Course- M.Sc. Botany, Part -I ,Paper -II

Topic - Ascus development in Ascomycetes (FUNGI)

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Ascus is the sac like body formed in most members of Ascomycetes. It bears the product of sexual fusion – the diploid nucleus. The diploid nucleus undergoes meiosis and mitotic divisions to produce haploid nuclei that aggregate with the cytoplasm to form haploid ascospores. The process of ascus formation is quite uniform in all the members except such as yeasts.

Sexual contact transmits stimulus for the pairs of nuclei of opposite strains in the ascogonium to undergo conjugate divisions. Hyphal outgrowths are formed on the ascogonium known as ascogenous hyphae. These hyphae become septate soon or immediately. Each of their cells may have a pair of nuclei or not but the terminal cells of these contain two nuclei, one male and one female. The ascogenous hyphae most often become branched. The terminal cell of each branch bends and forms a hook like structure called crozier. A contrasting pair of nuclei gets positioned at the bend of each crozier. Of another pair of nuclei, one lies at the tip while the other near the basal septum of the crozier. Three cells are formed – the terminal cell that has single nucleus, the penultimate cell that has two nuclei and the antepenultimate cell that too has only one nucleus.

Karyogamy occurs in the penultimate cell. This diploid cell is the ascus mother cell. It grows and forms the sac like body. The diploid nucleus normally undergoes meiosis first followed by a mitosis. That results into eight haploid nuclei. These nuclei get surrounded by the cytoplasm to produce haploid spores known as ascospores.

In many genera, hundreds of divisions do occur to form numerous nuclei along with the ascospore nuclei. It is free cell formation.

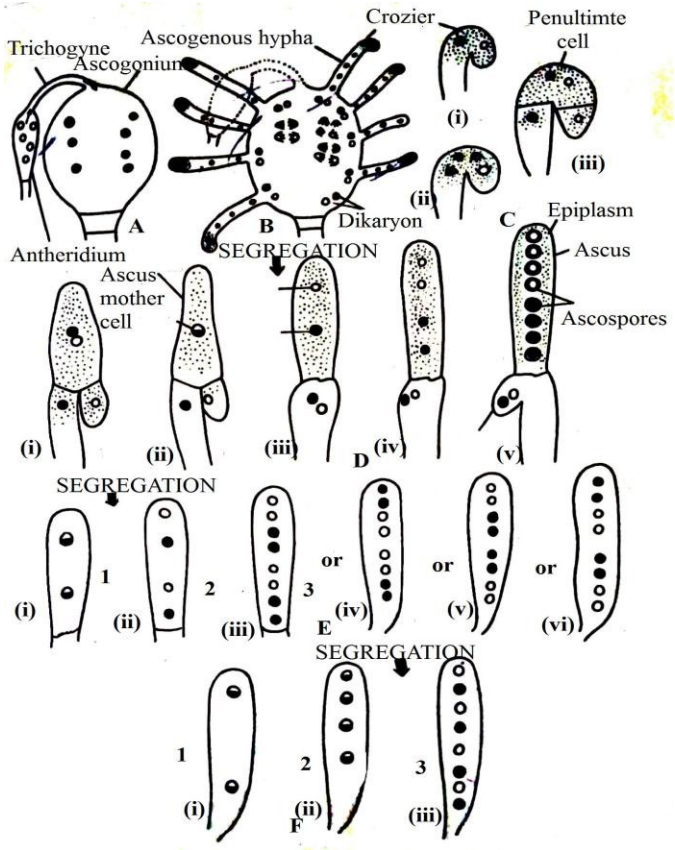
In some cases, antepenultimate and terminal cells fuse to form a new crozier.

In *Spermophthora,* a short ascogenous hypha is formed from the tip of which the ascus is developed. In *Sphaerotheca humuli,* there is development of ascogenous cell from the gametangial contact itself.

In *Pyronema confluens*, sex organs comprise an archicarp and antheridium produced side by side. The archicarp consists of a large globular cell known as

ascogonium having a receptive neck (trichogyne) at the base of which a septum is present. The antheridium is about the same length as the ascogonium but much more slender. Both ascogonium and antheridium are multinucleate as well as the trichogyne.

The trichogyne at first grows upright but later curves about and partially surrounds the top of the antheridium and its tip presses hard against the tip of the antheridium. The common walls at that point and the septum at the base of the trichogyne dissolve resulting in the formation of a continuous passage through which the contents of the antheridium pass into the ascogonium. Plasmogamy takes place in the ascogonium. The ascogonium now swells up and produces innumerable outgrowths on its surface which develop into hyphal structures and are known as ascogenous hyphae.



Typical ascus development

A. Copulation B. Development of ascogenous hyphae C. (i-iii) Ascus formation D. (i-v) Ascospore formation E. (i-vi) Variablity in ascospores' genetic arrangement due to meiosis at the second nuclear division F. (i-iii) Reduction division at the third nuclear division

Differing opinions have existed on the behaviour of the antheridial and ascogonial nuclei and with regard to the existence of the septum at the base of the trichogyne. Immediately after plasmogamy, the antheridial and ascogonial nuclei pair up within the ascogonium resulting in the formation of dikaryons. The dikaryons then pass into the ascogenous hyphae .

Opinions differ here too. Debatable point is whether they fuse in the ascogonium or merely pass in pairs in the ascogenous hyphae.

The ascogenous hyphae arising from the ascogonium are aseptate when young and subsequently become septate so that cells neighbouring the ascogonium bearing many nuclei and distant cells have only two niclei.

In *Dipodascus, Eremascus, Schizosaccharomyces*, and *Saccharomyces*, the zygotic cell directly develops into an ascus.

In *Taphrina deformans,* the dikaryotic cells of the mycelium behave as ascogenous cells.

Many other genera differ from the typical ascus development process.

In *Geopyxis catinus*, ascus development is not preceded by hook formation. The terminal cell of the ascogenous hypha is uninucleate, but the subterminal cell is binucleate. The binucleate subterminal cell grows out laterally to form an ascus mother cell. It directly develops into an ascus. In *Plicaria succosa*, the ascogenous hyphae are terminated by binucleate cells. They directly take part in the development of the asci. In *Pustularia vesiculosa*. there is development of crozier, but the loop cell of the crozier instead of developing into an ascus grows further to form a hypha. The terminal cell of this hypha develops into an ascus.

In several genera, asci are developed from all the binucleate cells of the ascogenous hyphae producing a chain of asci.

In the Laboulbeniales, dikaryotic condition is achieved by the process of spermatization. The female reproductive organ itself develops into an ascogenous cell and ascogenous hyphae are absent. The ascogenous cell directly develops into an ascus.