

6.6.3. Differences between covered Smut and loose smut in Barley

Covered Smut	Loose Smut
(i) Pathogen: <i>Ustilago horedei</i> (ii) Symptoms - Ear emergence - In which ears seem to be normal but grains appear to be covered by a thin membrane - Grains are replaced by black mass of spores - Spores are released by rupture of membrane during threshing.	(i) Pathogen : <i>Ustilago nuda</i> (ii) Symptoms - Ear emergence - Replaced by black spore mass - Spores released as soon as the ear emerges - The bare ear rachis is seen after spore release

6.7. AGARICUS LIFE HISTORY

Systematic Position

Alexopoulos	Ainsworth	Modern System
Kingdom - Myceteae	Fungi	Kingdom - Fungi
Division - Amastigomycota	Eumycota	Subkingdom - Dikarya
Subdivision -	Basidiomycotina	Phylum - Basidiomycota
Class - Basidiomycetes	Hypomycetes	Subphylum - Agaricomycotina
Subclass - Homobasidiomycetidae	Homobasidiomycetidae	Class - Agaricomycetes
Order - Agaricales	Agaricales	Subclass - Agaricomycetidae
Family - Agaricaceae	Agaricaceae	Order - Agaricales

Agaricus species, commonly known as mushrooms, are found all over the world and include both edible and poisonous types. They are variously named in different parts of the world and also in India. There are nearly over 300 types of mushrooms found in the world. They are all saprophytes and grow on decaying organic matters. They are found on forest floors growing on the forest litter in open grass lands in rainy seasons, on rotten woods, and the base of trees, on heaps of decaying straws and heaps of field crops. They prefer moist shades and rich humus and cellulose for their growth.

Mushroom is actually the edible basidiocarp or fruiting body of this fungus *Agaricus* that projects out of the substratum or soil in different shapes and sizes. The two species of mushrooms *Agaricus bisporus* (the common button mushroom) and *Agaricus campestris* are the most common mushrooms.

The fungus is known from the ancient times. It is viewed that *Agaricus* possibly originated from ancient Sarmatia Europea where people Agari, promontory Agarium and a river Agarus were known.

BASIDIOMYCOTA

(near modern Berdiansk is Ukraine). In old literature and books the generic name *Psalliota* has been used for *Agaricus*.

6.7.1. Somatic Organization

The organization of the thallus has two parts, the vegetative mycelium and the fructification.

(a) Vegetative mycelium

- (i) It is found inside the soil. The primary mycelium develops from the basidiospores and are uninucleate (monokaryotic) and either of +ve or -ve strain type.
- (ii) The primary mycelia become converted to secondary dikaryotic hyphae through fusion of opposite strains of primary mycelia. The dikaryotization proceeds from cell to cell through clamp connections.
- (iii) The hyphae are long, slender, branched septate with dolipore septum in each cell.
- (iv) The cells are dikaryotic with nuclei of opposite strains; contain oil globules, vacuoles.
- (v) Mycelia inside soil are long living and very extensive commonly the hyphae spread to all directions from a point forming a circular network of mycelia.
- (vi) The mycelia became inter woven and twist compactly to form a thick rope like strand called **rhizomorphs**.
- (vii) This network of mycelia remains in soil for years even upto 400 years if undisturbed.
- (viii) From this circular colony and rhizomorphs fructifications develop at regular intervals in rainy season which we call mushrooms.

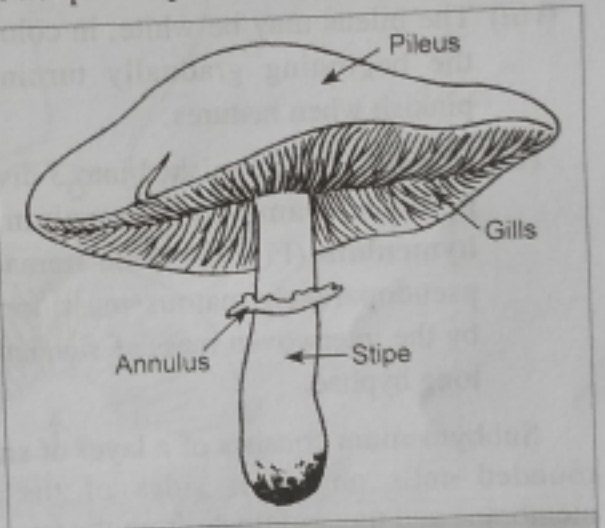


FIG. 6.12. An entire mature basidiocarp of *Agaricus*.

(b) Fructification (Fig. 6.12)

It is the aerial portion of the fungus that comes out as a cup or umbrella like structure.

