

## Cordaitales: Distribution, Features

- 1) Distribution of Cordaitales:
  - a) Cordaitales, an extinct group of **Palaeozoic tall** trees of gymnosperms, formed “the world’s first great forests”.
  - b) The name was given to honour an Australian botanist, A.J. Corda.
  - c) Majority of the Cordaitales were tall, large-leaved trees attaining a height of more than 30 metres.
  - d) The group started declining during Permian and became completely extinct by the end of this period.
  - e) As per records the Cordaitales occurred side by side with Pteridospermales.
  - f) Cordaitales fossils have been reported from North and South America, Europe, China, Ruccia, India, Australia and Africa indicating their world-wide occurrence during Devonian and Permian.
  - g) Cordaitales in India are represented in the form of impressions or compressions of leaves, seeds and petrified woods.
  - h) Representatives of the only family Cordaitaceae have been reported from India.
  - i) In India, Cordaitaceae are represented in lower Gondwana formations.
  - j) The **leaves** of several members were highly variable in shape and were put under a form-genus *Cordaites*.
    - i) The root-genera: *Amyelon*
    - ii) The Stem-genera: *Mesoxylon*,
    - iii) The cones or inflorescence: *Cordaianthus*
    - iv) Seeds are described under the form-genera:
      - (1) *Cardiocarpus*,
      - (2) *Mitrospermum*
  - k) *Cordaicarpus*, *Dodoxylon*, *Noeggerathiopsis* and *Samaropsis* are the Cordaitalean genera reported from India.
- 2) Distinguishing Features of Cordaitales:
  - a) This group of fossil plants had tall trees with slender trunks and a crown of several well- developed branches.
  - b) Plants were present from Devonian to Permian periods of Palaeozoic era.
  - c) The leaves were simple, spirally arranged and strap-shaped, grass-like or paddel-like.

- d) The leaves attained a length up to 1 metre or even more, and had parallel venation.
- e) A scanty primary wood was present.
- f) In mature stems, the secondary wood was mostly pycnoxylic.
- g) Compound unisexual cones were present.
- h) Each compound cone had a main axis with bracts subtending secondary fertile shoots possessing fertile and sterile appendages.
- i) Mega-strobili had sterile appendages below and ovule-bearing fertile appendages above.
- j) One to four ovules were present on each female fertile appendage.
- k) Micro-strobili had sterile appendages below and pollen-sac containing fertile appendages above.
- l) Four to six terminal pollen sacs were present on each male fertile appendage.
- m) Sperms have not been reported, but presence of pollen chambers suggests that motile sperms might have been formed.

### 3) External Morphology:

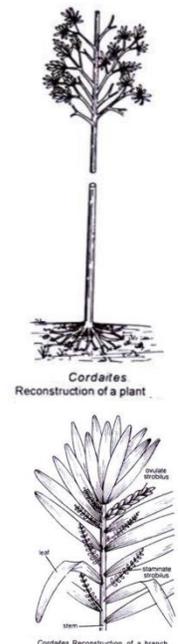
- a) Cordaitaceae grew luxuriently and formed large forests of tall trees during Upper Carboniferous period.
- b) Plants attained a height of more than 30 metres.
- c) They had terminal and spirally arranged well-spread branches bearing tufts of leaves.
- d) The leaves were large, leathery, grass--like or paddle-shaped, and attained a length of about 1 metre and a breadth of about 15 cm.
- e) They were, smaller than that of Cycads. Some members also had small needle-like leaves.

#### f) *Cordaites*:

- i) The leaves had a dichotomous venation.
- ii) The same name is now given to the stem as well as to the entire plant.
- iii) Cridland (1964) studied and reconstructed a cordaitan plant. According to him the plants attained a height of nearly 5 metre with stilt roots similar to mangrove plants. These studies suggest the habitat of *Cordaites* in the swamps along the seashores.

### 4) Anatomy of Cordaitaceae:

- i) Stem:



- (1) The stem resembled closely with Conifers.
- (2) Both *Cordaites* and *Mesoxylon* possessed a large central pith and cortex.
- (3) The wood was scanty in some species while in others it developed a large vascular

cylinder, and in still other cases distinct growth rings were present.

