Phylum - Zygomycota, Kingdom Fungi

Characteristics

Zygomycota, like all true fungi, produce cell walls containing chitin. They grow primarily as mycelia, or filaments of long cells called hyphae. Unlike the so-called 'higher fungi' comprising the Ascomycota and Basidiomycota which produce regularly septate mycelia, most Zygomycota form hyphae which are generally coenocytic because they lack cross walls or septa. There are, however, several exceptions and septa may form at irregular intervals throughout the older parts of the mycelium or are regularly spaced in two sister orders of Zygomycota, the Kickxellales and Harpellales.

The unique character (synapomorphy) of the Zygomycota is the zygospore. Zygospores are formed within a zygosporangium after the fusion of specialized hyphae called gametangia during the sexual cycle . single zygospore is formed per zygosporangium. Because of this one-to-one relationship, the terms are often used interchangably. The mature zygospore is often thick-walled , and undergoes an obligatory dormant period before germination. Most Zygomycota are thought to have a zygotic or haplontic life cycle (Figure 1). Thus, the only diploid phase takes place within the zygospore. Nuclei within the zygospore are believed to undergo meiosis during germination, but this has only been demonstrated genetically within the model eukaryote *Phycomyces blakesleeanus* (Eslava et al. 1975)

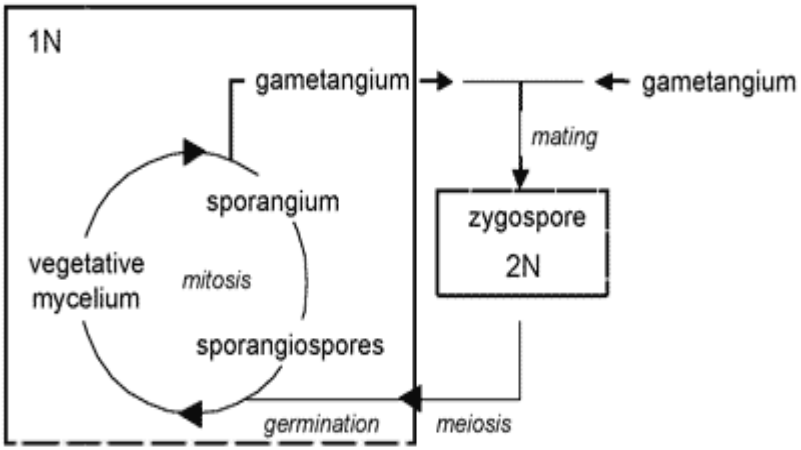


Figure 1. Generalized life cycle of Zygomycota. Asexual reproduction occurs primarily by sporangiospores produced by mitosis and cell division. The only diploid (2N) phase in the life cycle is the zygospore, produced through the conjugation of compatible gametangia during the sexual cycle

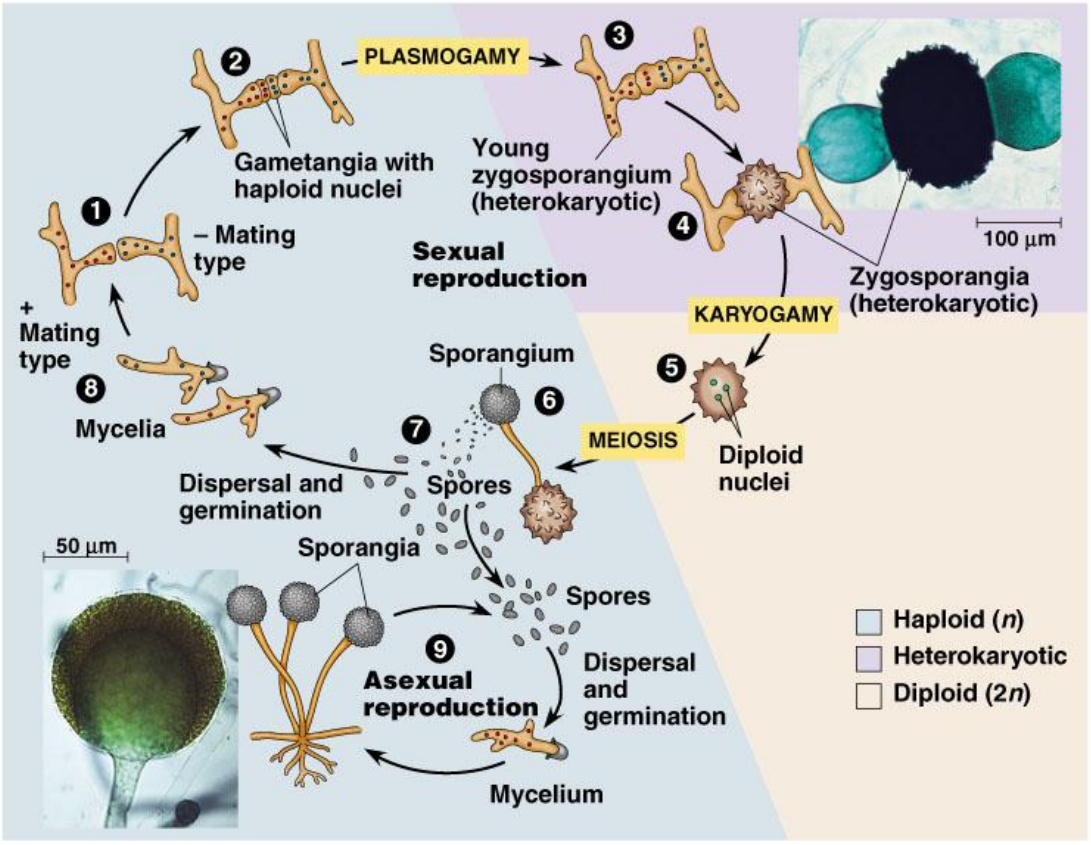
At maturity, the sporangial wall typically disintegrates or dehisces thereby freeing the spores that are usually dispersed by wind or water.

