others are deadly poisonous. Still other species are poisonous to some people and harmless to others.

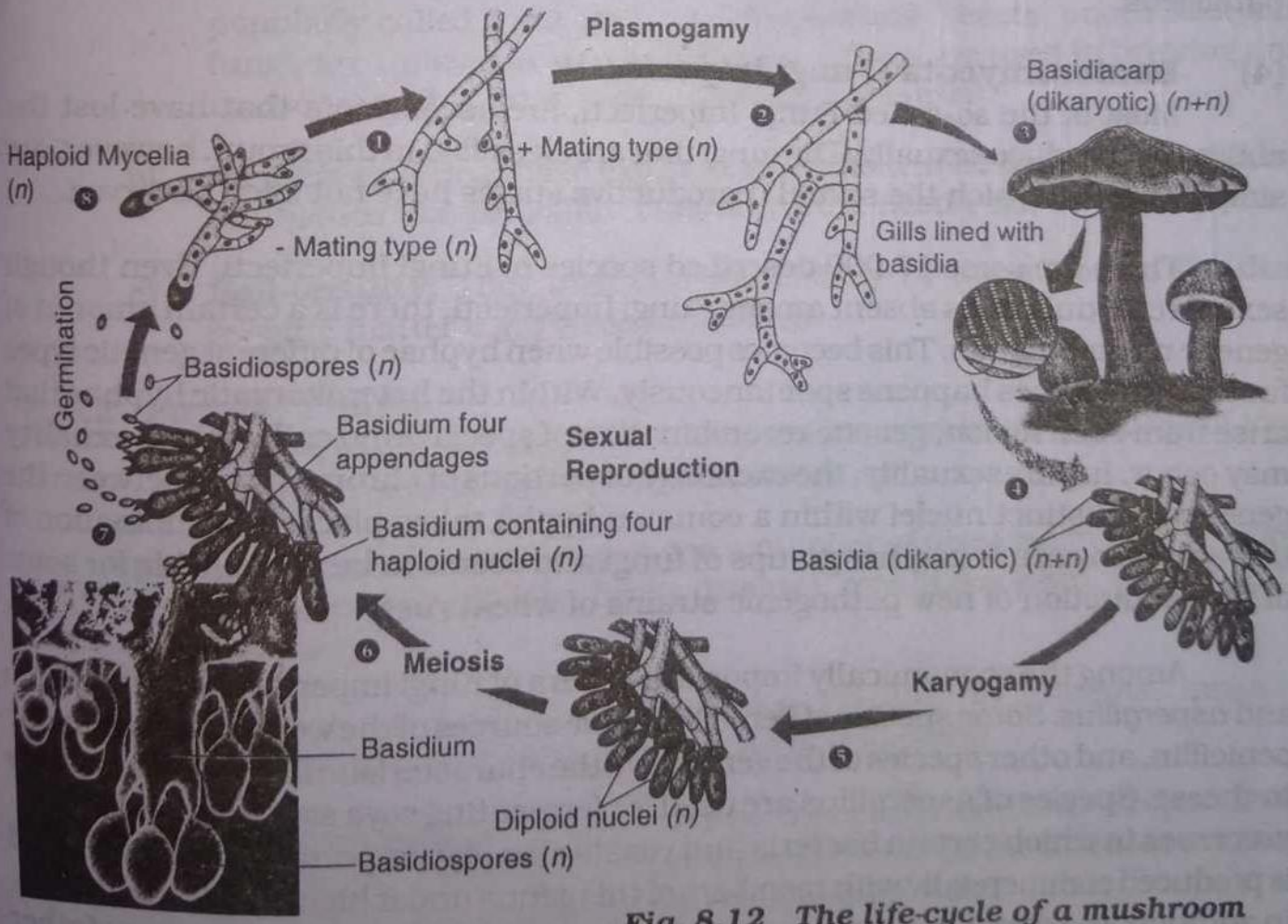


Fig. 8.12 The life-cycle of a mushroom forming Basidiomycete

Basidiomycetes are named for their characteristic sexual reproductive structure, the **basidium**. A basidium is club shaped, like an ascus. Syngamy, or nuclear fusion, occurs within the basidium, giving rise to the zygote, the only diploid cell of the life cycle (Fig. 8.12). As in all fungi, meiosis occurs immediately after the formation of the zygote. In the basidiomycetes, the four haploid products of meiosis are incorporated into basidiospore; in most of the members of this division, the basidiospore are borne at the end of the basidium on slender projections called **sterigmata** (singular: sterigma). In this way the structure of a basidium differs from that of an ascus, although functionally the two are identical. The septum that cuts off the young basidium is initially perforated but often becomes blocked, as it does in the asomycetes.

