Phylum Basidiomycota

An introduction to Basidiomycetes

The fungi comprising the phylum Basidiomycota commonly are known as Basidiomycetes. Basidiomycetes are large and diverse group of fungi include; mushrooms like boletes, puffballs, earthstars, stinkhorns, bird's nest fungi, jelly fungi, bracket or shelf fungi, and rust and smut fungi.

Basidiomycetes are characterised by their sexual spores, known as basidiospores. Basidiospores are produced on a specialized spore producing structures i.e. basidia. The basidiospores of most basidiomycetes are ballistospores and are discharged forcibly from their basidia by means of an elongate discharge mechanism. Basidiospores are formed after, plasmogamy karyogamy and meiosis.

occurance and importance:-

The most important group of plant disease i.e. rusts and smuts are caused by basidiomycetes. The other basidiomycetes cause forest and shade trees diseases, example Armillaria spp. on beneficial side, these fungi form the mycorrhizal relationship with the roots of forest trees. many basidiomycetes include important mushrooms which are commonly grown in Asia, Europe, and United states, Basidiomycetes are also known for the production of a wide variety of interesting secondary products like scents, tastes, colours and toxic properties.

Somatic structures :-

Basidiomycetes have well-developed septate hyphae that grow through the substrate and absorb nourishment. The mycelium is usually white, bright yellow, or orange and often spreads out in a fan-shaped growing front. However, the somatic mycelia of some species tend to exist as rhizomorphs. Rhizomorph consists of a number of hyphae lying parallel to one another and sometimes enveloped in a sheath or cortex. Rhizomorphs are produced by many ectomycorrhizal species and by various wood rotters and are important not only in the spread of certain species but also in exploration activities and nutrient accumulation. Usually the rhizomorphs are 4-5 mm in diameter. Rhizomorphs are most common in the soil organic horizons and in litter layers. Mycelium of most heterothallic basidiomycetes passes through three distinct stages of development. The primary mycelium or homokaryon, as it is sometimes called to emphasize the fact that all the nuclei are identical, usually develops after the germination of basidiospore. Mycelial compartments or nuclei of the basidiospore deviding many times as the germ tube emerges from the spore and begins to grow. However, such multinucleate phase of primary mycelium remains for shorter duration, and soon become uninucleate after division.

Although the primary mycelium in most basidiomycetes appears capable of indefinite growth, it characteristically gives rise to the so called secondary mycelium or heterokaryon. As most basidiomycetes are heterothallic, the formation of secondary mycelium usually involves an interaction between two compatible homokaryotic mycelia. After compatibility of two homokaryotic mycelia binucleate cell is established. From this cell the secondary mycelium or dikaryon in this case, is formed apparently one of two fashions. In the first, binucleate cell produces a branch into which a nuclear pair migrates; the two nuclei devide conjugately and the sister nuclei separate as the branch is devided into two cells by the formation of septs. After that, extensive mycelia is formed which are ~~heterokaryotic~~ dikaryotic. In second method, nuclei devide into binucleate cell followed by migration of daughter nuclei into primary mycelia of opposite mating type. In other words, an "a" nucleus mores into the "b" mycelium while "b" nucleus moves into the "a" mycelium. The foriegn nucleus in each mycelium then devides rapidly and its progeny migrates from cell to cell untill both parent mycelia have been completely dikaryotized. Septa of the homokaryon usually must be degraded to allow nuclei

to pass.

An interesting mechanism found in many basidiomycetes operates to ensure the maintenance of the dikaryotic condition in each new cell or compartment of the secondary mycelium. This mechanism involves special structures known as clamp connections. These clamp connections are formed during the conjugate division of the nuclei in the tip of growing hyphe. When the binucleate hyphal tip is ready to devide, a short branch - the clamp connection arise between two nuclei i.e. "a" and "b" and begins to form a hook. The nuclei now devide simultaneously. Division occurs in such a way that one daughter nucleus i.e. "b" forms in the clamp connections and the other "b" forms in the deviding cell. The division of second nucleus occurs in such a way that one daughter nucleus "a" forms near one end and other "a" approaches the nucleus "b" of the best division, near the other end of the cell. In the meantime, the clamp has bent over and fused with the subterminal cell, forming a bridge through which one of the daughter "b" nuclei passes to the other end of the cell and approaches one of the daughter "a" nuclei of other division. A septum forms to close the clamp connection at the point of origin and another septum forms vertically under the bridge to devide the parent cell into two daughter cells with "a" and "b" nuclei in one daughter cell and a' and b' nuclei in other. The presence of clamp connection is an indicator

of dikaryotic condition. clamp connections are comparable with "hooks" structure of the ascogenous hyphae in Ascomycots because both structures are associated with dikaryotic phase.

On some species the septum wall simply tapers toward the central pore while in others septal wall near the pore is thickened to form a characteristic doughnut-like or barrel shaped swelling, this type of septum is called Dolipore septum and is covered by septal pore cap known as "septal pore cap". The function of dolipore septum is unclear, however, it screens or sieves cellular components from one cell to the other cell.

