

# GYMNOLOGY

## GNETOPSIDA

### GENERAL CHARACTERISTICS

- Woody plants, some species are trees (*Gnetum gnemon*), many are lianes or shrubs and a few are stumpy turnip-like (e.g. *Welwitschia mirabilis*).



*Welwitschia*

- **Leaves** - simple, elliptical/ strap-shaped / scale leaves.
- They are generally opposite or whorled.
- **Vessels** are present in the secondary wood.
- **'Flowers'**- unisexual, dioecious and only monoecious in some species of *Gnetum*.



*Gnetum*

- 'Flowers' are arranged in compound strobili or 'inflorescences.'



- The male flowers are surrounded by a **perianth**.
- Each male flower contains an **antherophore** with **one to eight synangia**.
- A single erect **orthotropous ovule** is present in each female flower.
- Nucellus of the ovule remains **surrounded by two or three envelopes**.
- The micropyle of each ovule remains **projected** in the form of a long bristle-like tube.
- At the time of fertilization the pollen tube contains two male nuclei.
- Two cotyledons are present in the embryo.

## GNETUM

**Class-** Gnetopsida

**Order-** Gnetales

**Family-** Gnetaceae

**Genus-** *Gnetum*



## GENERAL CHARACTERS

- Gnetum **resembles** very much in its characteristics to an angiosperm than a gymnosperm.
- **Distributed** in the tropical and humid regions of the world
- Most species are climbers except few being shrubs and trees.
- 2 types of branches- **branches of limited growth** and **branches of unlimited growth**.
- Leaves - large, dorsiventral, unicostate reticulate venation

## MORPHOLOGY OF ROOT

- Tap root system which is profusely branched.
- Shows normal secondary growth.

## ANATOMY OF ROOT

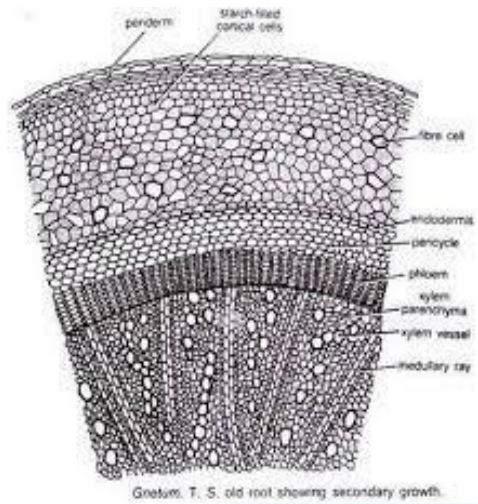
- Layers of starch filled cortical cells.
- 4-6 layers of pericycle.
- The primary vascular cylinder is **diarch** and **exarch**.
- The secondary xylem consists of **tracheids** possessing uniseriate bordered pits with conspicuous **Bars of Sanio**.
- The vessels are also present.

## MORPHOLOGY OF STEM

- Exhibits **two types of branches**- **dwarf shoots** or branches of limited growth and **long shoots** or branches of unlimited growth.

## ANATOMY OF STEM

- Resemble typical dicot stem.
- Sunken stomata is present.
- **Cortex** - Few layers
  1. **Outer chlorenchymatous**
  2. **Middle parenchymatous**
  3. **Inner sclerenchymatous layers**
- **Vascular bundles** - **Conjoint, Collateral, Open and Endarch**.
- Xylem comprises **tracheids & vessels**.
- Phloem comprises **sieve cells & phloem parenchyma**.
- Sclerotic cells present.
- The xylem parenchyma cells have simple pits.
- There are many uni- to multiseriate vascular rays.
- The secondary phloem consists of sieve cells and phloem parenchyma.
- The companion cells are totally absent in Gnetum.



## MORPHOLOGY OF LEAVES

- **Dimorphism**- foliage leaves and scale leaves.
- A **dwarf shoot** bears 9 to 10 foliage leaves.
- Opposite decussate.
- The leaves are large, simple having an oval-shaped broad lamina with unicostate reticulate venation.
- The leaves are exstipulate, shortly petiolate with entire margin.
- The leaf of *Gnetum* resembles a dicot leaf.



## ANATOMY OF LEAVES

- **Stomata** on both side except on veins.
- The **mesophyll** is differentiated into **palisade** and **spongy parenchyma**.
- **Stone cells** and **latex tubes** present on mid rib region.
- V.B- **conjoint, collateral**
- Xylem comprises **tracheids, vessels & xylem parenchyma**
- Phloem comprises **sieve cells & phloem parenchyma**.