> It has been estimated that a mushroom with a cap that is 7.5 centimetres across produces as many as 40 million spores per hour!

Some species of basidiomycetes are commonly cultivated; for example, the button mushroom, ***agaricus campestris***, is grown in more than 70 countries.

Although we are more familiar with the mushrooms, another kind of basidiomycete is represented by the rusts and smuts, which are important plant pathogens.

(4) Deuteromycota (Fungi imperfecti):

Most of the so-called Fungi Imperfecti, are ascomycota that have lost the ability to reproduce sexually. The fungi that are classified in this group, however, are simply those in which the sexual reproductive stages have not been observed.

There are some 17,000 described species of Fungi Imperfecti. Even though sexual reproduction is absent among Fungi Imperfecti, there is a certain amount of genetic recombination. This becomes possible when hyphae of different genetic types fuse, as sometimes happens spontaneously. Within the heterokaryotic hyphae that arise from such fusion, genetic recombination of special kind called **parasexuality** may occur. In parasexuality, the exchange of portions of chromosomes between the genetically distinct nuclei within a common hypha takes place. Recombination of this sort also occurs in other groups of fungi and seems to be responsible for some of the production of new pathogenic strains of wheat rust.

Among the economically important genera of fungi imperfecti are *penicillium* and *aspergillus*. Some species of Penicillium are sources of the well-known antibiotic penicillin, and other species of the genus give the characteristic flavours and aromas to cheese. Species of Aspergillus are used for fermenting soya sauce and soya paste, processes in which certain bacteria and yeasts also play important roles. Citric acid is produced commercially with members of this genus under highly acidic conditions. In addition, the enrichment of livestock feed by the products of fermentation of other species is being investigated.

8.3 LAND ADAPTATIONS OF FUNGI

Following characteristics enable fungi to live on land.

1. Hyphae that absorb water and soluble nutrients also anchor the plant.
2. Thick-walled drought resistant spores are produced in large number.
3. Instead of forming gametes having flagella, special gametes are produced which need no water for fertilization.

8.4 ECONOMIC IMPORTANCE

In many ways bacteria and fungi are similar in their importance to man. Like bacteria, fungi show both harmful and useful activities to human beings.

8.4.1 Useful Fungi:

a) **Food:** Many kinds of edible fungi in the form of mushrooms are a source of nourishing and delicious food-dishes. Today they are grown as a crop in many places throughout the world. But one must bear in mind that not all the mushrooms are edible. Some of them are poisonous and popularly called ***toad-stools*** or ***death-stool***. Yeasts, another kind of fungi, are utilized in baking industry. Others are used in brewing and in cheese and organic acid producing industries.

b) **Medicines:** Fungi have explored a new field in medicine by producing antibiotics like penicillin, chloromycetin, neomycin, terramycin etc.

c) **Soil-fertility:** They maintain soil fertility by decomposing the dead organic matter e.g. Mycorrhizal fungi.

8.4.2 Harmful Fungi:

a) **Food-spoilage:** Fungi cause tremendous amounts of spoilage of food-stuff by many of the saprophytic fungi.

b) **Human-diseases:** Fungi cause a number of diseases in humanbeings like aspergillosis (ear, lungs disease), moniliasis (skin, mouth, gums disease).

Most of the fungi that cause skin diseases in humans, including athlete's foot and ringworm, are also fungi imperfecti.

c) **Plant-diseases:** Fungi destroy many agricultural crops, fruits, ornamentals and other kinds of plants. Some of the diseases are loose-smut of wheat, downy and powdery mildews etc.

d) **Spoilage:** Many fungi spoil leather-goods, wool, books, timber, cotton etc.

8.4.3 Economic losses due to Fungi:

Fungi are responsible for many serious plant diseases because they produce several enzymes that can breakdown cellulose, lignin and even cutin. All plants are susceptible to them. Extensive damages due to rusts and smut diseases of wheat, corn and rice prompted mass displacement and starvation to death of many people.

Powdery mildews (on grapes, rose, wheat etc.), **ergot of rye, red rot of sugarcane,** potato wilt, cotton root rot, **apple scab** and brown rot of peaches, plums, apricots and cherries are some other common plant diseases caused by fungi.

