Lecture 2: Importance of Fungi

1. Fungi are the agents responsible for much of the **disintegration of organic matter** and such they affect us directly by destroying food, fabrics, leather and other consumer goods manufactured from materials subject to fungal attack; they cause majority of known plant disease, and many diseases of animals and humans.
2. They are the basis of a number of **industrial processes** involving **fermentation**, such as making of bread, wines, beers, the fermentation of cacao bean and the preparation of certain cheeses.
3. **Production of many organic acids** of some drugs such as ergotamine and cortisone and some **vitamin** preparations and are responsible for manufacture of a number of **antibiotics**, notably penicillin and grisofulvin.
4. Many fungi are particularly important in the **decomposition of plant debris** because of their ability to utilize cellulose.
5. Some of them are good for human consumer such as *Agaricus bisporus*-**edible mushroom**-.
6. Use it as important **research tools** in cytologists, Geneticists, and Biochemists such as *Neurospora*.

Living mode of fungi

In nature fungi obtain their food either by infecting living organisms as **parasites** or by attacking dead organic matter as **saprobes**, many also form symbiotic relationships with plants as in Lichens and mycorrhiza (**Ecto and Endotrophic**).

Fungi that live on dead matter and incapable of infecting living organisms are called (**obligate saprobes**); those capable of causing disease or of living on dead organic matter (**facultative parasites** (or) **facultative saprobes**); and those that can't live except on living protoplasm, (**obligate parasites**). A living organism infected by parasite is known as the **host**.

Cultivation of fungi:

Fungi which we can cultivated them on nutrient media are (**saprobes and facultative parasites**), and those fungi cultivate on different culture media such as:

1. **Natural media**: They are plant extract such as wheat extract, potato extract, carrot and others vegetable extract, also we can use fruit to prepare this kind of media.
2. **Synthetic media:** The main compositions of this medium are certain chemicals and some salts such as Czapek`s Dox Medium.
3. **Semi synthetic media**: they are mixed of two kinds of media (natural and synthetic) such as Potato Dextrose Media.

These three types of culture media are liquid so we can solidify them by adding **(1.5 – 2.0 %)** agar.

What are the important elements for fungal growth?

1. **Carbon sources:** (carbohydrates) such as monosugar (glucose and fructose) or di sugar such as sucrose and maltose and multisugar such as starch.
2. **Nitrogen sources:**
   A. **Organic source**: such as amino acids and peptone.
   B. **In organic source**: such as nitrate and ammonia.
3. **Salts** are added according to fungi requirements.
   A. Macro elements: which add in large quantities such as Na, Mg, k, Zn.
   B. Micro elements: which add in trace quantities such as Sc, Mn.

Environmental conditions suitable for fungi cultivation

1. Temperature: fungi are living in wide range of temperature and according to it, fungi classified in to:

A. Mesophilic fungi: The range is **(10 – 40 °C)** and the optimum is **(25 – 35° C)**

B. Psychrophilic fungi: The range is **(5 – 25°C)** and the optimum is **(15 °C)**

C. Thermophilic fungi: The range is **(20 – 50°C)** and the optimum is **(40°C)**

2- **Hydrogen Ion concentration (pH)** (as mention before).

4. **Aeration**: All fungi prefer living in aerobic condition.
5. **Light**: is not necessary for fungal growth but it is (some time) important to form sexual and asexual structures.
6. **Humidity:**

A) Some fungi are **water mold**.

B) Some fungi need **some water** for growth.

C) Some fungi are capable to growth in near-**dry condition**.

Reproduction:

Reproduction is the formation of new individuals having all the typical characteristics of the species. Two general types of reproduction are recognized: **Sexual and Asexual**.

Asexual reproduction sometimes called **somatic or vegetative**, does not involve the union of nuclei sex cells or sex organs. Sexual reproduction on the other hand, is characterized by union of two nuclei.

In the formation of reproductive organs, either sexual or asexual, the entire thallus may be converted into one or more reproductive structure, so that somatic and reproductive phases do not occur together in the same individual, fungi that follow this pattern are called (**Holocarpic**). In the majority of fungi, however the reproductive organs arise from only a portion of the thallus, while the remainder continuous its normal somatic activities, the fungi in this category are called (**Eucarpic**).