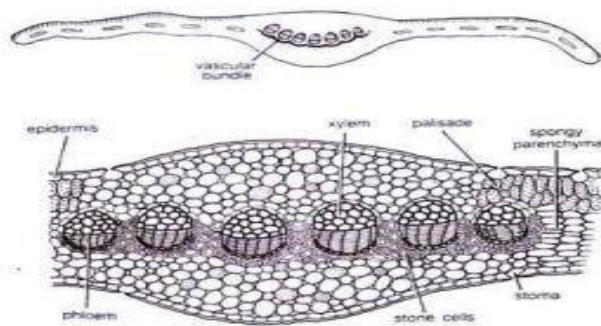
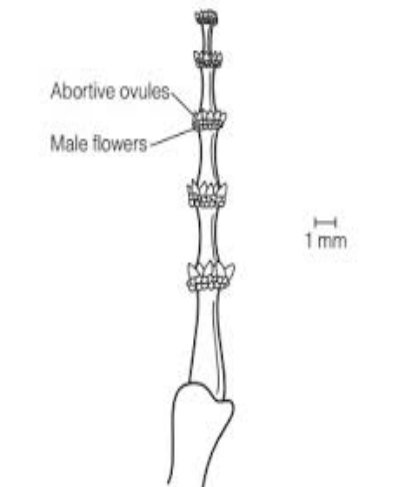
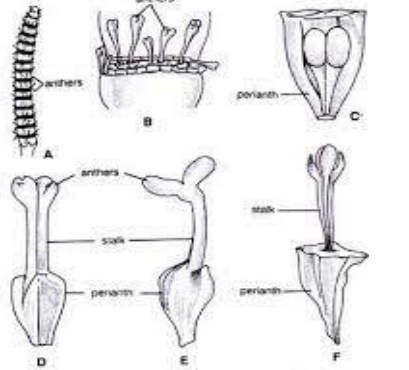
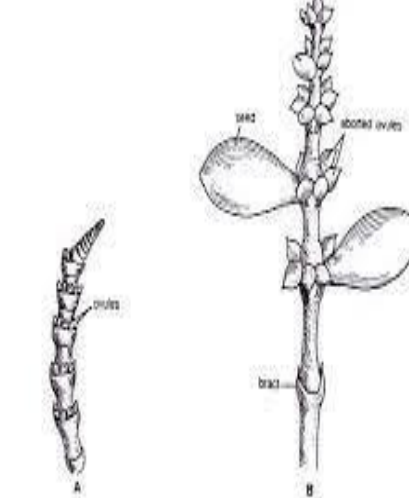
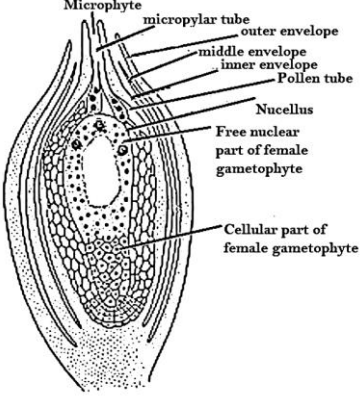


Fig. 13.9. Gnetum. Upper-T.S. leaf (diagrammatic) ; Lower-T.S. leaf (a part cellular).

## REPRODUCTION

- Sexual reproduction
- Dioecious
- **Cones or strobili** is the reproductive structure (*Inflorescence*).

<b>PLANT PART</b>	<b>FEATURES</b>	<b>FIGURE</b>
<b>Male strobilus</b>	<ul style="list-style-type: none"> <li>● Compound and has a long slender axis bearing 10-25 whorl of bracts (collars).</li> <li>● About 12-25 male flowers are arranged in three to six rings above each collar.</li> <li>● A single ring of 7-15 imperfect female flowers or abortive ovules is present just above the male flowers.</li> </ul>	
<b>Male flower</b>	<ul style="list-style-type: none"> <li>● A male flower consists of two unilocular anthers on a stalk (antherophore) enclosed in a small sheathing perianth.</li> <li>● The stalk of the anther elongates rapidly at maturity pushing the anther beyond the collars through a slit in the perianth.</li> </ul>	 <p data-bbox="1047 1297 1453 1333">Fig. 13.11. Gnetum sp. A, A male cone; B, A part of 'A' showing male flowers; C, L.S. male flower; D-E, Male flowers with anthers emerged out of a perianth; F, A dehiscent male flower.</p>
<b>Female strobilus</b>	<ul style="list-style-type: none"> <li>● The female strobilus is similar to the male strobilus.</li> <li>● A ring of 4-10 ovules (female flowers) is present above each collar. The male flowers are absent.</li> <li>● The upper few collars are devoid of ovules and are thus sterile.</li> </ul>	 <p data-bbox="1047 1858 1453 1890">Gnetum. A, An old female cone of G. ula; B, A fertile cone of G. gnemon bearing f</p>

