

Fig. 1 A-F. Modifications of hyphal structures: A-B. Rhizomorph; C-D. Sclerotia; E. Appressorium; F. Haustorium.

Sphacelotheca, *Tolyposporium*) can also grow on the dead organic material in the absence of living host and then they are known as facultative saprophytes.

(b) **Saprophytes.** These fungi obtain their nutrition from the dead decaying organic matter. Some saprophytes, such as *Mucor mucedo*, can obtain their nutrition only from the dead organic material and they do not have the capacity to infect living plants or animals. They are known as obligate saprophytes. On the other hand, those saprophytic fungi (e.g., *Fusarium*, *Pythium*) which have the capacity to infect living organisms, are known as facultative parasites.

(c) **Symbionts.** Some fungi grow on other living organisms and both are mutually benefited. Such an association is known as symbiosis. Lichens and mycorrhiza are common examples of symbionts.

- (13) In most of the fungi only a part of the vegetative mycelium forms reproductive unit and the rest remains vegetative. Such fungi are known as **eucarpic**. However, in unicellular fungi whole vegetative cell is transformed into a reproductive unit, and as such they are known as **holocarpic**.
- (14) They reproduce by vegetative, asexual and sexual means.
- (15) The vegetative reproduction may take place by fragmentation (e.g., *Rhizopus*, *Mucor*, *Aspergillus*, *Alternaria*), fission (e.g., yeast) and budding (e.g., yeast, *Ustilago*).
- (16) About 20% fungi propagate only by asexual means. Asexual reproduction takes place during favourable conditions by the formation of a variety of conidia or spores. The spores may be unicellular (e.g., *Aspergillus*, *Penicillium*) or multicellular (e.g., *Alternaria*, *Cercospora*). They may be endogenous, when

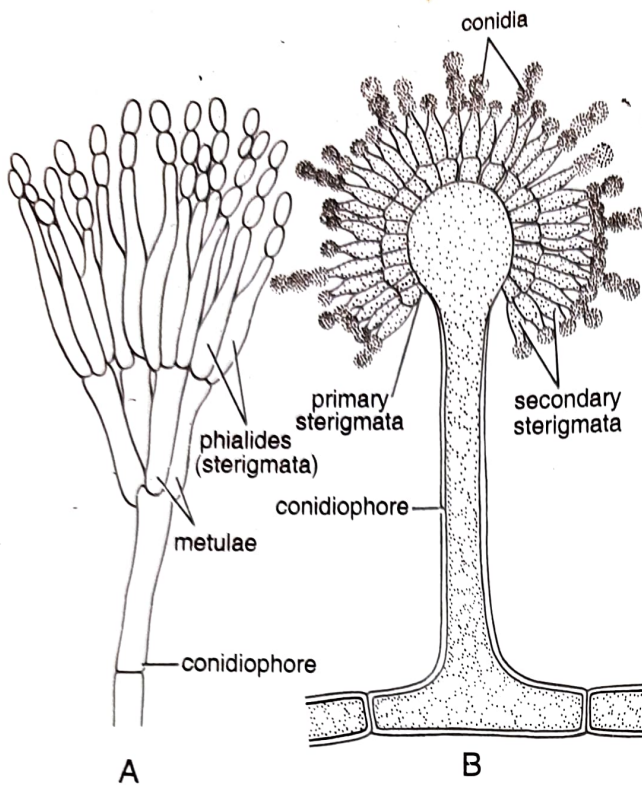


Fig. 2 A-B. Asexual reproduction by conidia formation: A. In *Penicillium*, B. In *Aspergillus*.

developed in pycnidia or sporangia (e.g., *Mucor*, *Rhizopus*), or exogenous, when developed on sporophores or conidiophores (e.g., *Aspergillus*, *Penicillium*) (Fig. 2A,B).

(17) Some common asexual spores in fungi are zoospores (e.g., *Achlya*, *Pythium*, *Phytophthora*), chlamydozoospores (e.g., *Ustilago*), oidia (e.g., *Collybia*, *Coprinus*) and aplanospores (e.g., *Mucor*, *Rhizopus*, *Pilobolus*) (Fig. 3A,B).

(18) With the exception of the class Deuteromycetes, sexual reproduction occurs in all the groups of fungi. The process of sexual reproduction is completed in the following three distinct phases:

(a) **Plasmogamy**. In the first step fusion of the protoplasts of two compatible gametes or sex cells takes place, and the two compatible nuclei come close to each other.