- (4) The primary wood was endarch but in *Mesoxylon* it was mesarch.
- (5) The secondary wood consisted of pitted tracheids having multiseriate pittings.
- (6) The tracheids were long and slender.
- (7) Bordered pits were present, and they were confined mainly on the radial walls.

- (8) In older tracheids, however, the pits were also present on the tangential walls. Medullary rays were one or two cells wide. The bordered tracheids were hexagonal in outline and the large pith was characteristically discoid.

- (9) *Mesoxylon* differed from *Cordaites* in the structure of the leaf trace.
- (10) A network of sclerenchyma, present in the outer cortex of *Mesoxylon*, was absent in *Cordaites*.

## ii) Root:

- (1) The roots of Cordaitales are known as *Amyelon* and resembled very much with the modern Conifers.
- (2) It was highly branched forming stilt roots supporting the stem.
- (3) They were diarch or triarch in structure.
- (4) Ectotrophic mycorrhizal fungi were present on the roots.
- (5) The protoxylem had spiral tracheids while the metaxylem was scalariform in structure.
- (6) Tracheids had multiseriate bordered pits.

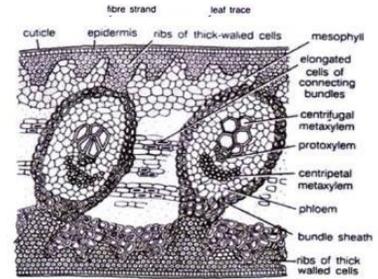
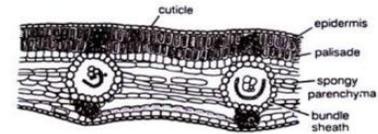
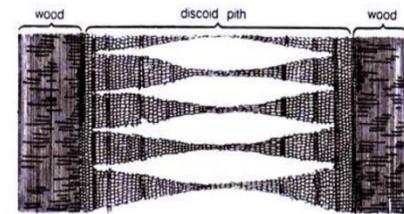


Fig. 9.7. *Cordaites angulostratus*. T.S. leaf.

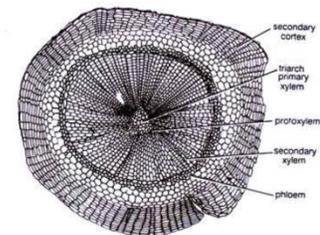


*Cordaites linguatus*. T.S. leaf.

*Cordaites*



*Cordaites brandingii*. R.L.S. stem showing discoid pith and wood



*Amyelon radicans* (probable root of Cordaitales). (after Scott, 1923).

- (7) The cortex was quite large and divisible into outer and inner cortex.
- (8) The secondary cortex and cambium were also quite distinct.

iii) Leaf:

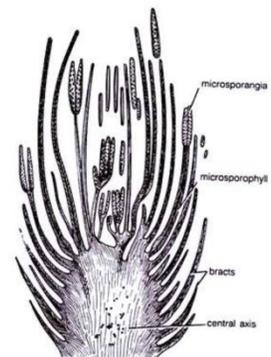
- (1) The Cordaitalean leaf is described under the name *Cordaites*.
- (2) Several xerophytic internal characters were present in the leaf.
- (3) The epidermal and hypodermal cells were thick-walled, and the hypodermal cells on both sides were grouped into ribs.
- (4) Several mesarch vascular bundles were present.
- (5) Each vascular bundle was surrounded by a thick-walled strong bundle sheath.
- (6) The transfusion tissue was present in the form of some elongated cells in between two vascular bundles.
- (7) The mesophyll was clearly differentiated into palisade and spongy parenchyma in species such as *Cordaites lingulatus*.

5) Spore-producing Organs:

- a) The strobili were usually monoecious but some Cordaitales were also dioecious.
- b) They were, never bisporangiate.
- c) The fructifications were borne on slender branches of about 10 cm length.
- d) These branches developed on the stem among the leaves.
- e) The slender stalk had many stiff but tapering bracts.
- f) A short bud-like strobilus was present within the axil of each bract.
- g) The bracts were probably spirally arranged.
- h) Each strobilus attained a length of about 1 cm.
- i) Both male and female reproductive organs are known as *Cordaianthus*

i) Male Strobilus:

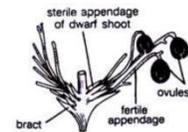
- (1) It consisted of a thick central axis possessing many spirally arranged bracts and some microsporophyll's.