Asexual Reproduction

In general, asexual reproduction is more important for the propagation of the species **because** it results in **the production of numerous individuals**, and particularly since the **asexual cycle is usually repeated several times during the season**, whereas the sexual stage of many fungi is produced **only once a year.**

The **Asexual Methods** of reproduction commonly found in fungi may be summarized as follows: -

1. **Fragmentation**: Each fragment growing into a new individual. Some fungi employ fragmentation of hyphae as a normal means of propagation. The hyphae may break up into their component cells that behave as spore. These spores are known as **arthrospores**. If the cells become enveloped in a thick wall before they separate from each other or from another hyphal cell, they are often called **chlamydospores** Figure 5.

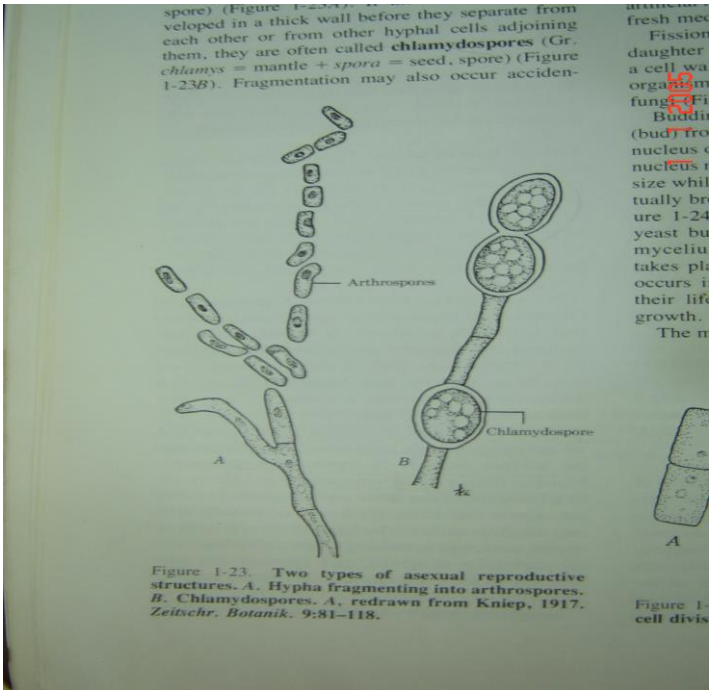


Figure 1-23. Two types of asexual reproductive structures. *A*. Hypha fragmenting into arthrospores. *B*. Chlamydospores. *A*, redrawn from Kniep, 1917. *Zeitschr. Botanik*. 9:81–118.

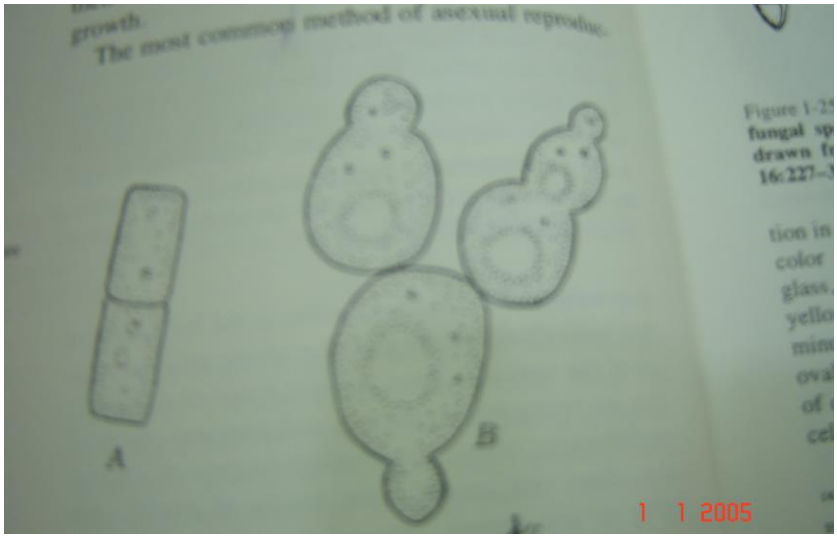
Fragmentation may also occur accidentally by the tearing off of parts of the mycelium through **external forces**. Such pits of mycelium under favorable conditions will start a new employ mycelia fragmentation to keep fungal cultures growing on artificial media by transferring a bit of mycelium to fresh media and thus starting a new colony.

2. **Simple fission of somatic cells into daughter cells**

   Fission, the simple splitting of a cell into two daughter cells by constriction and formation of a cell wall, is characteristic of a number of simple organisms including some yeast.