(b) **Karyogamy**. In the second step, fusion of the two nuclei from the two fusing gametes takes place and a diploid zygotic nucleus is formed. In Phycomycetes

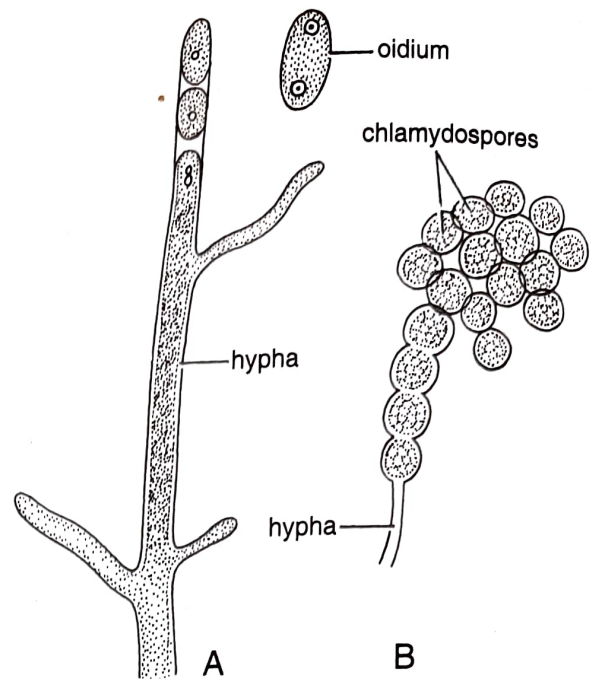


Fig. 3 A-B. Asexual reproduction: A. Oidia formation; B. Chlamydozoospore formation.

karyogamy occurs just after plasmogamy, but in Ascomycetes and Basidiomycetes karyogamy is much delayed. In the latter groups, the nuclei of the opposite strains get themselves arranged in pairs (**dikaryon**). This phase in the life cycle is known as **dikaryophase** and the process by which this stage is accomplished is called **dikaryotization**. The two nuclei of a dikaryon fuse to form a diploid nucleus.

(c) **Meiosis**. After karyogamy, reduction division takes place in the diploid nucleus, and haploid stage is reestablished.

(19) The compatible nuclei are brought together by the following sexual processes:

(a) **Planogametic copulation**. This involves fusion of two naked motile gametes (**planogametes**). The planogametic copulation is of three types, depending on the nature and structure of the fusing gametes.

(i) **Isogamy**. The fusing gametes are morphologically similar but physiologically different, and are formed on different hyphae (e.g., *Synchytrium*, *Catenaria*) (Fig. 4A).

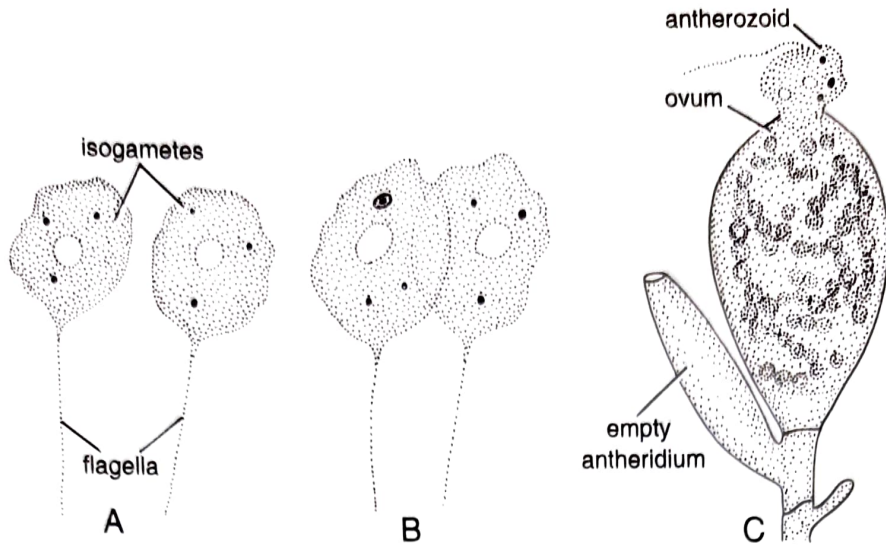


Fig. 4 A-C. Planogametic copulation: A. Isogamy; B. Anisogamy; C. Oogamy.