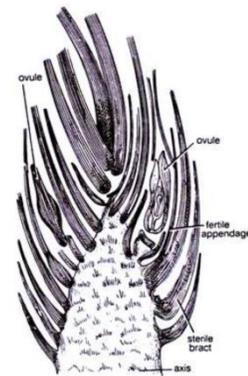
- (2) At the tip of each microsporophyll were present 1-4 microsporangia (Fig. 9.9).
- (3) These sporangia probably dehisced longitudinally.
- (4) Three well-studied forms of male strobilus include *Cordaianthus concinnus*, *C. penjonii* (Fig. 9.9) and *C. saportanus*.
- (5) The microsporangium wall was probably only one-celled thick and enclosed many microspores.
- (6) Taylor and Taylor (1987) studied the structure of pollen grains of Cordaitales.
  - (a) According to them the grains may be alete or range from monolete to trilete.
  - (b) They are mono-saccate with saccus attached on both distal and proximal poles.

ii) Female Strobilus:

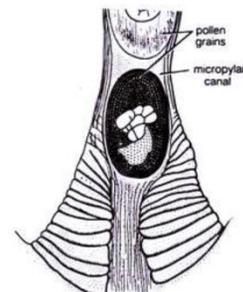
- (1) Similar to male strobilus, the female strobilus also had a stout axis bearing a large number of spirally arranged bracts.
- (2) The bracts were more in number than that of male strobilus. *Cordaianthus pseudofluitans* possessed a few elongated and dichotomously branched fertile megasporophylls (Fig. 9.10).
- (3) Two or more ovules were present at the apex of each megasporophyll.
- (4) In *Cordaianthus williamsonii*, a single ovule was present on each fertile appendage (Fig. 9.11).
- (5) The ovule was bitegmic and the integuments were free in the lower part but fused above.
- (6) The nucellus of the ovule was free from the integument throughout.
- (7) A prominent beak with a large pollen chamber was also present.
- (8) *Cordaianthus zielleri* differed from *C. pseudofluitans* in the size of megasporophylls, number of functioning megasporophylls, dichotomies and total number of ovules in each strobilus.



*Cordaianthus pseudofluitans*. A part of female inflorescence with two dwarf shoots, each in the axil of a sterile bract.



*Cordaianthus williamsonii*. L.S. female strobilus.



*Cordaianthus*. Section of nucellar beak.

iii) Male Gametophyte:

- (1) Much is not known about the male gametophyte
- (2) Only the upper part of the nucellus provides some picture of the male gametophyte (Fig. 9.12).
- (3) The inner structure was multicellular and the mature pollen grains were present in the micropylar canal.
- (4) It could, however, not be ascertained that whether the cells of the multicellular region were vegetative or spermatogenous in nature.
- (5) Most probably, both vegetative and spermatogenous tissues were present in the pollen grains.

iv) Female Gametophyte and Embryo:

- (1) Not much is known about the structure of female gametophyte and embryo. Andrews and Flix (1952), however, observed some seeds with well-preserved female gametophyte in *Cardio carpus*. In a few specimens, they also observed archegonia. The elongated gametophyte in such specimens had only two archegonia, each of which exhibits a beak-like projection of the endosperm.
- (2) In many seeds, well-preserved gametophytes with megaspore wall, a tent pole and two archegonia near micropyle have been observed by many workers. Even the starch grains have been reported in the ovule of *Cardio carpus spinatus* by Baxter (1964).

v) Seed:

- (1) It is believed that *Cordaianthus* type of strobili possessed seeds known as *Cardio carpus* (=Cordaicarpus=Samaropsis).
- (2) *Mitrospermum* and *Kamarospermum* are the other two seed-genera of Cordaitaceae.
- (3) Seeds were heart-shaped, bilaterally symmetrical and crassinucellate.
- (4) Central nucellus was surrounded by a two-layered envelope, of which the outer layer was probably expanded in the form of a wing.
- (5) In *Cardiocarpus spinatus* the seeds were large and surrounded by five distinct layers, including two layers each of sarcotesta and sclerotesta and a layer of endotesta.