Sporangia are formed at the ends of specialized hyphae called sporangiophores. In the model organism, *Phycomyces blakesleeanus*, sporangial development has been studied extensively to understand the genetic basis for various trophisms, including the strong phototrophic responses to blue light. A unique spore dispersal strategy for the Mucorales is exhibited by the dung fungus *Pilobolus*, whose name literally means 'the hat thrower'. The entire black sporangium is explosively shot off of the top of the sporangiophore up to distances of several meters. Phototrophic growth of the sporangiophore facilitates dispersal away from the dung onto a fresh blade of grass where it may be consumed by an herbivore, thereby completing the asexual cycle after the spores pass through the digestive system.

Life cycle

- **Vegetative mycelium is haploid, reproduces asexually by producing sporangiospores in sporangia**
- **In a heterothallic species, when two compatible strains come together, hyphal branches form, enlarge to form progametangia**
- **Septa form, producing multinucleate gametangia and suspensors**

- **Plasmogamy occurs, end walls of gametangia dissolve and cytoplasm of gametangia mixes**



Zygomycota

- **Two classes:**
- **Zygomycetes – a polyphyletic class, the largest (665 spp) and best known class**
- **Trichomycetes – smaller (135 spp), less well understood, are commensals on surface and in guts of arthropods**

Class - Zygomycetes

- **Zygospore production is generally similar among species, therefore classification is based on characteristics of asexual reproductive structures**
- **Asexual reproduction is typically by production of sporangiospores, but we will see lines of evolution in which the number of spores/sporangium is reduced until there is only 1 spore/sporangium - conidium**

- **Generally divided into 7 orders, we will discuss 3**
- **Mucorales – mainly saprotrophs, many to one sporangiospore/sporangium**
- **Entomophthorales – mainly parasitic on arthropods, limited mycelium, one sporangiospore/sporangium**
- **Glomales – obligate biotrophs, form arbuscuar mycorrhizae**

- **Other orders:**
- **Kickxellales – produced septate hyphae and modified one spored sporangia**
- **Dimargaritales – mycoparasites**
- **Zoopagales – parasites of small animals (amoebae, rotifers & nematodes) and fungi including the lethal lollipop, *Zoophagus*)**
- **Endogonales – saprotrophs**

Mucorales

- **Grow saprotrophically on decaying plant and animal remains in soils, dung, etc.**
- **Produce large numbers of asexual spores that are dispersed in the air**
- **Common contaminants in laboratory**
- **Some are important in spoiling food – common bread mold, storage diseases of fruits and vegetables**
- **Typically form aseptate hyphae, septa formed to delimit reproductive structures**
- **Some species form rhizoids**

Sexual reproduction

- **Involves fusion of two multinucleate gametangia that are similar in structure, may differ in size**
- **Gametangia are produced as terminal swellings of hyphal branches**

Entomophthorales

- **Arthropod parasites, 240 spp.**
- **Asexual reproduction by one spored sporangiola (conidia)**
- **Mycelium exhibits limited growth in the body of the host, forms septa and fragments**

- ***Entomophthora*** **is a parasite of flies – seen when fly is stuck to window, white halo around it**