3. **Budding of somatic cell or spores**

   Each bud producing a new individual. As the bud is formed, the nucleus of parent cell divides and one daughter nucleus migrates into the bud. The bud increases in size while still attached to the parent cell and eventually breaks off and form a new individual Figure 6.



4. **Spore formation**

   The most common method of asexual reproduction in fungi is by means of spores. Spores vary in **color** from hyaline through green, yellow, orange, red, brown to black; in **size** from minute to large; in **shape** from globose through oval, oblong, needle-shape to helical; in **number of cells**, from one to many; in the **arrangement of cells**; and in **the way** in which the spores them-self is **borne** Figure7.

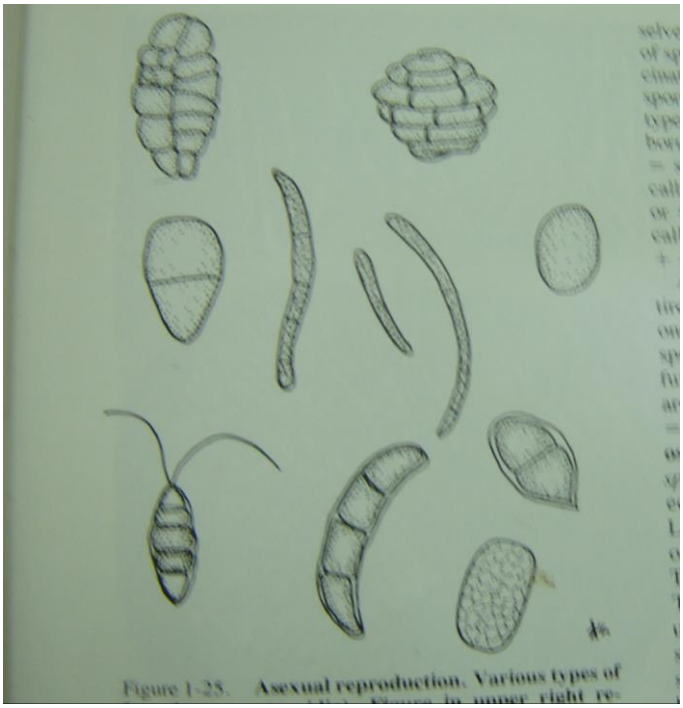
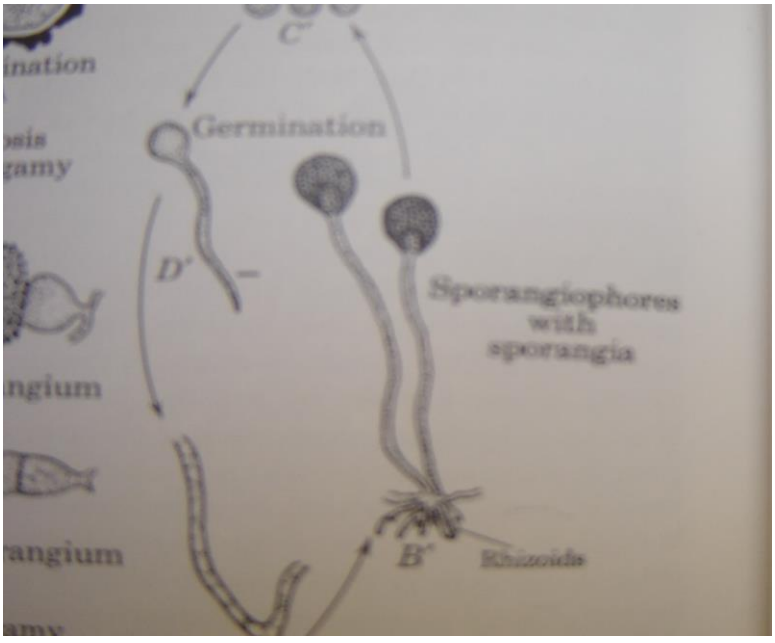
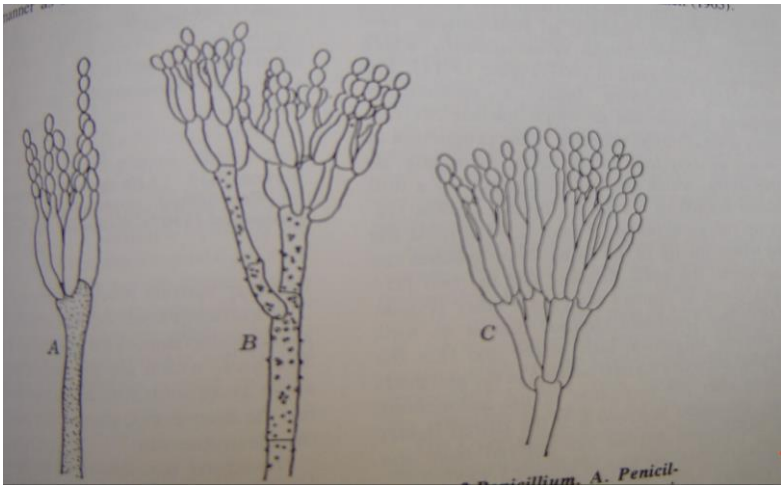


