Benha University
Faculty of science
Botany Dept.
Time : 2hrs

2nd year students
systematic mycology (1)
8, Sep. 2016 (summer semestre)
Course code : B262

Write on four only of the following?

1. Reproduction in fungi

Fungi have averity and a complexed reproductive systems. Most can propagate by the simple growing of hyphae or by fragmentation, in which a separated piece of mycelium can generate a whole new colony. Spores can be considerd as the primary reproductive mode of fungi. Fungal spores are responsible not only for multiplication but also for survival, producing genetic variation, and dissemination. Because of their

relatively light weight, spores are dispersed widely through the environment by air, water, and living things. Upon a favorable substrate, a spore will germinate and produce a new fungus colony in a very short time.

The fungi exhibit such a marked diversity in spores. Therefor, they are largely classified and identified by their spores and spore forming structures. We will present only a basic overview of the principal types. The most general subdivision is based on the way the spores arise. Asexual spores are the products of mitotic division of a single parent cell, and sexual spores are formed through a process involving the fusing of two parental nuclei followed by meiosis.

Asexual Spore Formation

On the basis of the nature of the reproductive hypha and the manner in which the spores originate, there are two subtypes of asexual spore: 1. Sporangiospores are formed by successive cleavages within a saclike head called a sporangium, which is attached to a stalk, the sporangiophore. 2. Conidia (conidiospores) are free spores not enclosed by a spore-bearing sac. They develop either by pinching off the tip of a special fertile hypha or by segmentation of a preexisting vegetative hypha. Conidia are the most common asexual spores, and they occur in these forms: arthrospore, chlamydospore blastospore . A spore produced by budding from a parent cell that is a yeast or another conidium; also called a bud. Microconidium and macroconidium . The smaller and larger conidia formed by the same fungus under varying conditions. Microconidia are one-celled, and macroconidia have two or more cells…….. and so on.

Sexual Spore Formation:

Fungi can propagate successfully either asexual spores, sexual spores or bother of them. Sexual reproduction, linking of genes from two parents creates offspring with combinations of genes different from that of either parent. The offspring from such a union can have slight variations in form and function that are potentially advantageous in the adaptation and survival of their species.

The majority of fungi produce sexual spores at some point. The nature of this process varies from the simple fusion of fertile hyphae of two different strains to a complex union of differentiated male and female structures and the development of special fruiting structures. There are three common sexual spores: zygospores, ascospores, and basidiospores. These spore types provide an important basis for classifying the major fungal divisions.

Zygospores are diploid spores formed when hyphae of two opposite strains) fuse and create a diploid zygote that swells and becomes covered by strong, spiny walls. Under suitable condition, the zygospore germinates and forms a mycelium that gives rise to a sporangium. Meiosis of diploid cells of the sporangium results in haploid nuclei that develop into sporangiospores.

In general, haploid spores called ascospores are created inside a special fungal sac, or ascus (pl. asci). The ascus and ascospores are formed when two different strains or sexes join together to produce offspring. Dikaryons (diploid nucleus) undergo differentiation, each of these cells enlarges to form an ascus, and its diploid nucleus undergoes meiosis (often followed by mitosis) to form four to eight haploid nuclei that will mature into ascospores.

Basidiospores are haploid sexual spores formed on the outside of a club-shaped cell called a basidium. In general, spore formation follows the same pattern of two mating types coming together, fusing, and forming terminal cells with diploid nuclei.

1. Asexual reproduction:

The asexual reproduction takes place by means of biflagellate zoospores formed inside the sporangia. In the very beginning the hyphae accumulate just beneath the epidermis of the infected leaf. From these hyphae, certain thick-walled, clavate aerial sporangiophores come out.On the maturation of the sporangium the protoplast is cleaved into uninucleate protoplasts. Each protoplast metamorphoses into a naked, biflagellate, uninucleate, reniform and vacuolate zoospore. The sporangium bursts anteriorly and the zoospores liberate in the film of water.The flagella are withdrawn and the zoospore becomes encysted. Each encysted protoplast germinates, producing a germ tube on the surface of the suitable host. The germ tube enters through stoma, develops into new mycelium and ramifies in the intercellular spaces of the host tissue.Sometimes the sporangia behave as conidia and germinate directly producing germ tubes. The conidia may germinate from 3°C to 25°C temperature, but the optimum temperature is 10°C.