Entomophthora

- **Mycelium fills up body of fly, forms sporangiophores that extend out of segments of abdomen**
- **Sporangiophore builds up pressure, shoots off sporangiolum when there is air movement (another fly)**
- **If misses, can form another structure that shoots it off, up to 3 times**
- **Sexual reproduction not well understood, form resting spores that are similar to zygospores**

Entomophthorales

Basidiobolus

- **Another fungus that forcibly ejects its sporangiolum**
- **Grows on a variety of substrates including frog and beetle dung**
- **Sporangiola may be eaten by beetles, which may then be eaten by frog and then grows in dung**

Glomales

- **Obligate biotrophs**
- **Biotrophic in the roots of higher plants, form arbuscular mycorrhizae**
- **Now placed in a separate phylum by some – the Glomeromycota**
- **Form large spores in soil – zygospores, azygospores, and chlamydospores depending on species**
- **A zygospores**
- **Chlamydospores**

Trichomycetes

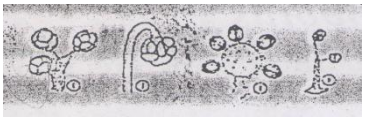
- **Second class in Zygomycota**
- **Small class, contains 3 orders**
- **All but a few species are obligate commensals in guts or on exoskeleton of arthropods**
- **Found in freshwater (mayfly, stonefly, midges) and terrestrial (millipedes)**
- **Thallus is relatively simple – produce a holdfast that anchors**

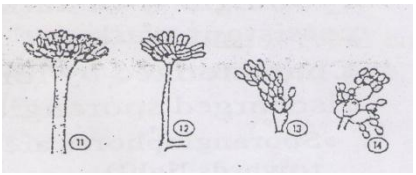
them to lining of gut

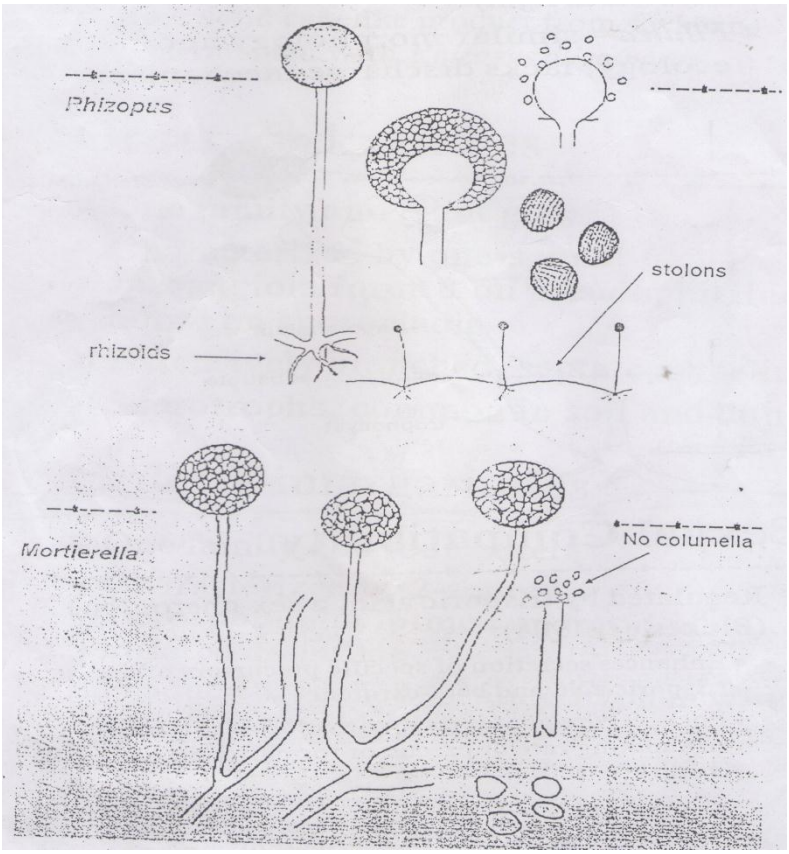
- **Thallus may be unbranched and aseptate or branched and septate**
- **Variety of asexual spores produced (generally 1 spore/sporangium)**
- **Sexual reproduction involves formation of zygospores (in one order)**
- **Fusion of cells in thallus**
- **Formation of zygosporophore and then zygospore**

Sporangiolum

- **Sporangium**
- **Containing 1-50 Spores**
- **Merosporangium is a Sporangiolum with spoes in linear series**







Pilobolus

-common fungus sporulation on dung

-sporangia with dark, thick, persistent wall