Lecture 11 & 12

Division 2: Eumycota

Class 6: Basidiomycetes

General characteristics

1- Basidiomycetes consist of form people call mushroom. Some basidiomycetes are saprobes, other are parasites which causes smut and rust diseases.

2- They produce their spores, called basidiospores on the outside of a specialized, spore-produced structure, the basidium.

3- The mycelium of most basidiomycetes passes through three distinct stages before the fungus completes its life cycle:

= The primary mycelium (1n):- Usually develops from the germination of a basidiospore. It is septate and uninucleate from the beginning. It gives rise to;-

= Secondary mycelium: Usually involves an interaction between two compatible mycelia (n+n) (Dikaryon).

There are no sexual organs in class basidiomycetes, so the sexual reproduction occurs by spermatization or somatogami.

Basidiomycetes characterized by presence of clamp connections, that are formed during nuclear division when the binucleate cell is ready to dived, a short-branch arises between the two nuclei (a) and (b) and begins to form a hook. The nuclei now divide. One division becomes oriented obliquely, so that one daughter nucleus (b) forms in the clamp connection and the other (b□) forms in the dividing cell. The second division orients it self along the long axis of the dividing cell, so that one daughter nucleus (a) forms near one end of the cell and the other (a□) approaches the nucleus (b□) of the first division near the other end of the

cell. In the meantime, the clamp has bent over, and its free end has fused with the cell, so that the clamp forms a bridge through which one of the daughter nuclei (b) passes to other end of the cell and approaches one of the daughter nuclei (a) of the other division. A septum forms to close the clamp at the point of its origin and another septum forms vertically under the bridge to divide the parent cell into two daughter cells with (a) and (b) nuclei in one daughter cell and (a□) and (b□) in the other as shown in the diagrams below Figure 39.

= Tertiary mycelium: is represented by organized specialized tissues that compose the basidiocarps of the more complex basidiomycetes.

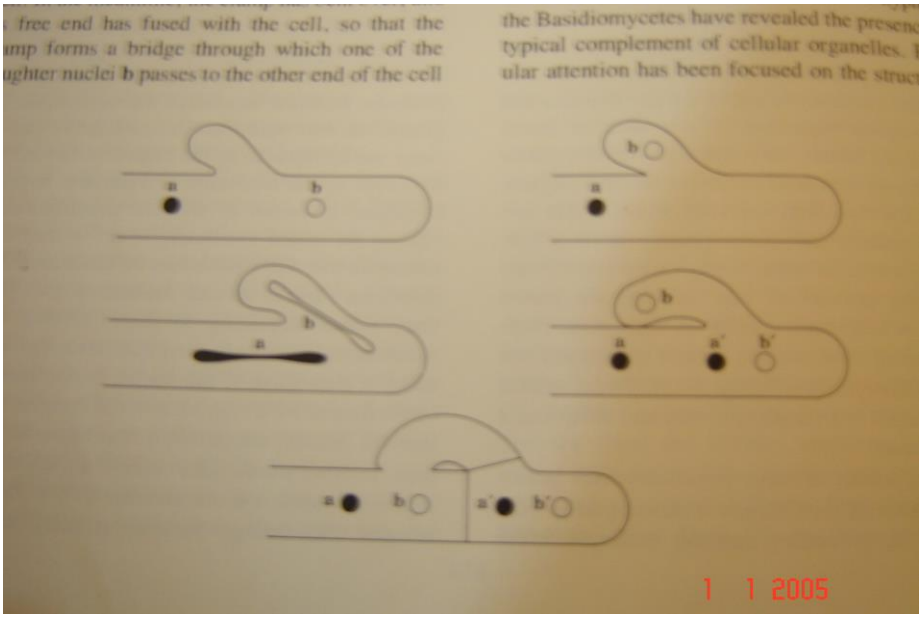


Figure 39: Diagram shows the formation of clamp connection in Basidiomycetes.

Asexual reproduction:

It does not important in this class, and it occurs either by budding or fragmentation.

The basidiocarps:- The more complex basidiomycetes produce their basidia in highly organized fruiting bodies of various types. In a basidiocarp the hymenium is a layer composed of basidia as well as any other sterile elements such as cystidium Figure 40.