Tertiary mycelium of basidiomycetes is represented by the organized, specialized tisshes that comprise the basidiocarps of the more complex species. Such sprophores originate when the secondary mycelium forms complex tisshes. The hyphae making up the sprophores of some species actually may be morphologically differentiated into several types.

The Basidiocarps:-

Most basidiomycetes produce their basidia in fruiting bodies of various types called basidiocarps (Gr. basidion = small base, basidium + karpos = fruit), which are comparable to ascocarps of ascomycetes. Rust and smut fungi do not produce basidiocarps.

Basidiocarps are variable in size i.e. from microscopic to several feet in diameter and sometimes up to many pounds in weight. For example, a basidiocarp, discovered from soil was 147 cm in diameter and having weight over 5 lb. Basidiocarps may be thin and paint-to crust like, gelatinous, cartilaginous, pspecy, fleshy, spongy, corky, woody or indeed of almost any texture. Those of morphologically complex forms are probably the most familar fungal structures recognized by humans. Example include mushrooms, bracket fungi, coral fungi, puffballs, stinkhorns and bird's nest fungi. Basidiocarps may be open or closed. Basidis are formed into the basidiocarp in definit layer, this layer is called hymenial. Among the basidis sterile structures like "basidioles" and "cystidis" are present. Role of these sterile structures is to support the basidis, trapping air and evaporation of moisture and other volatile compounds.

The Basidis

A basidium may be defined as "a structure bearing on its surface a definit number of basidiospores (usually four) that are formed as a result of karyogamy and meiosis. The simple club-shaped basidium of the larger, more morphologically complex basidiomycetes may be regarded as

the characteristic form of the basidium and will be considered first. A simple club-shaped basidium originates as a terminal cell of a ~~membrane~~ binucleate hypha and is delimited from the rest of the hypha by a septum over which a clamp connection generally is found. At first, basidia is narrow and elongated, but then it enlarges and becomes broader. Then karyogamy occurs following meiosis of zygote nucleus and four haploid nuclei are formed in the young basidium. In the meantime, small out-growths pushes out from the top of basidium, these are known as sterigmata, and basidiospores initials are started to form. After that, vacuoles are formed at the base of the basidium which push the contents into the basidiospore initials. Later on, mitosis occurs in the basidiospore initials and sends one nuclei into the basidiospore forming the basidiospore uninucleate. At the end four basidiospores are formed on the basidia. However, under some cases, basidiospore number may increase or decrease from four.

Basidium is devided into three parts. These are;

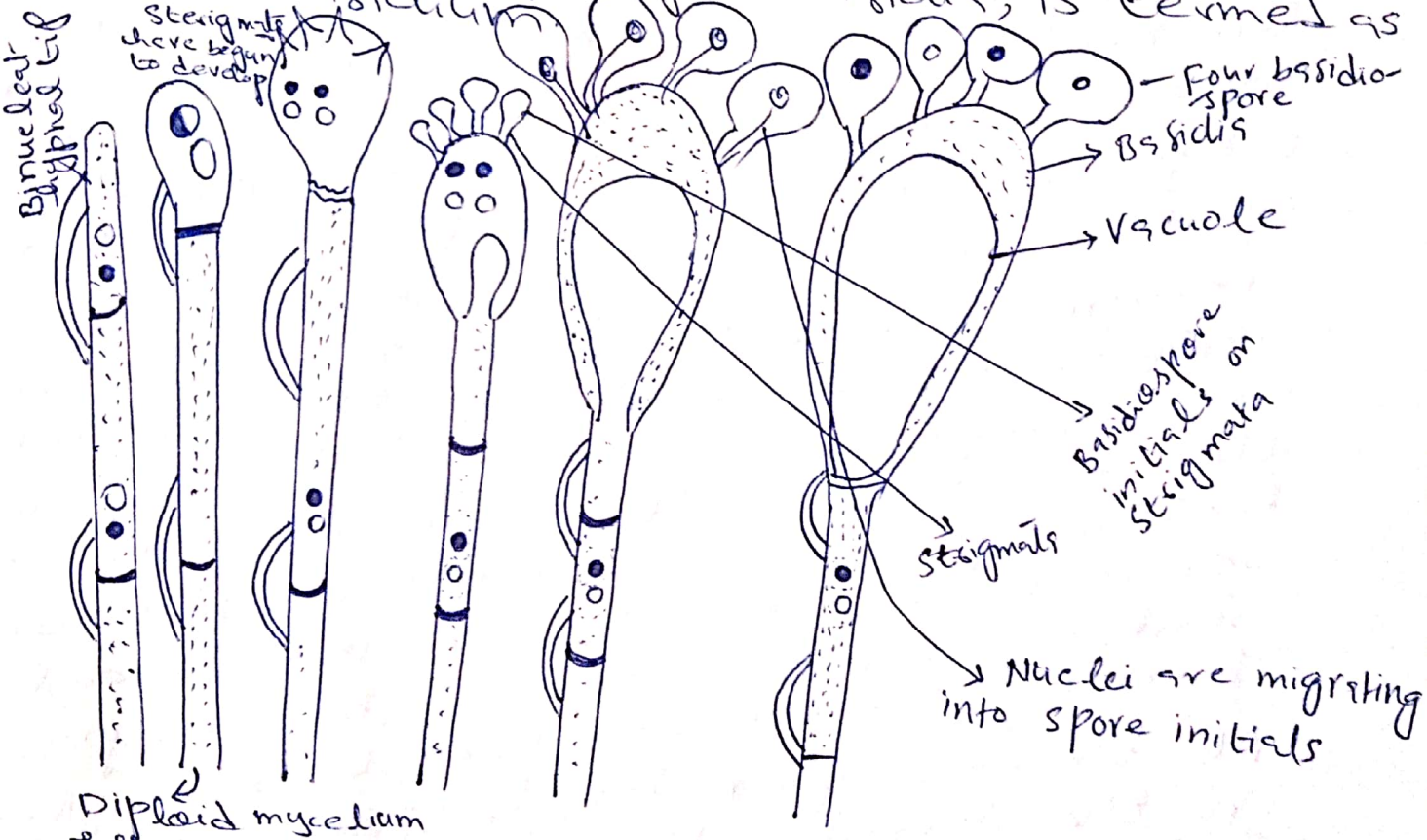
1- Probasidium:- In this portion karyogamy takes place