- (ii) **Anisogamy.** The fusing gametes are both morphologically and physiologically different; the male gamete is smaller and more active than the female gamete (e.g., *Allomyces*) (Fig. 4B).
- (iii) **Oogamy.** The female gamete (ovum) is non-motile and the male gamete (antherozoid) is motile; they are formed in specialised gametangia, known as oogonium and antheridium respectively (Fig. 4C).
- (b) **Gametangial contact.** Here gametes are never released from gametangia, instead

the male and female gametangia come in close contact with the help of a fertilization tube. Then one or more male nuclei migrate to the female gametangium. The gametangia never fuse or lose their identity during the sexual act. The male and female gametangia are known as antheridium and oogonium (ascogonium in Ascomycetes) respectively. *Albugo*, *Aspergillus*, *Pythium* and *Phytophthora* are some common examples of gametangial contact (Fig. 5A-B).

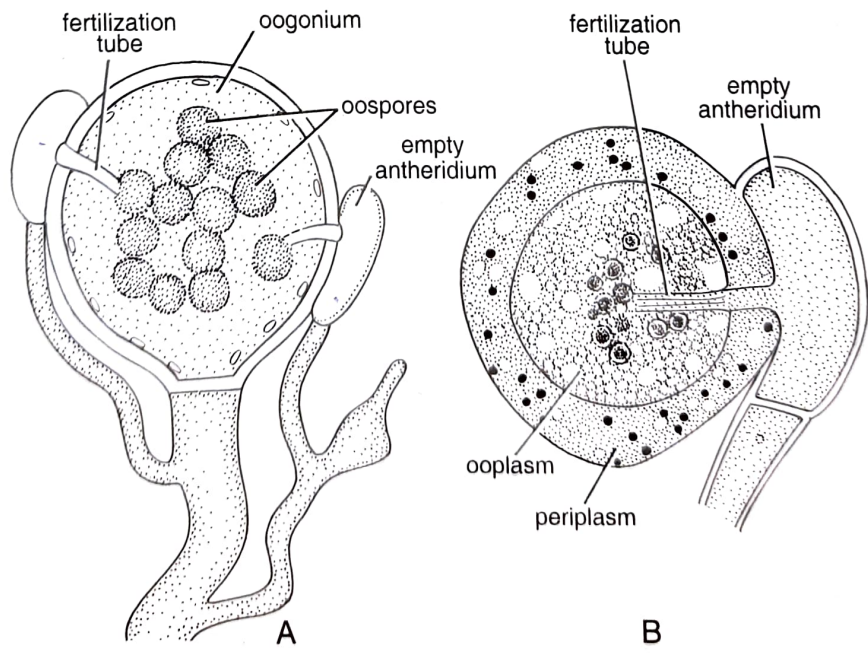


Fig. 5 A-B. Sexual reproduction: Gametangial contact.

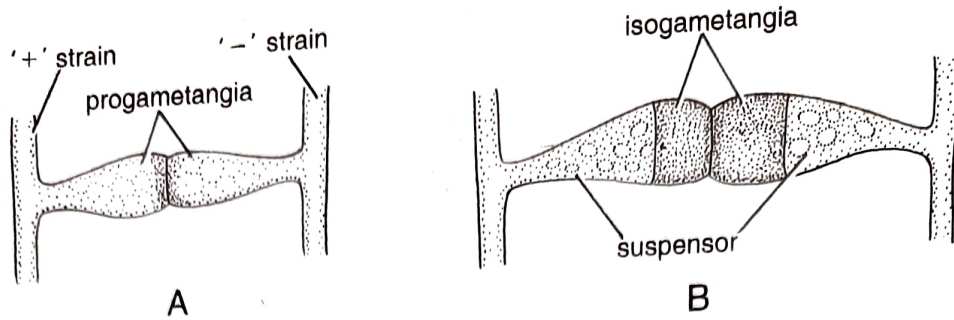


Fig. 6 A-B. Sexual reproduction: Gametangial copulation.

