Gnetum - reproductive structure and male gametophyte

3. Reproductive structures and Reproduction —

All species of *Gnetum* are dioecious. Flowers are unisexual. Male flowers are represented by microsporophylls (stamens) and female by megasporophylls (carpels). Male and female flowers are borne in clusters on male and female plants respectively forming respective cones equivalent to panicle type of inflorescence of angiosperms. Flowers are provided with simplest type of perianth. In a few cases bisexual flowers are also noted. Both types of cones i.e. inflorescences arise either singly in the axils of the leaves, or in fascicles at the apices of dwarf shoots.

Male cone —The male cones are compact and slender axis-like structures, which are upto 6 cm in length. Each male cone is generally a panicle which is either solitary and axillary or fascicled at the apex (i.e. terminal of the dwarf shoot).

Each cone (Fig. 3.36, A-B) or inflorescence consists of a stout axis which bears at the base two opposite and connate bracts, in the axil of this bract other cones may also arise. A little higher upon the cone-axis, whorls of circular connate bracts are present and they are arranged one above the other to form 'collars' or 'cupules'. In the axil of each collar, male i.e. staminate flowers (microsporophylls) are arranged in several definite rings, usually 3 to 6 in number. Above the male flowers, a single ring of abortive i.e. imperfect female flowers may also be present.

Each mature microsporophyll i.e. male flower (Fig. 3.37, B) consists of a stalk bearing two unilocular (one-lobed) microsporangia i.e. anthers. The stalk is invested at the base by a sheath-like perianth. In the young condition, the stalk bearing two anthers of a male flower remains enclosed in the sheath-like perianth. With the maturity of anthers, the stalk elongates rapidly and pushes the anthers through the slit (formed in the perianth) beyond the collars of the cone. Each microsporangium is oval and consists of a wall of single layer of cells.

During the development of an anther (microsporangium) the outermost layer of the archesporium divides periclinally to form the parietal and the sporogenous cells. The parietal layer by another division produces the outer wall layer (jacket) and the tapetum.