2. Sexual reproduction:

The sexual reproduction is oogamous. The sex organs develop on the hyphal ends in the intercellular spaces of the deeper tissues of petioles and stems. The female sex

organs are oogonia and the male sex organs are antheridia. The oogonium is rounded and the antheridium club-shaped. The developing oogonia and antheridia are separated from rest of the mycelium by septa. The cytoplasm, vacuoles and nuclei are uniformly distributed in the young oogonium. On the maturation of the oogonium the protoplasm of the oogonium differentiates into two regions. The outer region is called the periplasm containing thin cytoplasm, many nuclei and many vacuoles. The central protoplasm with denser consistency surrounded by periplasm is called the oosphere or the egg. The dense cytoplasm within the oosphere contains one female nucleus in it and called the ooplasm. In the beginning of the development of the oogonium there are many nuclei, which degenerate soon leaving one functional female nucleus. The antheridium develops on the terminal end of another hypha lying very close to the oogonium. The hyphal end swells, becomes club-shaped and separates from rest of the mycelium by a septum. This swollen multinucleate club-shaped portion is called the antheridium. The antheridium attaches itself to the oogonial wall and at the point of contact a fertilization tube develops from the antheridium. The fertilization tube penetrates the oogonial wall and reaches the oosphere through the periplasm. One functional male nucleus transfers through the tube, reaches the egg, fuses with the female nucleus and the rest of the nuclei of the antheridium degenerate. (with drawing)

2. *Compare between general characters of Basidiomycotina & Ascomycotina*

The fungi in the Phylum Basidiomycota are easily recognizable under a light microscope by their club-shaped fruiting bodies called basidia (singular, basidium), which are the swollen terminal cell of a hypha. The basidia, which are the reproductive organs of these fungi, are often contained within the familiar mushroom, commonly seen in fields after rain, on the supermarket shelves, and growing on your lawn . These mushroom-producing basidiomyces are sometimes referred to as "gill fungi" because of the presence of gill-like structures on the underside of the cap. The "gills" are actually compacted hyphae on which the basidia are borne. This group also includes shelf fungus, which cling to the bark of trees like small shelves. In addition, the basidiomycota includes smuts and rusts, which are important plant pathogens, and toadstools. Most edible fungi belong to the Phylum Basidiomycota; however, some basidiomycetes produce deadly toxins. For example, *Cryptococcus neoformans* causes severe respiratory illness.
The lifecycle of basidiomycetes includes alternation of generations . Spores are generally produced through sexual reproduction, rather than asexual reproduction. The club-shaped basidium carries spores called basidiospores. In the basidium, nuclei of two different mating strains fuse (karyogamy), giving rise to a diploid zygote that then undergoes meiosis. The haploid nuclei migrate into basidiospores, which germinate and generate monokaryotic hyphae. The mycelium that results is called a primary mycelium. Mycelia of different mating strains can combine and produce a secondary mycelium that contains haploid nuclei of two different mating strains. This is the dikaryotic stage of the basidiomyces lifecyle and it is the dominant stage. Eventually, the secondary mycelium generates a basidiocarp, which is a fruiting body that protrudes from the ground; this is what we think of as a mushroom. The basidiocarp bears the developing basidia on the gills under its cap.

Ascomycota is a division or phylum of the kingdom Fungi that, together with the Basidiomycota, form the subkingdom Dikarya. Its members are commonly known as the sac fungi or ascomycetes. They are the largest phylum of Fungi, with over 64,000 species. The defining feature of this fungal group is the "ascus" (from Greek: ἀσκός (askos), meaning "sac" or "wineskin"), a microscopic sexual structure in which nonmotile spores, called ascospores, are formed. However, some species of the Ascomycota are asexual, meaning that they do not have a sexual cycle and thus do not form asci or ascospores. Previously placed in the Deuteromycota along with asexual species from other fungal taxa, asexual (or anamorphic) ascomycetes are now identified and classified based on morphological or physiological similarities to ascus-bearing taxa, and by phylogenetic analyses of DNA sequences.

The ascomycetes are a monophyletic group, i.e. it contains all descendants of one common ancestor. This group is of particular relevance to humans as sources for medicinally important compounds, such as antibiotics and for making bread, alcoholic beverages, and cheese, but also as pathogens of humans and plants. Familiar examples of sac fungi include morels, truffles, brewer's yeast and baker's yeast, dead man's fingers, and cup fungi. The fungal symbionts in the majority of lichens (loosely termed "ascolichens") such as Cladonia belong to the Ascomycota. There are many plant-pathogenic ascomycetes, including apple scab, rice blast, the ergot fungi, black knot, and the powdery mildews. Several species of ascomycetes are biological model organisms in laboratory research. Most famously, Neurospora crassa, several species of yeasts, and Aspergillus species are used in many genetics and cell biology studies. Penicillium species on cheeses and those producing antibiotics for treating bacterial infectious diseases are examples of taxa that belong to the Ascomycota.

