FACULTY OF AGRICULTURE SCIENCES AND ALLIED INDUSTRIES

Course Material

Course Name: Fundamentals of Plant Pathology

Course Code: PPA-121

B.Sc. Agriculture

Semester- II

Course Instructor

Dr. Kartikay Bisen

Faculty of Agricultural Sciences and Allied Industries

Rama University, Kanpur

LECTURE 5

REPRODUCTION IN FUNGI AND FUNGAL LIKE ORGANISMS CAUSINGPLANT DISEASES

REPRODUCTION

Fungi may reproduce in three ways:

- Vegetative reproduction
- Asexual reproduction
- Sexual reproduction

I Vegetative Reproduction

- Fragmentation of hyphae
- Production of thin walled spores such as oidia or arthrospores
- Production of swollen, thick walled spores with storage of rich food, i.e. chlamydospores which are formed to tide over the adverse environment.
- In Fragmentation, a bit of broken hyphae establishes a new colony. Fragmentation occurs in nature and is usually employed in the laboratory to keep the fungus growing by transferring small portions of hyphae to new culture tubes.
- In Budding, small soft portion of the cell wall bulges out and a daughter nucleus migrates into it. Then the bud is pinched out by a constriction at the point of its origin. Sometimes the budding is so quick that a chain of buds is formed due to non-detachment of the daughter buds, and is called pseudomycelium.
- In Fission, a cell divides in a transverse plane into two cells. Although, it is a characteristic of bacteria and it also occurs in fission yeasts.

II. Asexual Reproduction

- It occurs through internally or externally produced spores which also act as agents of dissemination, survival and infection.

- In Straminopila (Oomycota) and some Fungi (Zygomycota), asexual spores are produced endogenously inside a sac like structure called sporangium and are released either by rupture of sporangial wall or through a pore or opening in its wall.
- They are either motile with one or two flagella called zoospores or non-motile aplanospores.
- Sporangia are formed on specialized hyphal branches called sporangiophores.
- Conidia are another type of asexual spores which are cut off terminally or laterally from specialized hyphal branches called conidiophores.
- Conidiophores may be unbranched or may branch variously, both monopodially or sympodially and conidia are produced singly or serially in chains on these branches.
- While conidiophores of most fungi remain free, in some they appear to be aggregated and often compactly arranged to form a variety of characteristic structures such as coremia, synnema, sporodochia, acervuli and pycnidia. These are primarily designed to provide large number of spores within a small space available to the fungus.
- The locomotory appendages or flagella of zoospores are of two types, i.e. whiplash and tinsel.
- The whiplash flagella are much thinner at the tip.
- The tinsel type flagella, which are found only in the members of kingdom Straminopila (Oomycota) have large number of small hair like outgrowths called mastigonemes or flimmers on their entire length.

Structure of Flagella

- The flagellum of fungi has a typical 9+2 structure as in case of other eukaryotes. In 9+2 structure, the flagellum is composed of 9 peripheral pairs of fibrils surrounding the two central fibrils (hence the name 9+2). The two central fibrils are attached to the blepharoplast lying inside the motile cell. The membrane surrounding the 9+2 fibrils is continuous with the plasma membrane of the cell. Sometimes, a threadlike rhizoplast connects the blepharoplast to the nucleus.
- The bacterial flagella lack this 9+2 structure and are made of 8 rows of flagellin (protein) molecules twisted around each other like a rope.