2- Metabasidium:- In this portion meiosis takes place

3- Sterigmata:- Any portion of basidium between

metabasidium and basidiospore

Traditionally two terms i.e holobasidia and phragmobasidia are also used. Holobasidia is single celled while phragmobasidia are typically devided into four cells. There is another term i.e. heterobasidium. A basidium is morphologically different neither single celled, club-shaped nor holobasidium and phragmobasidia, is termed as heterobasidium



Developmental Phases of basidium

The Basidiospores:-

Basidiospores are usually one celled and may be globose, oval, elongated, sausage shape, or even angular. Basidiospores germinate and form primary mycelium

This type of germination is called direct germination. However, in some cases, basidiospores germinate and form the secondary spores, buds, micro and macro-conidia which then germinate and form primary mycelium, this type of germination is called indirect germination. Basidiospores are lying on the stigmata in oblique fashion, and discharged outwhen a bubble or drop of liquid is formed at the apex of the stigmata. Basidiospores are colourless or pigmented.

Asexual Reproduction:-

Asexual reproduction in basidiomycetes takes place by budding, fragmentation, conidia, arthrospores or oidia. Hyphae of some basidiomycetes may breaks up into unicellular sections which develop into arthrospores. oidia are produced on specialized hyphae, the oidiophores, which cut off oidia in succession, form the tip of the oidiophore

Sexual Reproduction:-

Sexual reproduction in the basidiomycetes culminates in the production of a basidium bearing haploid basidiospores. karyogamy and meiosis take place in the basidium. First two compatible mycelia are brought together which fuses with each other and share their nuclei. After that karyogamy,

meiosis, and mitosis occur resulting in the formation of basidiospores. All sexual processes occur in the basidium.

Sexual Compatibility:-

Most of the species of basidiomycetes are Heterothallic-Heterothallic fungi have mating types that are determined by alleles at a single genetic locus, this type of Heterothallism is known as Unifactorial or bipolar heterothallism. Unifactorial heterothallism is found in rusts and smuts. If Heterothallism is controlled by one pair of genes that are located on different chromosomes As this type of Heterothallism is controlled by two pairs of genes, it was referred to as bifactorial or tetrapolar Heterothallism. Most of the studies regarding Heterothallism have been conducted on corn smut (Ustilago maydis), mushroom (Coprinus commune), and wood rotting species (Schizophyllum commune).

Mating and sexual development is controlled by four mating type loci on two chromosomes. Four different loci designated as Aα, AB, Bα, Bβ are involved and regulate a developmental change from non-fertile Homokaryotic mycelia to a fertile dikaryotic mycelium capable of producing highly differentiated basidiocarps. These loci are are arranged in pairs, with Aα, Aβ

being closely linked on one chromosomes and Bα and Bβ closely linked on second chromosomes. Any two homokaryons are capable of fusing, but for resulting dikaryon or secondary mycelium to be fully compatible, the fusing homokaryons must differ at the Aα and/or the Aβ and at Bα and/or Bβ loci. After the fusion of two Homokaryon, a series of events takes place. A series of events include, nuclear migration, mitotic division, dissolution and reformation of septe, and pairing of nuclei, all of which lead to the formation of a dikaryotic mycelium with hyphal tips that elongate and exhibit conjugate mitotic divisions and the formation of clamp connections. It is now discovered that "A" loci is involved in nuclear pairing, initiation of clamp connection and formation of the clamp connection cell. The conjugate nuclear division and separation of the clamp connection cell. The "B" loci is involved in nuclear migration and fusion of the tip of the clamp connection cell with hypha.

The End