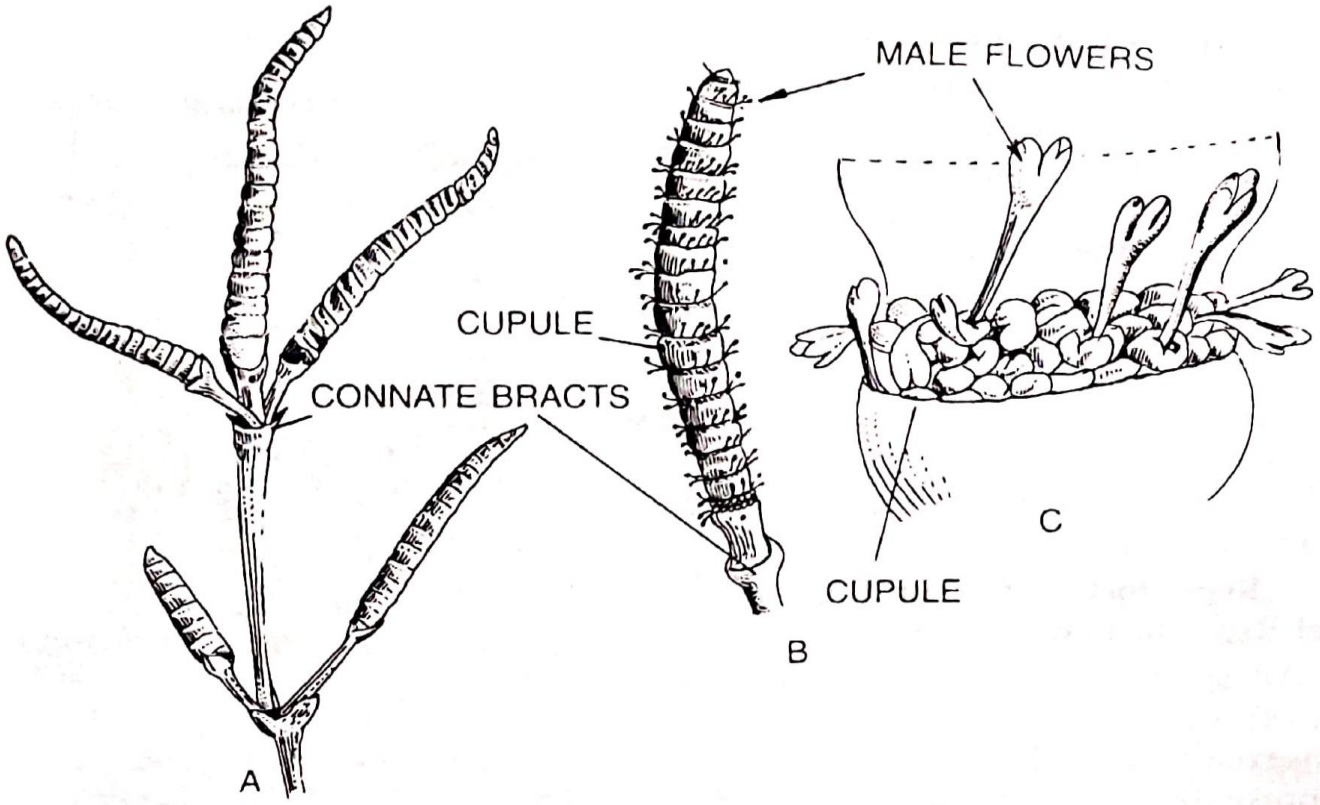

Fig. 3.36 —*Gnetum* sp. A —Branch-apex bearing a cluster of male cones. B—Male cone at the time dehiscence. C—Portion from B enlarged to show the dehiscing male flowers.

Sporogenous cells later differentiate into spore mother cells ($2n$). Many wingless haploid pollen grains i.e. microspores are formed meiotically from the spore mother cells. The pollen grains are liberated by the longitudinal dehiscence of the anthers.

Female cone —Female cones are also compact, slender axil-like structures; each cone is either solitary and axillary or fascicled at the apex of the shoot. The female flowers are also hidden by the connate bracts i.e. cupules.

Each cone consists of a stout axis bearing at the base of two opposite and connate bracts; a little above this, whorls of circular bracts called "collars" or "cupules" are present one above the other. In the axil of each collar, 4 to 10 female flowers i.e. ovules are developed in a single ring. In the young stage female flowers are not visible, at maturity the female flowers i.e. ovules are visible as minute protuberances. Only a few ovules develop into mature seeds.

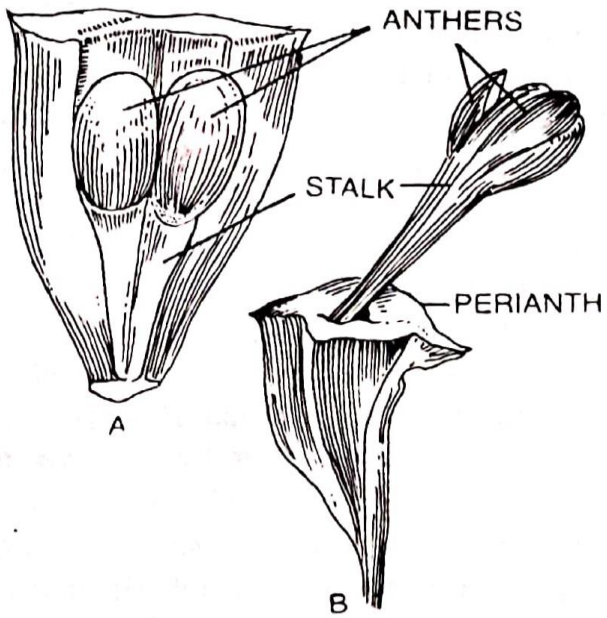

Fig. 3.37 —*Gnetum* sp. A—L.s. of a male flower showing two anthers. B—Entire mature flower dehisced.