<p><b>Ovule</b></p>	<ul style="list-style-type: none"> <li>● A single ovule represents a female flower.</li> <li>● The ovules are orthotropous, crassinucellate (with massive nucellar tissue)</li> <li>● Three envelope are present</li> <li>● The outer envelope - perianth</li> <li>● The middle and the inner envelope are the integuments.</li> <li>● Numerous laticiferous ducts and sclereids are present.</li> <li>● Epidermal stomata is present</li> </ul>	 <p>L.S. of Gnetum ovule</p>
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- Two sets of vascular bundles are formed.
- A shallow pollen chamber is present at the **tip of the nucellus**.
- The sporogenous cells function as **megaspore mother cells** which undergo **meiotic division**.
- The female gametophyte of Gnetum is **tetrasporic**.

### GAMETOPHYTIC DEVELOPMENT

- The **spore** is the first phase of gametophyte generation.
- The **microspore/pollen grain** - Male gametophyte.
- **Tetranucleate coen megaspore** - Female gametophyte.

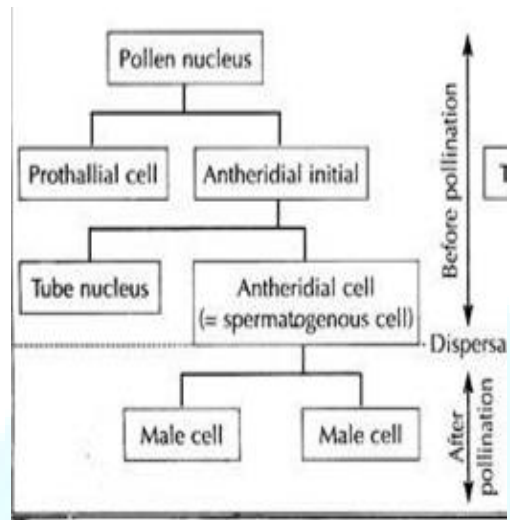
### MICROSPORE DEVELOPMENT

- The pollen grains are released from the microsporangium at this **3-celled stage**.
- The exine is cast off during pollen germination.



## **E ▶ ENTRI**

- Pollen tube arises from tube cell.
- The spermatogenous cell moves into the pollen tube and subsequently it divides to form two male cells
- The male gametes are non-motile.



## **POLLINATION**

- Gnetum is wind-pollinated.
- Pollination drop is formed at micropylar end.
- The pollen grains get trap in the pollination drop.
- Due to the drying off of the fluid, the pollen grains are sucked into the micropylar canal and are finally collected in the pollen chamber.
- The mouth of the micropyle is then sealed from the outer environment due to the development of flage.

## **FERTILIZATION**

- The pollen tube enters the female gametophyte and the male gametes move ahead of tube nucleus.
- The pollen tube ruptures to discharge the male gametes into the egg cell.
- One of the male nuclei fuses with the egg nucleus and zygote forms.

## ENDOSPERM

- In gymnosperms, endosperms are cellular and haploid and are formed before fertilisation.

## EMBRYOGENY

- Gnetum represents an intermediate stage between gymnosperms and angiosperm as there are **both free nuclear divisions and cell divisions**.
- Polyembryony is present.

## SEEDS

- Gnetum seeds are oval in shape and green/brown/red in colour.
- The **seeds remain covered** with a three-layered envelop, of which **outer is fleshy, middle is stony and inner is papary**.
- The nucellus is used up and the embryo is embedded within the endosperm.
- The germination of seed is epigeal.

