

## **Reproduction in fungi**

- Reproduction may be define as a process in which individual species increase their number by producing the progeny.
- Fungi are achlorophyllas, heterotrophic eukaryotic thallophytes, which adopted the various methods of reproduction.
- When the fungal mycelium has reached a certain stage of maturity and has accumulated reserve food material, it start reproduction.
- Reproduction involves the production of new individuals resembling the parent or parents.
- In fungi, reproduction is of three kinds;
  - Vegetative reproduction
  - Asexual reproduction
  - Sexual reproduction

<b>Vegetative Reproduction</b>	<b>Asexual Reproduction</b>	<b>Sexual Reproduction</b>
1. Fission 2. Budding 3. Fragmentation 4. Sclerotia 5. Rhizomorphs	1. Endogenous Spores 2. Exogenous Spores	1. Planogametic Copulation 2. Gametangial Contact 3. Gametangial Copulation 4. Spermatization: 5. Somatogamy

### **Vegetative reproduction in Fungi**

Vegetative reproduction is any form of reproduction occurring in plants in which a new plant grows from a fragment of the parent plant or a specialized reproductive structure. Fission, budding and fragmentation are most common methods of vegetative reproduction in a number of fungi. In addition to above-mentioned common methods they also reproduced vegetatively by other means, such as sclerotia, rhizomorphs, etc.

**1. Fission:** Some single-celled fungi, reproduce by simple cell division, or fission, in which one cell undergoes nuclear division and splits into two daughter cells; after some growth, these cells divide, and eventually a population of cells forms.

#### **Process of Fission:**

- In binary fission a mature cell elongates and its nucleus divides into two nuclei.
- The daughter nuclei separates, cleaves cytoplasm centripetally in the middle till it divides parent protoplasm into two daughter protoplasm.
- A double cross wall is deposited in the middle to form two daughter cell.

- Ultimately the middle layer of double cross wall degenerates and daughter cells are separated.

Examples: *Saccharomyces*, *Psygosaccharomyces*

**2. Budding:** It is another method of vegetative reproduction, occurs in most yeasts and in some filamentous fungi. In this process, a bud develops on the surface of either the yeast cell or the hypha, with the cytoplasm of the bud being continuous with that of the parent cell. The nucleus of the parent cell then divides; one of the daughter nuclei migrates into the bud, and the other remains in the parent cell. The parent cell is capable of producing many buds over its surface by continuous synthesis of cytoplasm and repeated nuclear divisions. After a bud develops to a certain point and even before it is severed from the parent cell, it is itself capable of budding by the same process. In this way, a chain of cells may be produced. Eventually, the individual buds pinch off the parent cell and become individual yeast cells.

**Process of budding:**

- The cell wall bulge out and softens in the area probably by certain enzymes brought by vesicles.
- The protoplasm also bulge out in this region as small protuberance.
- The parent nucleus also divides into two, one of the daughter nucleus migrates into bud, the cytoplasm of bud and mother remain continuous for some time
- As the bud enlarges, a septum is laid down at the joining of bud with mother cell. Then bud separates and leads independent life.
- Some time, bud starts reproducing while still attached with mother cell. This gives branching appearance.
- Budding is the typical reproductive characteristics of Ascomycetes.

Examples: Yeast

**3. Fragmentation:** In filamentous fungi the mycelium may fragment into a number of segments, each of which is capable of growing into a new individual. In the laboratory, fungi are commonly propagated on a layer of solid nutrient agar inoculated either with spores or with fragments of mycelium.

**4. Sclerotia:** The sclerotia are resistant and perennating bodies. They survive for many years. Each sclerotium is cushion-like structure of compact mycelium. They give rise to new mycelia on the approach of favourable conditions.

**5. Rhizomorphs:** A modified mycelium, the rope-like rhizomorphs are also resistant to unfavourable conditions and give rise to new mycelia even after several years on the approach of favourable conditions.

### **Asexual reproduction in Fungi**

Typically in asexual reproduction, a single individual gives rise to a genetic duplicate of the progenitor without a genetic contribution from another individual. Perhaps the simplest method of reproduction of fungi. The majority reproduce asexually by the formation of spores. Spores that are produced asexually are often termed mitospores, and such spores are produced in a variety of ways. The spores are of diverse type and borne upon special structures called the sporophores. These spores are produced asexually and called the asexual spores. Usually the spores are uninucleate and nonmotile but multinucleate and motile spores are also found. The fungus producing more than one type of spores is called the pleomorphic or polymorphic. The spores produced inside the sporangia are termed the endogenous spores and the spores developing exogenously on the terminal ends of sporophores are called the exogenous spores.