Each female flower i.e., ovule may be stalked or sessile and consists of a massive

nucellus surrounded by three envelopes[1]. Each envelope is supplied with a separate vascular bundle. The outer envelope, often called the perianth, is thick and fleshy. The middle envelope is known as outer *integument*, this is very thin; the inner envelope is

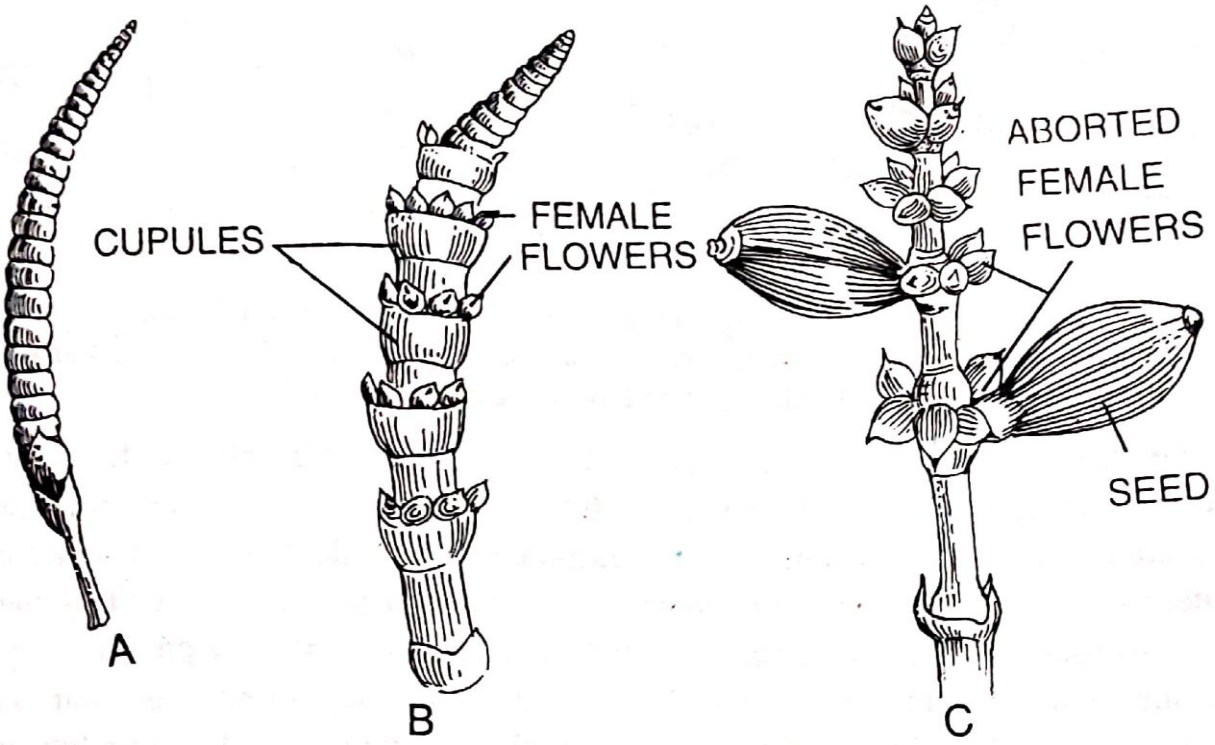

Fig. 3.38 —*Gnetum* sp. A—Young female cone. B—Mature female cone showing female flowers (ovules). C—A female cone bearing two seeds and few aborted female flowers (ovules).

often designated as inner *integument*, this inner envelope is fused with the nucellus in its basal part and narrows above to form the *micropylar tube* or so-called "*style*" which

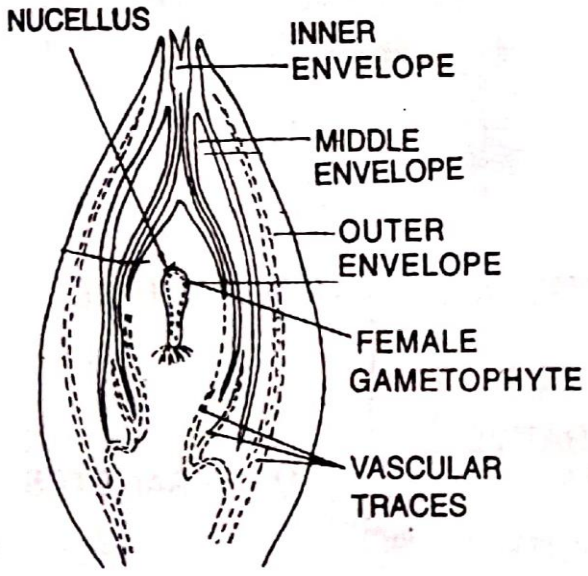

Fig. 3.39—*Gnetum* sp. Median L.s. of an ovule (female flower).