- (c) **Gametangial copulation.** This process involves fusion of the entire contents of two compatible gametangia. The gametangia come in close contact, their walls at the point of contact dissolve and their contents mix. The two gametangia ultimately fuse, resulting in karyogamy (e.g., *Mucor*, *Rhizopus*) (Fig. 6A-B).
- (d) **Spermatization.** In some advanced genera (e.g., *Puccinia*), sex organs are completely absent and the sexual process is accomplished by minute spore-like spermata (male gametes) and specialized receptive hyphae (female gametes). The

spermata are carried by air, water or insects to the receptive hyphae, and the contents of the spermatum enter the receptive hyphae through a pore (Fig. 7A-B)

- (e) **Somatogamy.** Here sex organs are not at all formed, but two vegetative cells or two vegetative hyphae take over the sexual function and fuse together. *Morchella*, *Peziza* and *Agaricus* are some common examples of somatogamy (Fig. 7C).
- (20) There are five basic types of life cycles in fungi, i.e., asexual, haploid, haploid-dikaryotic, haploid-diploid and diploid.

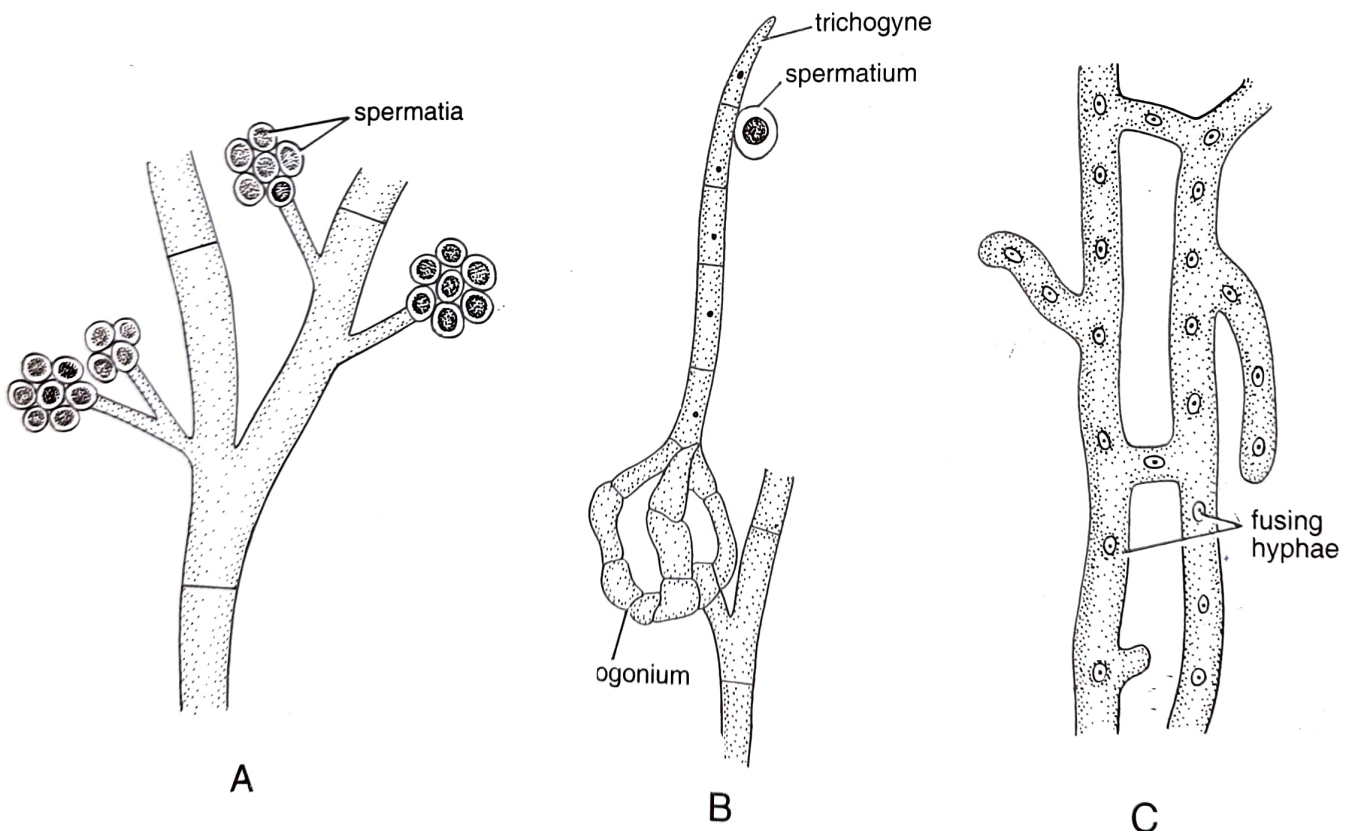


Fig. 7 A-C. Sexual reproduction: A-B. Spermatization; C. Somatogamy.