3. Life cycle of Albugo sp.

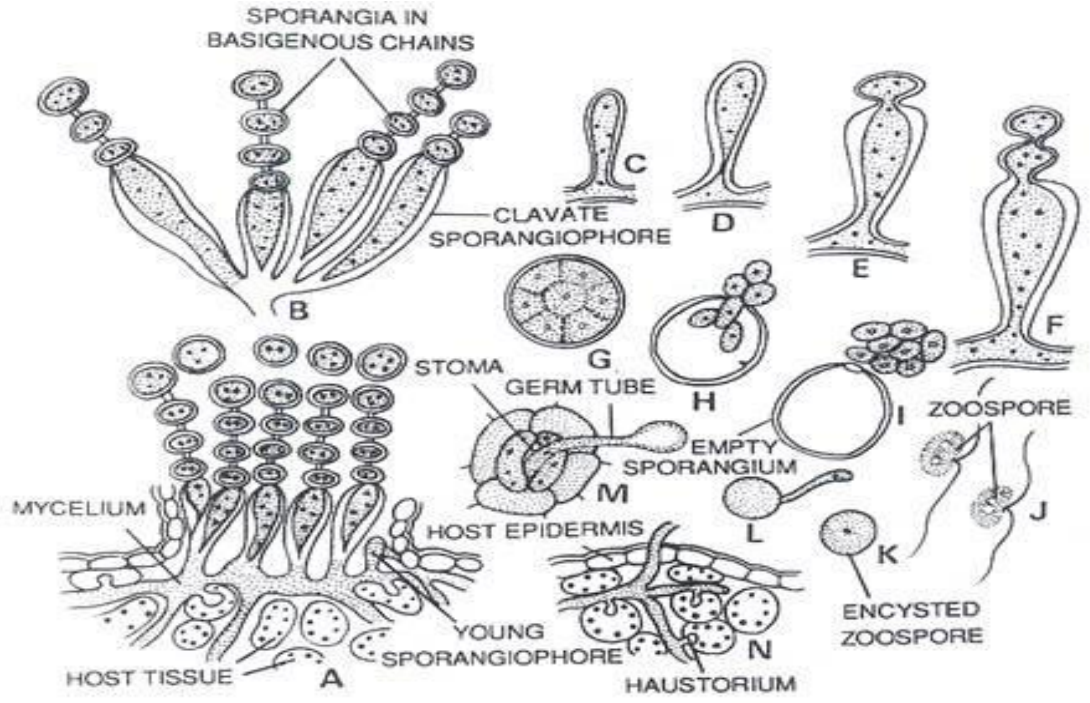

Fig. 10.18. *Albugo candida*. White rust of crucifers—asexual reproduction of *Albugo*—A, section of infected host leaf showing mycelium, haustoria, sporangiophores and sporangia; B, branching of sporangiophores with basigenous chains of sporangia; C-F, development of sporangiophore and sporangia; G-I, germination of sporangium and formation of zoospores; J, biflagellate zoospores; K, encysted zoospores; L, germinating encysted zoospores; M, infection; N, intercellular mycelium and rounded haustoria within host tissue.

An ascocarp, or ascoma (plural: ascomata), is the fruiting body (sporocarp) of an ascomycete phylum fungus. It consists of very tightly interwoven hyphae and may contain millions of asci, each of which typically contains four to eight ascospores. Ascocarps are most commonly bowl-shaped (apothecia) but may take a spherical (cleistothecia) or flask-like (perithecia) form.

An apothecium is a wide, open, saucer-shaped or cup-shaped fruit body. It is sessile and fleshy. The structure of the apothecium chiefly consists of three parts: hymenium (upper concave surface), hypothecium, and excipulum. The asci are present in the hymenium layer. The asci are freely exposed at maturity. An example are the members of Dictyomycetes. Here the fertile layer is free, so that many spores can be dispersed simultaneously. The morel, Morchella, an edible ascocarp, not a mushroom, favored by gourmets, is a mass of apothecia fused together in a single large structure or cap. The genera Helvella and Gyromitra are similar.

Perithecium: These are flask shaped structures opening by a pore or ostiole (short papilla opening by a circular pore) through which the ascospores escape. The ostiolar canal may be lined by hair-like structures called periphyses. The unitunicate asci are usually cylindrical in shape, borne on a stipe (stalk), released from a pore, developed from the inner wall of the perithecium and arise from a basal plectenchyma-centrum. Examples are members of Sphaeriales and Hypocreales. Perithecia are also found in Xylaria (Dead Man's Fingers, Candle Snuff) and Nectria.

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With my best wishes