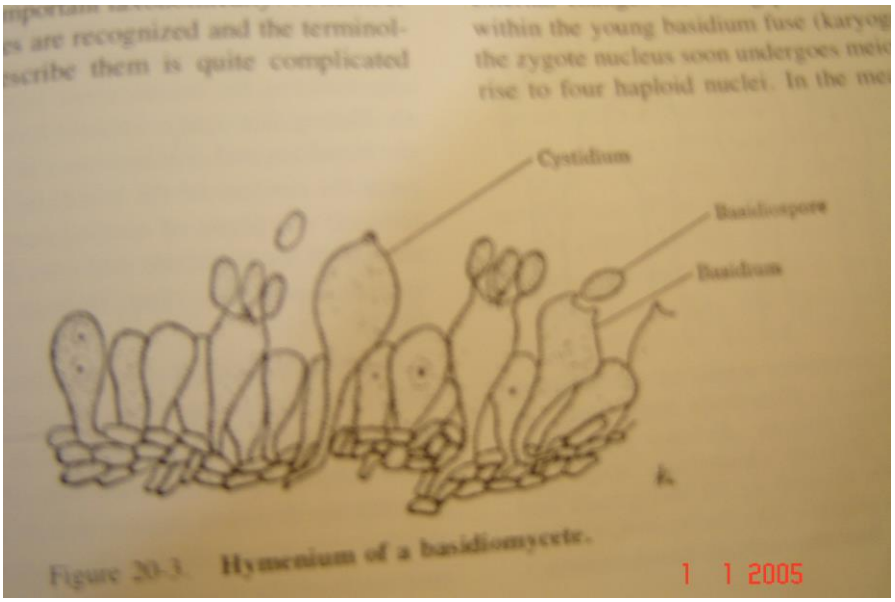


Figure 40: Hymenium of basidiomycetes

The basidium:

The basidium may be defined as a structure bearing on its surface a definite number of basidiospores (usually four) that are typically formed as a result of karyogamy and meiosis. There are two types of basidium:

1-A simple club-shaped basidium originated as a terminal cell of a

binucleate hypha and is separated from the rest of the hypha by a septum over which a clamp connection is generally found (Holobasidium) Figure 41 A.

2- Phragmobasidium: Divided into four cells by transverse or longitudinal primary septa Figure 41D&E.