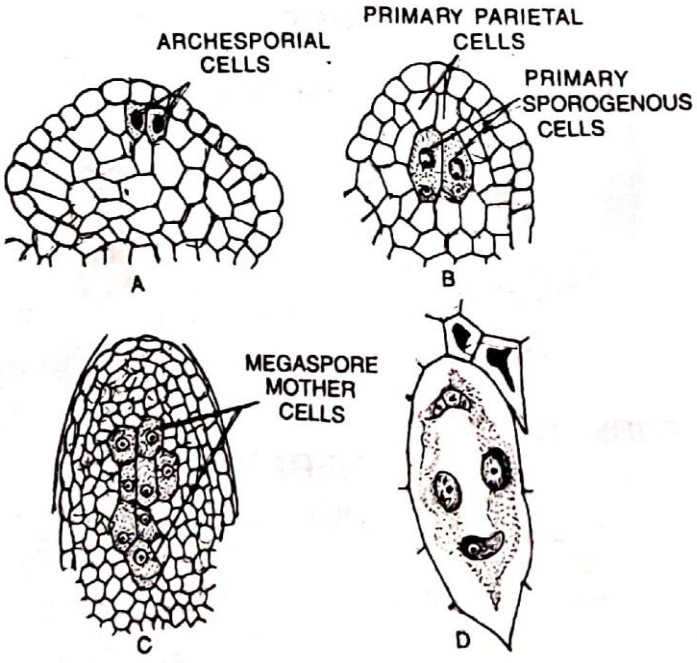

Fig. 3.40—*Gnetum* sp. A-D—Different stages in megasporogenesis. D—Four functional megaspores within a megaspore mother cell.

extends beyond the middle and outer envelopes (Fig. 3.39). Nucellar beak is absent but a pollen chamber has been noted in various species of *Gnetum* at the time of pollination.

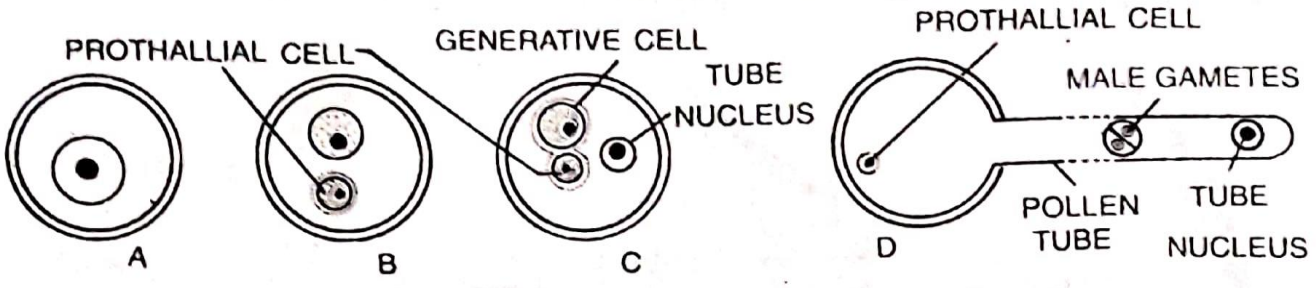

fig. 3.41 —*Gnetum* sp. A-D —Diagrammatic representation of the development of male gametophyte. D—Fully developed male gametophyte with two male gametes, a tube nucleus within pollen tube and a prothallial cell.

In *Gnetum* several *sporogenous cells* (8 to 16) are differentiated from several hypodermal archesporial cells of the nucellar tissue. These sporogenous cells are arranged in longitudinal rows and later function as megaspore mother cells (Fig. 3.40, C). According to Maheshwari and Vasil (1961) the nucleus of each megaspore mother cell by meiosis gives rise to four functional megaspores which lie crosswise in the peripheral cytoplasm around the central vacuole (Fig. 3.40, D). All the four megaspores take part in the development of the female gametophyte. The female gametophyte is therefore tetrasporic like angiosperms.

Structure of the Gametophytes

1. MALE GAMETOPHYTE —Microspore is the first cell of the male gametophyte which has a thick spiny exine and a thin intine. Germination of the microspore begins within the pollen sac i.e. microsporangium.