- (i) The young fructification or fruiting body is small, pear-shaped or spherical bud like and is called the **button**.
- (ii) The full grown fructification is upright and consists of long stalk known as **stipe**, an upper umbrella like structure called **cap** or **pileus**.
- (iii) The stipe is a compact rope like rounded upright structure composed of twisted mycelia. It pushes the cap up.

- (iv) The cap or pileus is the expanded portion which is 6-9 cm in diameter when fully developed. In the young developing stage a whitish thin membrane called **velum** covers it. But when it grows up, the velum is ruptured and remains around the stipe as annulus.
- (v) On the lower side of the pileus a large number of thin vertical membrane like structures called **gills** run outwards in a radiating manner.
- (vi) On both surfaces of these gills thousands of basidiospores are present.
- (vii) A cross section of stipe shows two regions: Central **medulla** and outer **cortex**. The medulla contains loosely woven mycelia with air spaces and the cortex is more compact mass of mycelia.
- (viii) The pileus may be white, in colour in the beginning gradually turning to pinkish when matures.
- (ix) The gill is distinguished into 3 distinct portions: **trama**, **subhymenium** and **hymenium** (Fig. 6.13) the trama is a pseudoparenchymatous mass formed by the interwoven mass of slender and long hyphae.

Subhymenium consists of a layer of small, rounded cells on either sides of the gill membrane and they originate from the trama.

Hymenium is a layer of clavate, palisade like cells containing basidia and paraphyses on both sides of the gill membrane.

6.7.2. Reproduction

- (i) *Agaricus* species mainly reproduce by sexual reproduction which is a typical Basidiomycetes type. There are no sex organs like antheridia or oogonia.
- (ii) The species are **heterothallic**. The sexual reproduction here includes the plasmogamy, karyogamy and meiosis.
- (iii) Plasmogamy occurs inside the soil by fusion of two primary mycelia of opposite strains to form the dikaryotic mycelia.
- (iv) Dikaryotic mycelia form the network and rhizomorphs and give rise to the fruiting body (whose structure has been described already). In the fruiting body especially in the hymenium

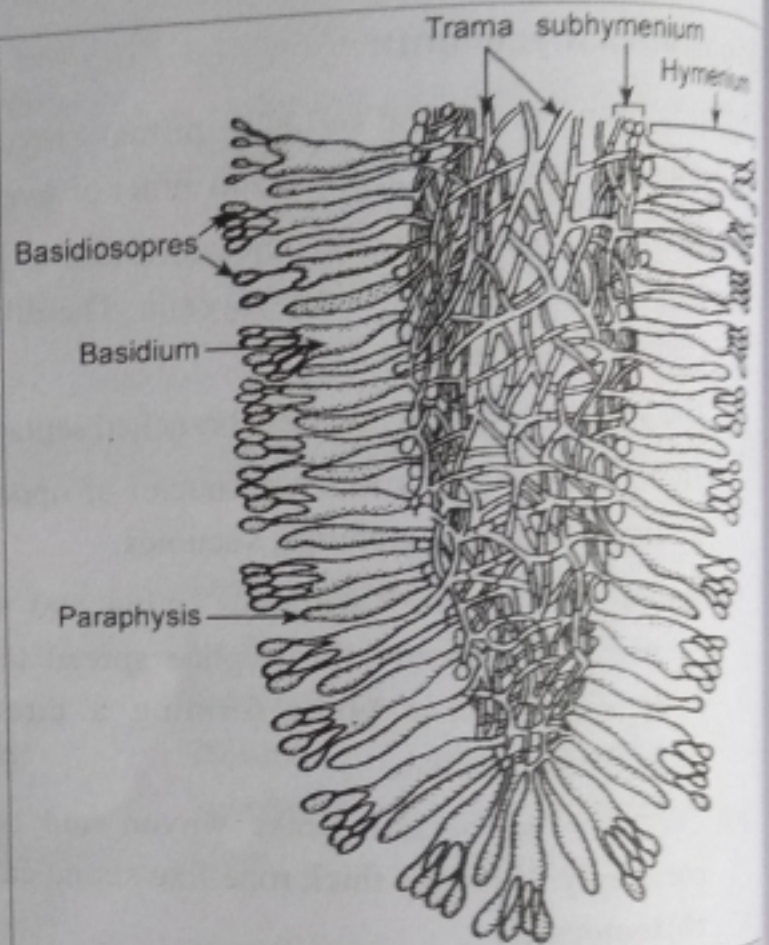


FIG. 6.13. *Agaricus*. L.S. through a gill.

layer of the gills the basidia develop where karyogamy occurs followed by meiosis and formation basidiospores.

(v) **Development of fruiting body and basidiospore** (Fig. 6.14).