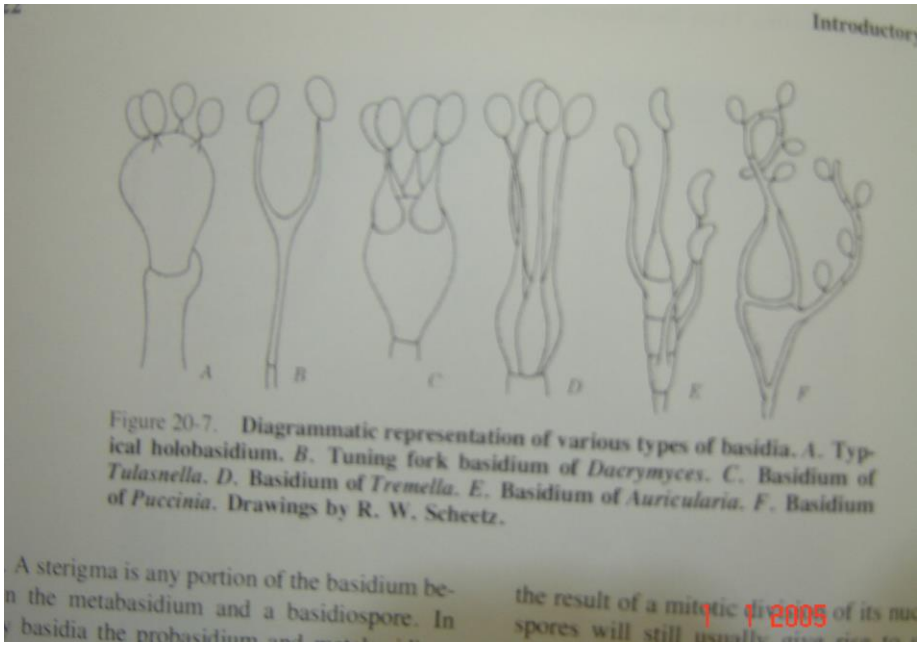


Figure 41: Types of basidium A- Holobasidium D&E-Phragmobasidium

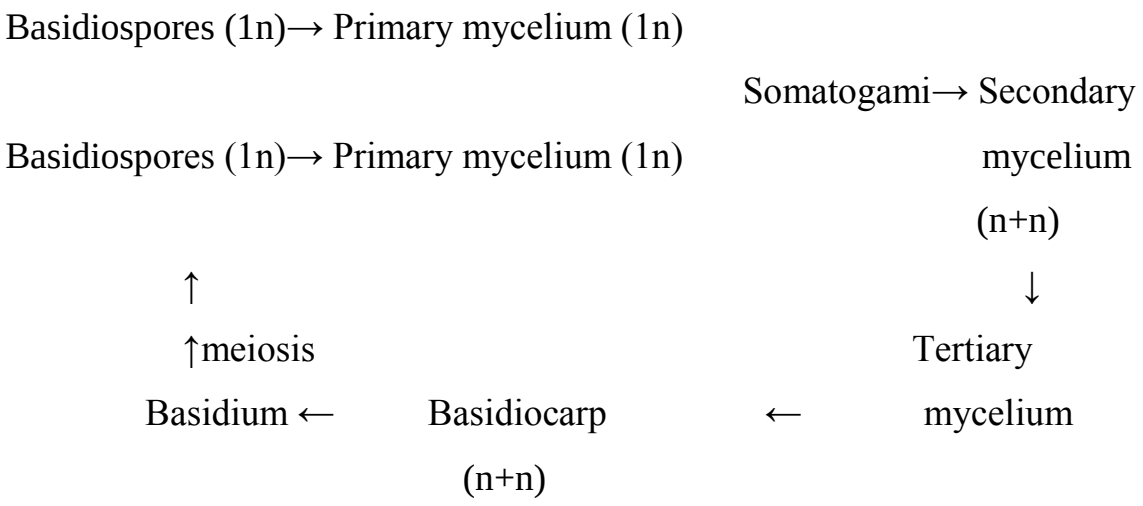


Diagram shows the life cycle of bsasidiomycetes

Classification of class basdiomycetes:

Subclass 1: Heterobasidiomycetidae

General characteristics:

1- There is no basidiocarp.

2- Basidium septate by transverse septa.

3- Parasitic fungi.

It involves two orders:-

Order 1: Uredinales (Rust fungi).

Order 2: Ustilaginales (Smut fungi).

Order 1: Uredinales (Rust fungi):-

This order involves fungi which economically important causes rust diseases. These fungi are obligate parasites on cereals crops causing black stem-rust. There are no basidiocarps but these fungi contain many spore stages which forming within pustules. The mycelium presence