Fungi also cause certain animals diseases. Ring worm and athlete's foot are superficial fungal infections caused by certain imperfect fungi. *Candida albicans*, a yeast, causes oral and vaginal thrush. **Histolplsmolysis** is a serious infection of lungs caused by inhaling spores of a fungus which is common in soil contaimin atd with bird's feces. If infection spreads into blood stream and then to other organs (which is very occassional), it can be serious and even fatal. *Aspergillus fumigatus* caused **aspergillosis**, but only in person with defective immune system such as AIDS and may cause death. Some strains of aspergillus flavus produce one of the most carcinogenic (cancer-causing) mycotoxins (toxins produced by fungi), called **aflatoxins**. Aspergillus contaminates improperly stored grains such as peanuts and corn etc. Milk, eggs and meat may also have small traces of aflatoxins. Any moldy human food or animal forage product should be discarded. **Ergotism** is caused by eating bread made from purple ergot- contaminated rye flour. The poisonous material in the ergot causes nervous spasm, convulsion, psychotic delusion and even gangrene.

Saprobic fungi are not only useful recyclers but also cause incalculable damage to food, wood, fiber and leather by decomposing them. 15-50 percetage of world's fruit is lost each year due to fungal attack. Wood-rotting fungi destroy not only living trees but also structural timber. Bracket/ shelf fungi cause lot of damage to stored cut timber as well as stands of timber of living trees.

A pink yeast (*Rhodotorula*) grows on shower curtains and other moist surfaces.

KEY POINTS

- It includes non-chlorophyllus, multicellular (except yeast) organisms having chitinous cell wall and coenocytic body called mycelium. e.g. Agaricus (mushroom) yeast, etc. They are absorptive hetrotrophs.
- There are four major division/phyla of fungi. Zygomycota, Ascomycota, Basidiomycota and Deuteromycota.
- The four divisions of fungi are distinguished primarily by their sexual reproductive structures.
- Sexual reproduction occurs by the fusion of gametangia, which contain numerous nuclei in zygomycota.
- The ascomycota are named for their characteristic reproductive structure, the microscopic, club-shaped ascus.
- Basidiomycetes are named for their characteristic sexual reproductive structure, the basidium.
- Most of the so-called Fungi Imperfecti, are ascomycota that have lost the ability to reproduce sexually. The fungi that are classified in this group, however, are simply those in which the sexual reproductive stages have not been observed.
- Among the economically important genera of *fungi imperfecti* are penicillium and aspergillus.

EXERCISE

1. Encircle the correct choice:

(i) Which chemical substance is more resistant to decay?

(a) Cellulose (b) Cutin

(b) Lignin (c) Chitin

(ii) Zygomycota hyphae have:

(a) No septa (b) Septa

(b) Perforated septa (c) Double septa

(iii) Ascocarp or fruiting bodies having small opening at the apex are called:

(a) Opothecium (b) Cleistothecium

(b) Perithecium (c) Porothecium

(iv) yeast which are unicellular belongs to kingdom:

(a) Prokaryotae (b) Protoctista

(c) Fungi (d) Monera

(v) Most serious plant pathogens e.g. powdery meldew belongs to:

(a) Zygomycota (b) Ascomycota

(c) Basidiomycota (d) Deuteromycota

(vi) Which one is mis-match :

(a) Zygomycota Zygospore

(b) Ascomycota Club-shaped Ascocarp

(c) Deuteromycota No sexual reproduction

(d) Basidiomycota Club- shaped basidum

(vii) Which one is not basidiomycota?

(a) Cup-Fungi (b) Jelly-Fungi

(c) Shelf-Fungi (d) Smut-Fungi

(viii) Parasexuality occur in

(a) Zygomycota (b) Ascomycota

(c) Basidiomycota (d) Deuteromycota

(ix) Seroius infection of Lungs

(a) Aspergillosis (b) Histoplasmolysis

(c) Moniliasis (d) Amoebiosis

(x) *Aspergillus flavus* produce carcinogenic toxin called

(a) Aflatoxin (b) Neurotoxin

(c) Haematoxin (d) Mycotoxin

2. Write detailed answers of the following questions:

(i) What are fungi? Describe its one division in detail.

(ii) Write an essay on economic importance of fungi.

(iii) Describe nutrition and reproduction in fungi.

(iv) What do you know about fungi? Describe fungal body and mode of reproduction in fungi.

(v) Give diagnostive features of four classes of fungi.

3. Write short answers of the following questions:

(i) Name the four groups of fungi with their reproductive structures.

(ii) What is the economic importance of yeast?

(iii) Why fungi imperfecti are so called?

(iv) Why fungal non-septate hyphae are called coenocytic?

(v) Why yeast is placed in fungi, when it is unicellular?

4. Define the following terms:

(i) Fungi

(ii) Mycelium

(iii) Zygomycota

(iv) Ascomycota

5. Distinguish between the following:

(i) Zygomycota and ascomycota.

(ii) Fungi and plants.