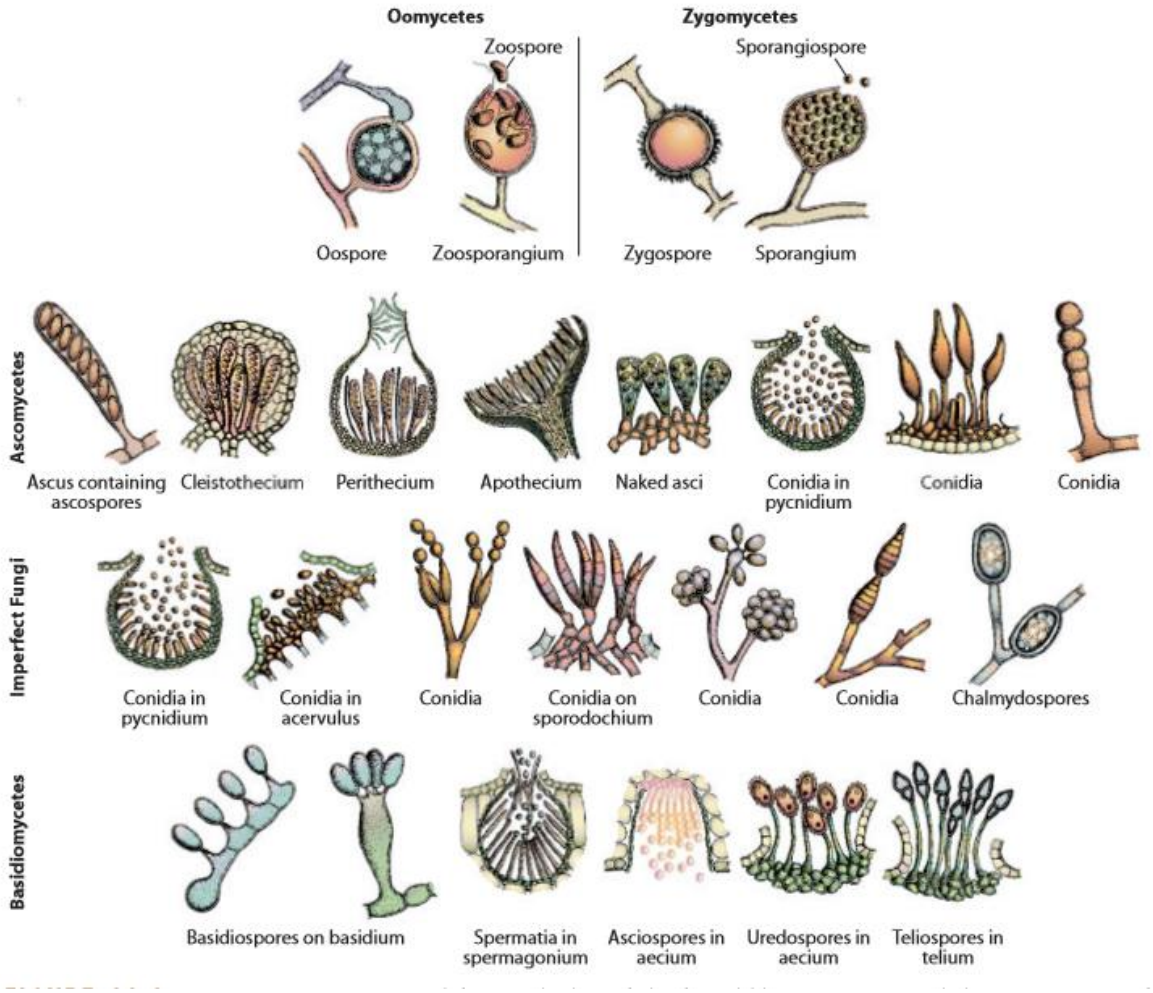

Figure: Representative spores and fruiting bodies of the fungal-like Oomycetes and the main groups of fungi.

III. Sexual Reproduction

The sexual reproduction in fungi and other similar micro-organisms involves:

- **Plasmogamy-**. fusion between two sexual cells.
- **Karyogamy-** fusion of the nuclei. It results in the formation of a diploid nucleus, which immediately or later undergoes meiosis to form 4 haploid nuclei.

Fungi achieve plasmogamy by a variety of methods:

i. Gametogamy

ii. Gametangiogamy,

iii. Spermatization

iv. Somatogamy.

i) Gametogamy: It is the fusion (or copulation) between gametes.

- Gametes are naked wall- less sex cells which copulate to form a zygote.
- If two gametes are similar in size, they are called isogametes and their copulation is called isogamy.
- Copulation between two dissimilar gametes, one smaller (male) and the other bigger (female) is called anisogamy.
- The fusion between motile male gamete and non- motile female gamete (oosphere or egg) lying in the oogonium is called heterogamy.

ii) Gametangiogamy: It is the fusion between gametangia (or the sex organs) when gametangia are similar in shape and size, these are called isogametangia and are designatedas (+) and (-) gametangia rather than male and female.

- When the gametangia are different in shape and size, they are called heterogametangia.
- The male is usually smaller and club shaped while the female is bigger and globular.
- Fusion between two similar gametangia results in a zygote which is called a zygospore.
- The zygote formed by the fusion between morphologically distinct gametangia iscalled oospore and the process oogamy.
- The plasmogamy between them is called gametangial copulation or contact.

Gametangial copulation is of two types:

- The entire gametangia fuse, the intervening wall disappears and their contents come to lie in the common cell formed by their fusion, e.g., Mucor.
- The contents of the male gametangia migrate into the female gametangium

through a pore or fertilization tube and the male gametangium is left empty, e.g., Rhizophidium.

Gametangial contact: The male nuclei and not the cytoplasm of antheridium migrate into the oogonium through a pore dissolved at the point of contact or through a fertilization tube formed by the antheridium.

e.g. *Pythium*, *Phytophthora*, *Albugo*.

iii. Spermatization: It occurs in Ascomycota and Basidiomycota.

- Spermatia (sing. Spermatium), minute male gametes, are formed like conidia on spermatiophores.
- The spermatiophores may be formed exogenously or inside a spermogonium e.g. Puccnia.
- The spermatium when comes in contact with the female gametangium (or the receptive hyphae) releases the male nucleus into the female gametangium through a pore.

iv. Somatogamy:

In this, sex organs are not formed and somatic cells as such act as gametangia and fuse together. e.g. *Agaricus*. Somatogamy may occur between cells of the same hypha (in a homothallic fungus) or between cells of the different thalli (in a heterothallic fungus). Anastomosis, which is the fusion of hyphae is frequent in Ascomycota and Basidiomycota.

IV. Parasexual Reproduction

- The anamorphic (=imperfect) fungi lack sexual reproduction involving karyogamyand meiosis. But the genetic recombination in this case is achieved through theparasexual method.
- In this, the haploidization takes place by aberrant mitosis, whose frequency is, however, very low. It was first discovered by Pontecorvo and Roper in 1952 in *Aspergillus nidulans*.