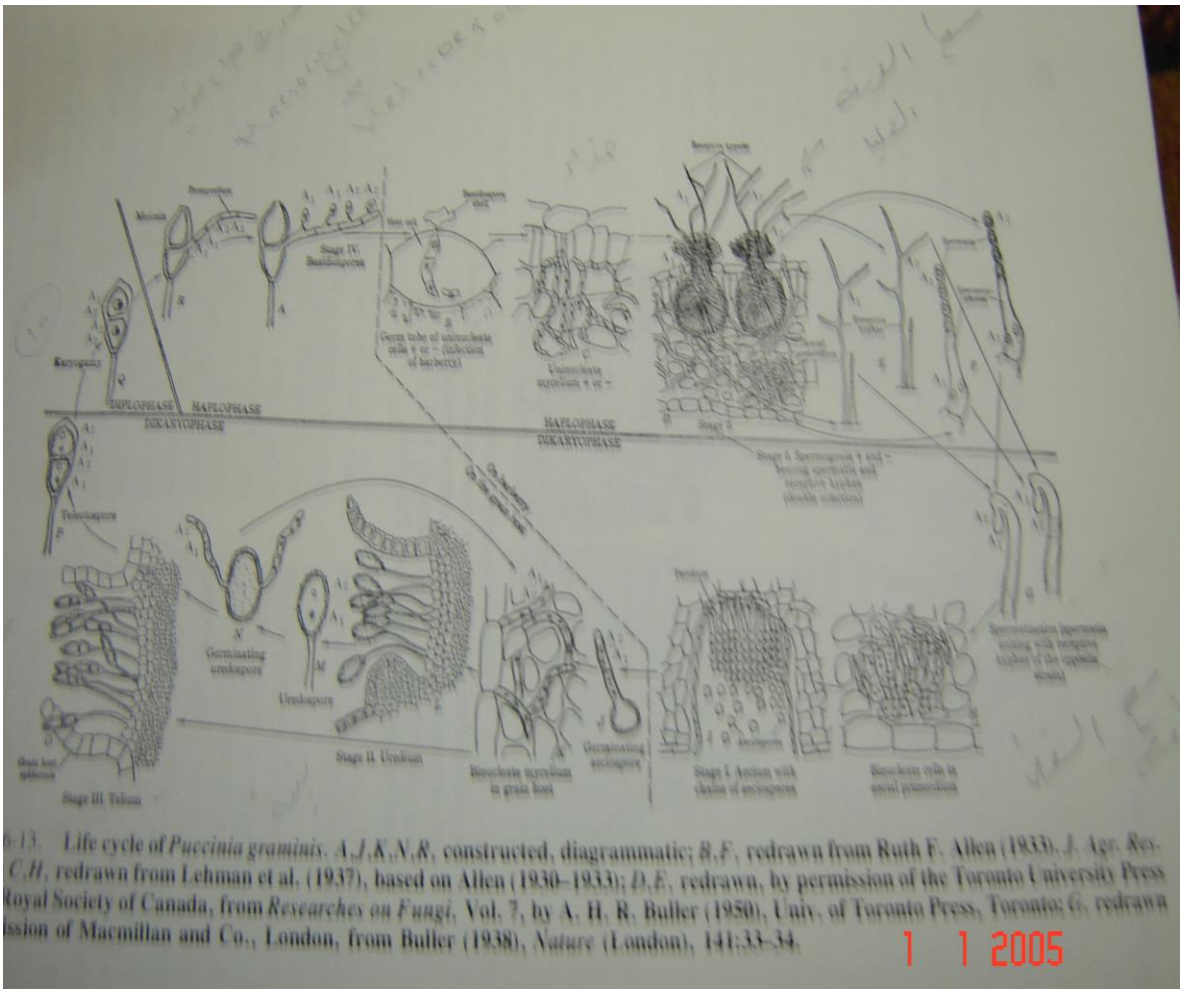
between host cells and send haustoriun. The fungi which have five types of spore stages called macrocyclic rust which needed either one host (autoecious rust) or two hosts that called (heteroecious rust), the life cycle of these fungi is long. Those which have short life cycle are called (microcyclic rust). The example of macrocyclic but autoecious is *Melanposora lini* which causes flax rust. And macrocyclic heteroecious rust is *Puccinia graminis* which causes black rust on gramineae.

Life cycle of *Puccinia graminis* :-

The two-celled teliospores (p) that produce in midsummer on the leaves and stems of wheat remain dormant until the following spring, passing the winter on the stubble in the fields. Over wintering takes place in the uninucleate, diploid stage after karyogamy has occurred. Early in the spring, each cell of the teliospore germinates and produces a promycelium (R) into which the diploid nucleus migrates, undergoes meiosis, and form four haploid nuclei. Septa are then laid down separating the nuclei from one another into four cells. Each cell of the promycelium produces a sterigma on which a minute basidiospore is formed. Two of the basidiospores are of one strain and two are of other (A). The basidiospores are carried away by the wind and then germinated producing germ tubes on barberry (B), with their germ tubes penetrating into the tissues of barberry through haustoria. Thus, a well-developed, branched, monokaryotic mycelium develops; its nuclei carry the factor (A1 or A2) that the parent basidiospore happens to carry (C). A few days after infection, the hyphae of the fungus nearest the upper epidermis of the host develop. Spermogonia -in the manner already described- that open to the surface of the leaf (D). Each spermogonium contains

numerous spermatiophores that cut off a succession of minute spermatia (F). Several periphyses are also formed in the upper part of the spermogonium. Each spermatium contains a large nucleus carrying the A1 or A2 factor, depending on the strain of mycelium that produced the spermogonium. The same mycelium that produces the spermatia also gives rise to receptive hyphae with the same genetic makeup as the spermatia. These arise in the spermogonia and protrude through the ostioles (E). If (A1) spermatia thus happen to be transferred to (A2) receptive hypha or (A2) spermatia to (A1) receptive hyphae, spermatization is effected and the spermatial contents pass into the receptive hyphae by a pore dissolved in the walls at the point of contact (G). Meanwhile the mycelium has penetrated the entire leaf, and the hyphae near the lower epidermis have formed a number of aecial primordia (H). The aeciosporese that first binucleate spores produced in life history of the fungus. The aeciospore chains eventually break through the lower epidermis of barberry, permitting the spores to escap (I). The aeciospores are now disseminated by the wind and germinate (J). If germination occurs on a susceptible grass host, infection results and binucleate mycelium develops (K). Soon after infection, the binucleate mycelium in the grass host begins to form masses of cells – the uridinia- from which binucleate urediniospores are arise on rather long stalks. The urediniospores are oval, yellowish and spiny. The pressure from the developing spores causes a break in the host epidermis and an elongated streak-like rust-red pustule develops (L). The urediniospores upon germination produce binucleate mycelium (N) that grows between the cells of the grass plant and in a few days produces new uredinia and a new crop of urediniospores. This repeating cycle of *Puccinia graminis*