Figure 1-25. Asexual reproduction. Various types of

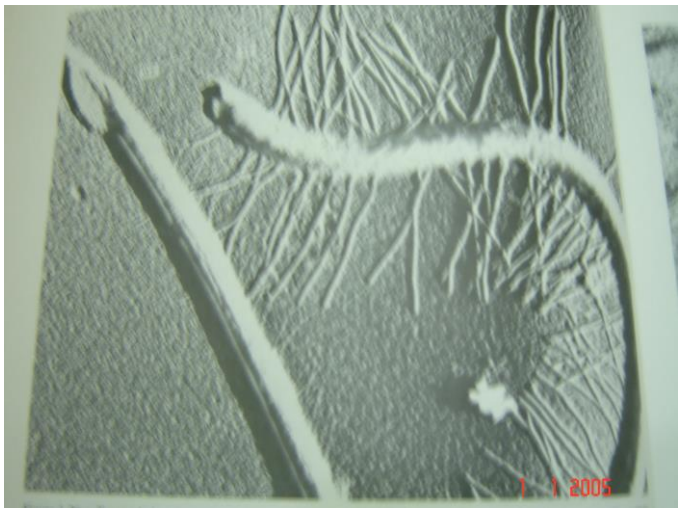
Some fungi produce only one type of spore, whereas other produces as many as four types.

Fungal spores produced asexually are either **borne in sporangia** (sporangium) and then are called **sporangiospores**, or are produced at the **tips or sides of hyphae** in various way and are then called **conidia** (conidium) Figure 8.





Sporangiospores may be **motile** or **non-motile**. In simpler fungi the sporangiospores are usually **motile** and are called (**zoospores**), if **non- motile** are called **aplanospores.** Fungal zoospores are equipped with one or two flagella (flagellum). There are at least two types of flagella in the fungi: The **whiplash** and **tinsel.** The flagella in fungi are differ in position, types, and number Figure 9.



Sexual Reproduction

Sexual reproduction in fungi as in other living organisms involves the **union of two compatible nuclei**. The process of sexual reproduction typically consists of **three distinct phases**

1) **Plasmogamy**: a union of two protoplasts brings the nuclei close together within the same cell.
2) **Karyogamy**: The fusion of the two nuclei brought together by plasmogamy.
3) **Meiosis**: The reduction of chromosomes number to the half.

Karyogamy follows plasmogamy almost immediately in many of the simpler fungi. In the more complex fungi, however, those two processes are separated in time and space, with plasmogamy resulting in a binucleate cell containing one nucleus from each parent. Such pair of nuclei we call a **(Dikaryon)**.

The **sex organs** of fungi are called **gametangia** (gametangium), these may form differentiated sex cell called **gametes** or may contain instead one or more gamete nuclei. We use the terms **(isogametangia and isogametes)** to designated gametangia and gametes that are **morphologically indistinguishable**; we use **(heterogametangia and heterogametes)** to designate male and female gametangium and gamete that are **morphologically different**, in the later case, the male gametangium is called the (**antheridium**) and the female is called the (**Oogonium**).

What is the third phase of sexual reproduction?

We now list the various **methods by which compatible nuclei are brought together in the process of plasmogamy**. These methods are often referred to as **methods of sexual reproduction**. Fungi employ five general methods to bring compatible nuclei together for fusion. These methods are:

1- **Planogametic copulation.**
2- **Gametangial contact.**
3- **Gametangial copulation.**
4- **Spermatization.**
5- **Somatogamy**.

Sexual compatibility: Those in which every thallus is **sexually self-fertile** and, can therefore, reproduce sexually by it self without the aid of anther thallus, this type of fungi we called **(Homothallic fungi).** Those in which every thallus is **sexually self-sterile**, and requires the aid of anther compatible thallus or a different mating type for sexual reproduction, these types of fungi called (**Heterothallic fungi**).