#### **Endogenous spores:**

- The endogenous spores are produced within the special spore producing cell the sporangium.
- The sporangia may be terminal or intercalary in their position. The sporophores which bear the sporangia on their apices are called the sporangiophores. They may be branched or unbranched.
- The spores produced inside the sporangia are called the endospores or endogenous spores produced inside the sporangia are called the endospores or endogenous spores.
- They may be motile or non-motile. The motile spores are called the zoospores and the nonmotile aplanospores. The zoospores are produced inside the zoosporangia.
- The protoplasm of the sporangium divides into uninucleate or multinucleate protoplasmic bits and each bit metamorphoses into a spore.
- The endogenously produced zoospores are uni or biflagellate. Each spore is without any cell wall, uninucleate and vacuolate. They can move with the help of their flagella.
- They are usually kidney-shaped or reniform and the flagella are inserted posteriorly or laterally on them. Such zoospores have been recorded from Albugo, Pythium, Phytophthora and many other lower fungi.
- The aplanospores are non-motile, without flagella and formed inside the sporangia. They may be uni or multinucleate (e. g., Mucor, Rhizopus).

- These spores lack vacuoles and possess two layered cell walls.
- The outer thick layer is epispore or exospore which may be ornamented in many cases. The inner thin layer is endospore.

#### **Exogenous spores:**

- The spores producing externally or exogenously are either called the exogenous spores or conidia. They are produced externally on the branched or unbranched conidiophores.
- The conidiophores may be septate or aseptate. The conidia borne upon the terminal apices of the conidiophores or the ends of the branches of the conidiophores.
- The conidia may be produced singly on each sterigma or in chains.
- The conidial chains may be basipetal to acropetal in succession. The conidia are diverse in their shape and size.
- They may be unicellular or multicellular, uninucleate or multinucleate. Different genera may be recognized only by the presence of various shaped and various coloured conidia.
- The conidia of Fungi Imperfecti are multicellular and variously shaped, whereas the conidia of *Aspergillus* and *Penicillium* are smoky green coloured and the fungi are called 'the blue-green molds.
- In other type of exospores, the sporophores develop in groups and form the specialized structure called the pustules, pycnia, aecidia, acervuli, and sporodochia.
- The pycnia are flask-shaped producing pycniospores in them.
- The acervuli are saucer- shaped widely open bodies having developed conidia in them on small conidiophores.
- In mushrooms the sporophores are compactly arranged and form an umbrella-like fructification.
- The terminal expanded portion bears gills.
- In each gill there are hundreds of sporophores called the basidia bearing basidiospores.
- The sporophores (basidia) are arranged in hymenia.

#### **Some Examples of Asexual Spores**

✓ **Sporangiospore:** These asexual spore are produced in a sac like structure called sporangia.

- Sporangium are produced at the end of special aerial hyphae called sporangiophore.
- Sporangium contains large numbers of haploid spores, which are released by rupture of sporangial wall. Examples: *Rhizopus*

✓ **Conidiospore:** Conidiospore or conidia are single celled, bicelled or multicelled structure born on the tip or side of aerial hyphal structure called conidiophore

- Conidia are different from sporangiospore as these are not produced inside sporangium or any sac like structure.

- Conidia are born singly or in chain. Examples: *Penicillium*, *Apergillus*

✓ **Arthrospore:** It is primitive type of spore formed by the breaking up of fungal mycelium.

- A spore is formed by separation followed by fragmentation of hyphae. Examples:

*Trichosporium*, *Geotrichum*, *Coccidioides immitis*

✓ **Chlamydospore:** These are usually formed during unfavorable condition and are thick walled single celled spore, which are highly resistant to adverse condition.

- Hyphal cell or portion of hyphae contracts, loses water, round up and develops into thick walled chlamydospore.

- When favorable condition returns, each chlamydospore give rise to a new individual fungi.

Examples: ascomycetes, basidiomycetes, zygomycetes, *Histoplasma capsulatum*,

✓ **Blastospore:** It is a budding spores usually formed at the terminal end of hyphae.

- These spore may remain attached to hyphae and bud further to give branching chain of blastospores. Examples: ascomycetes, basidiomycetes, zygomycetes