recurs several times in the spring and summer. About the time the grain is ripening, the uredinia begin producing a few teliospores and a fewer uridiniospores are produced until finally only teliospores are formed (O). The pustules that produce teliospores are known as telia and constitute the black stage of the rust. The uredinia thus gradually change into telia Figure 42.



Life cycle of *Puccinia graminis*. *A,J,K,N,S*, constructed, diagrammatic; *B,F*, redrawn from Ruth F. Allen (1933), *J. Agr. Res. C,H*, redrawn from Lehman et al. (1937), based on Allen (1930–1933); *D,E*, redrawn, by permission of the Toronto University Press Royal Society of Canada, from *Researches on Fungi*, Vol. 7, by A. H. R. Buller (1950), Univ. of Toronto Press, Toronto; *G*, redrawn ission of Macmillan and Co., London, from Buller (1938), *Nature* (London), 141:33–34.

Figure 42: Life cycle of *Puccinia graminis*

Order 2: Ustilaginales (Smut fungi)

Ustilaginales are obligate parasites fungi on Angiosperms such as wheat. The smuts are so called because they form black, dusty spores masses that resemble soot or smut. The teliospores (chlamydospores) are binucleate which have external wall (exine) and internal wall (intine) and dikaryon. When teliospore germinates it give rise promycelium which bearing basidiospores (sessile). Basidiospores can be budding in asexual reproduction, and some of smut fungi do not obligate parasites so we can cultivate it in laboratory. The sexual reproduction occurs by somatogami.

This order is divided into two families:

Family 1: Ustilaginaceae: The promycelium is transversely septate, with lateral and terminal basidiospores Figure 43A.

Ustilago nuda causes loss smut on wheat.

Ustilago hordei causes covered smut on wheat

Tolyposporium eherenbergi causes long smut on sorghum.

Family 2: Tilletiaceae: The promycelium is aseptate and only terminal basidiospores are produced Figure 43B.

Tilletia caries causes stinking smut on wheat.

Tilletia foetidae causes stinking smut on wheat.

Urocystis agropyri causes flag smut on wheat

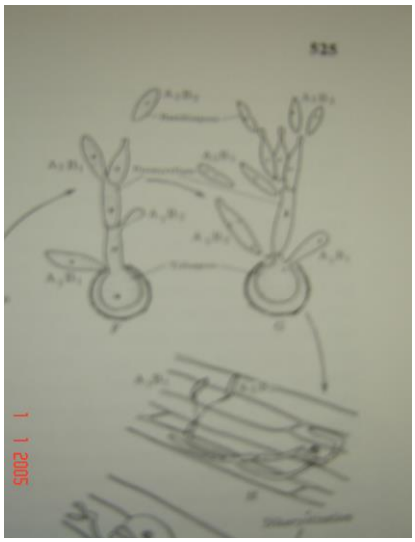


Figure 43 A

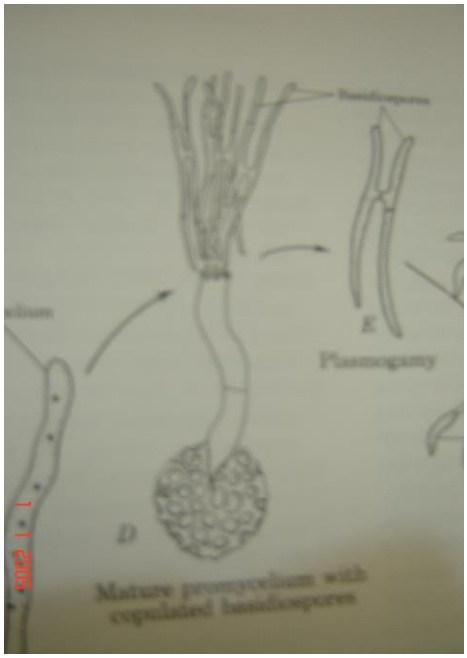


Figure 43 B