Development of the basidiocarp (fruiting body) (Fig. 6.14) is **angiocarpic type**. It begins on the dikaryotic mycelium as a hyphal knot which become a button like. This is known as the **button stage** of basidiocarp.

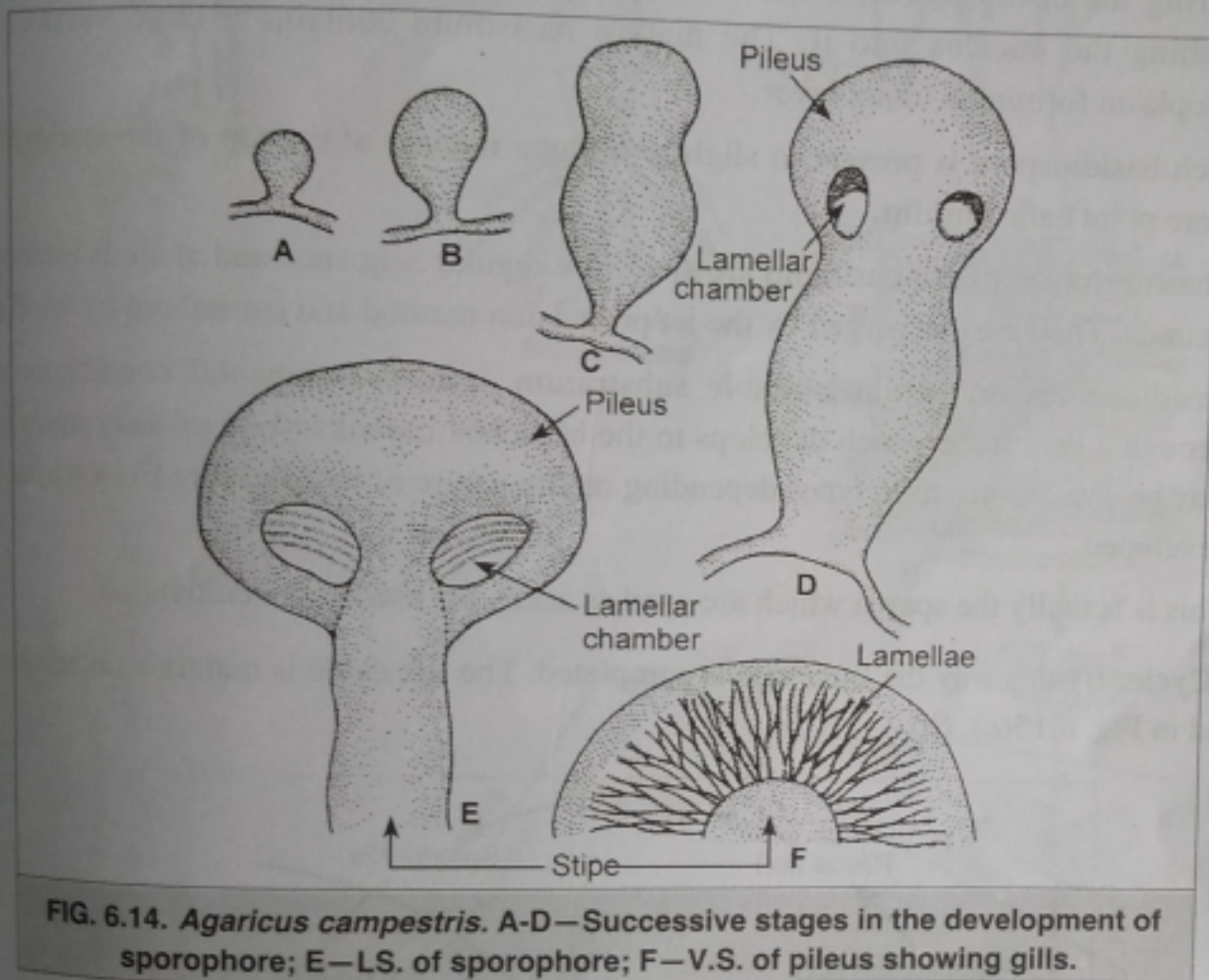


FIG. 6.14. *Agaricus campestris*. A-D—Successive stages in the development of sporophore; E—LS. of sporophore; F—V.S. of pileus showing gills.

Inside the button a dome-shaped structure is present which is surrounded by a ring like cavity called **gill chamber cavity**.

From the roof of this cavity gills are differentiated. The dome develops to the broad pileus.

The button is pushed upward by the rapid elongation of the basal hyphae forming the stipe.

The elongation of stipe pushes the pileus. The pileus grows more on the upper surface and slower on the lower surface.

In some mushrooms like *Amanita*, the button is totally covered by a membrane called **universal veil**.