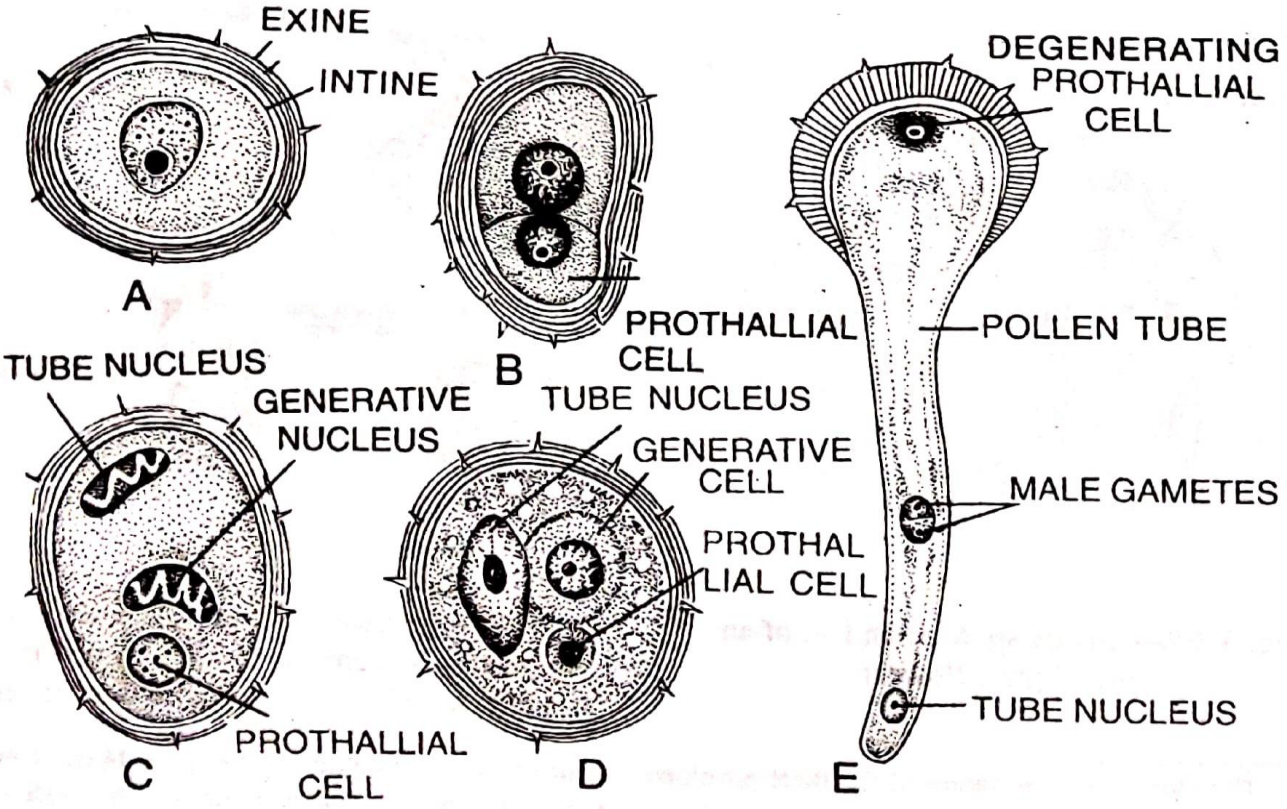

Fig. 3.42—*Gnetum* sp. A-D—Different stages in the development of the male gametophyte. E—Fully developed male gametophyte with two male gametes, one tube nucleus within the pollen tube and a prothallial cell.

Microspore nucleus cuts off a small lenticular prothallial cell at one end leaving a larger nucleus; the prothallial cell rounds up very soon and does not take part in the development of the gametophyte but degenerates as such. The larger nucleus divides again into two nuclei. Of these two nuclei, one is hyaline with a large nucleolus known as *tube nucleus* and the other is coloured known as *generative cell*. Thus the mature pollen grain i.e. microspore consists of a prothallial cell, a generative cell and a tube nucleus.

At this three-nucleate stage microspores are liberated from the microsporangium and further development of the male gametophyte takes place after pollination.

Pollen tube now develops from the intine. Within the pollen tube, tube-nucleus enters first; the generative cell next enters and divides within the pollen tube into two non-motile naked male cells *i.e.* gametes. The prothallial cell remains in the body of the microspore and ultimately disappears. Stalk cell is not formed at all.