## LIFE CYCLE OF GNETUM

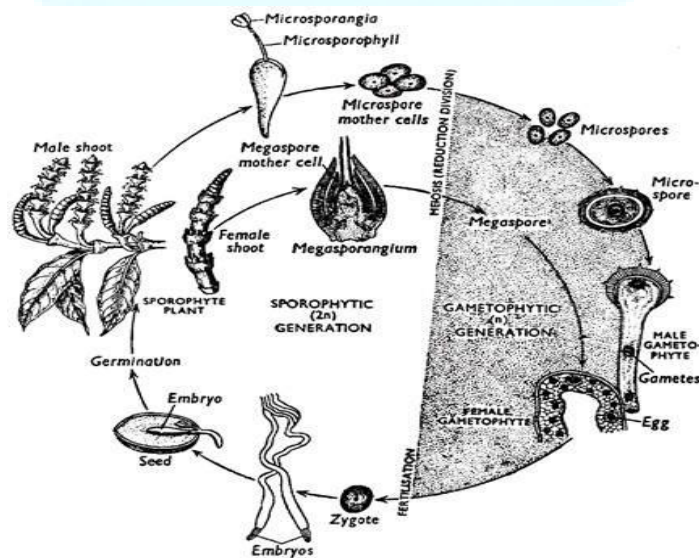





Fig. 1.82 : Life cycle of *Gnetum*

## ECONOMIC IMPORTANCE OF GYMNOSPERMS

<p><b>1. Ornamental value</b></p>		<ul style="list-style-type: none"> <li>• A number of gymnosperms are grown as ornamental plants, e.g., <i>Cycas</i>, <i>Araucaria</i>, <i>Thuja</i> etc.</li> <li>• Various species of <i>Taxus</i>, especially <i>T. baccata</i> (English yew) and <i>T. cuspidata</i> (Oriental yew) are commonly planted as ornamentals.</li> <li>• <i>Podocarpus macrophyllus</i> is widely planted as ornamental.</li> </ul> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>
<p><b>2. Food value</b></p>		<ul style="list-style-type: none"> <li>• ‘Sago’ starch obtained from pith and cortex of stem of <i>C. revolute</i>, <i>C. rumphi</i> etc.</li> <li>• ‘Seed starch’ obtained from seeds of <i>Cycas rumphii</i>, <i>Dioon edule</i> etc. It is prepared into flour and cooked before eating.</li> <li>• Seeds of <i>Pinus gerardiana</i> (chilgoza) are edible.</li> <li>• ‘Kaffir bread’ prepared from the stem pith of <i>Encephalartos</i>.</li> <li>• Young leaves of <i>Cycas</i> cooked as vegetables.</li> </ul> <div style="text-align: center; margin-top: 20px;">  </div>

<p><b>3. Medicinal value</b></p>		<ul style="list-style-type: none"> <li>• Ephedrine (alkaloid) extracted from <i>Ephedra</i> used in treating asthma, cough, cold, bronchitis etc.</li> <li>• The juice extracted from young leaves of <i>Cycas revoluta</i> is used for curing blood vomiting and flatulence.</li> <li>• The presence of taxol, a highly toxic alkaloid having <b>antimitotic activity</b> makes it potential agent for anticancer chemotherapeutic treatment.</li> <li>• The kernels of <i>Gnetum ula</i> yield an oil used as a massage oil in rheumatism.</li> </ul> <div data-bbox="735 590 1279 898" data-label="Image"> </div>
<p><b>4. Industrial uses</b></p>		<ul style="list-style-type: none"> <li>• <b>Gum</b> <ul style="list-style-type: none"> <li>➤ <i>Cycas</i> gum used as adhesive, antidote for snake bites.</li> </ul> </li> <li>• <b>Tannins</b> <ul style="list-style-type: none"> <li>➤ Tannins extracted from bark of <i>Araucaria</i>, <i>Pinus</i>, <i>Sequoia</i> etc. used in leather industry.</li> </ul> </li> <li>• <b>Canada balsam</b> <ul style="list-style-type: none"> <li>➤ It is turpentine obtained from <i>Abies balsamea</i> and used as a mounting medium in biological preparations.</li> </ul> </li> <li>• <b>Amber (fossil resin)</b> <ul style="list-style-type: none"> <li>➤ Obtained from <i>Pinus succinifera</i>.</li> <li>➤ Wood of <i>Pinus</i> is used for doors, poles, beams, railway wagon flooring etc.</li> <li>➤ Plywood prepared from <i>Podocarpus</i>.</li> <li>➤ Papers like newsprints, writing and printing papers are being prepared from the wood pulp of, <i>Gnetum</i>, <i>Pinus</i>, <i>Picea</i>, <i>Abies</i> etc.</li> <li>➤ The leaves of cycads are used for preparing baskets, mats, hats, brooms etc.</li> <li>➤ The fibres obtained from the leaves of <i>Cycas</i> and <i>Macrozamia</i> are used for stuffing pillows and</li> </ul> </li> </ul>

		making mattresses.
<b>5. Source of oil</b>		<ul style="list-style-type: none"><li>• Oils extracted from seeds of <i>C. revoluta</i>, <i>Macrozamia riedlei</i>, <i>Pinus cembra</i> and <i>Cephalotaxus drupacea</i> are used as edible oils.</li><li>• Red cedar wood oil extracted from the heartwood of <i>Juniperus virginiana</i> is used for cleaning microscopic preparations and for oil immersion lenses.</li><li>• Oils obtained from <i>Cedrus deodara</i>, <i>Cryptomeria japonica</i> and <i>Cupressus serm-peruvians</i> are used in preparations of perfumes.</li></ul>