(vi) **Development of basidiospores:** Basidia are developed from the hymenial hyphae on either sides of the gill membrane. The hyphae grow vertically, enlarge and cut from the hyphae by septa. This forms several basidia arranged in vertical parallel manner like the palisade cells. They are the young basidia and each of them contains two nuclei.

The karyogamy occurs in this basidium to form a $2n$ nucleus which divides immediately by meiosis to form 4 nuclei. After this, 4 slender projections develop from the terminal surface of the basidium which are the sterigmata. The 4 daughter nuclei pass into the sterigmata, one to each. Each sterigma swells at its tip to which the nucleus passes and this is cut off by a septum to form a basidiospore which is haploid.

During the development, a vacuole appears at the base of the basidium which helps in pushing the nucleus into it. The mature basidium contains a large vacuole with the cytoplasm forming a lining layer.

Each basidiospore is present in slightly oblique manner at the top of the sterigma with the spore point called **hilum**.

- (vii) 4 basidiospores of the basidium are shed in a regular sequence and at short intervals of few seconds. They are discharged by the jet propulsion method and carried out by wind currents.
- (viii) Basidiospores on getting suitable substratum and environmental conditions germinate through a germ tube which develops to the branched monokaryotic primary mycelium. They may be +ve or -ve strain types depending on the nature of basidiospore from which they have developed.

This is actually the spawn which are used as seeds for mushroom cultivation.

Life Cycle: By this way the life cycle is completed. The life cycle is mainly a dikaryotic phase. It is depicted in Fig. 6.15(a), (b).

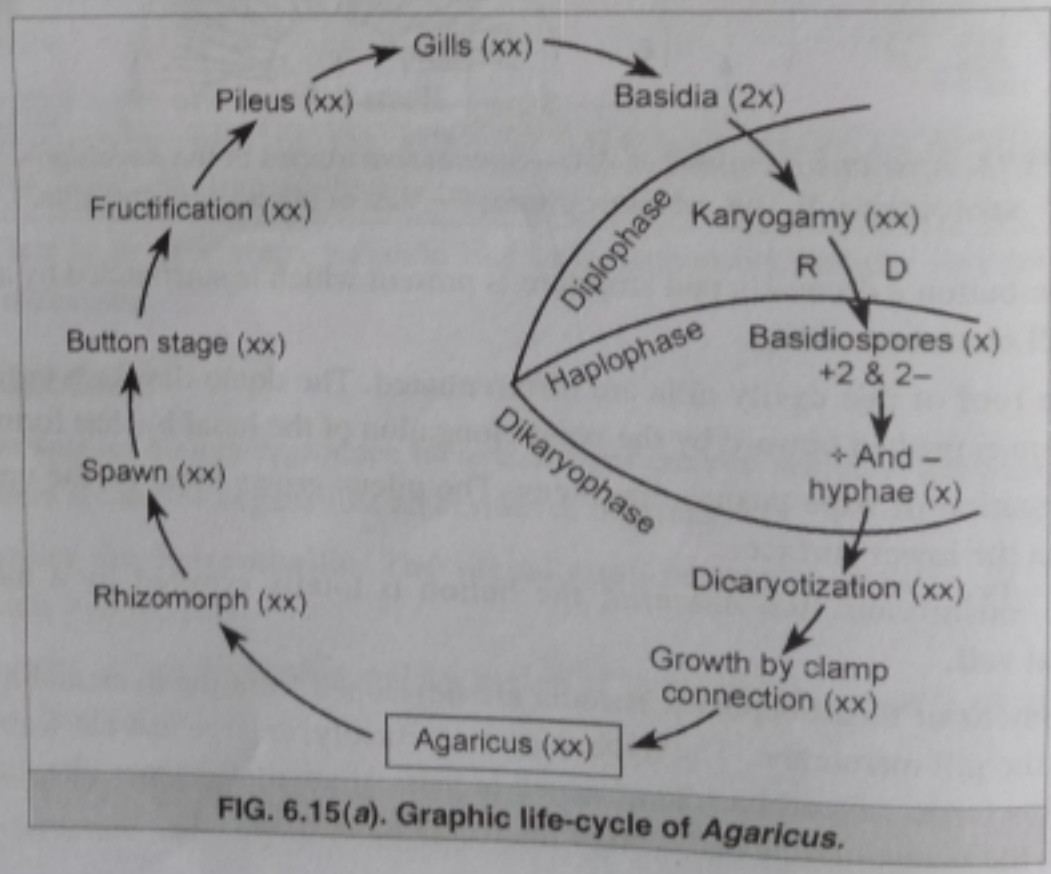


FIG. 6.15(a). Graphic life-cycle of *Agaricus*.