

06

APRIL WEDNESDAY  
 DEVELOPMENT OF MALE AND FEMALE  
 GAMETOPHYTE OF GINKGO

WEEK - 15

## Male Gametophyte:

- (i) The microspore is the pioneer structure of the gametophyte.
- (ii) It is almost circular in outline and is surrounded by two coats or layers i.e. Exine and Intine.
- (iii) Intine completely covers the spore but the Exine does not cover the whole and is lacking at the apical end.
- (iv) There is a single nucleus surrounded by dense cytoplasmic contents.
- (v) The Pollen grains start germinating within the microsporangium and are released in the four celled stage.
- (vi) Before this division the microspore nucleus migrates from the centre to the other end where the Exine is lacking into two daughter nuclei (ii) later wall formation takes place resulting in the formation of small ventricular male prothallial cell and large cell.
- (vii) The large cell divides again to form another male prothallial cell and larger Antheridial cell.
- (ix) The first formed prothallial cell usually degenerates where as second one persists.
- (x) The antheridial cell divides to form generative cell and a tube cell.
- (xi) The generative cell is in contact with second prothallial cell.
- (xii) At this stage, the microsporangium dehisces and liberates the semi-germinated microspore.
- (xiii) Further germination takes place in the Pollen Chamber through out the summer.
- (xiv) The Intine protrudes out slightly and fixes the semi-germinated Pollen grain to the tissue of the nucellus.

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 23 24 25 26 27 28 29 30 31

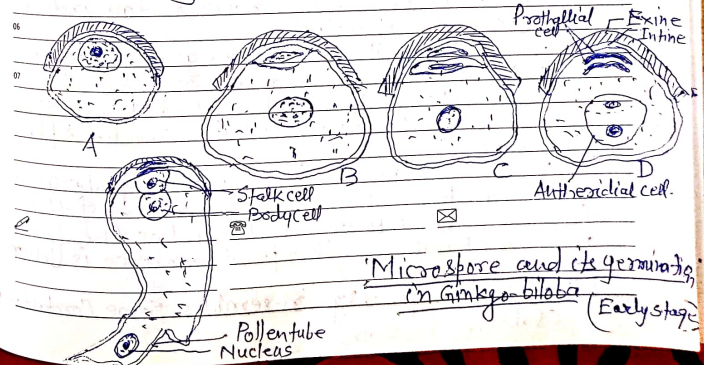
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APRIL  
 THURSDAY

07

- (xv) This protruded Intine acts as a haustorium and absorb food for the germinating spore.

- Other post-Pollination changes include-
- (xvi) The division of the generative cell into a stalk cell or a body cell or a sterile cell and a body cell or spermatogenous cell.
  - (xvii) The division of the generative cell is antichlinal. During later development the stalk cell surrounds the second male prothallial cell.
  - (xviii) The body cell divides to form two motile spermatozoid.
  - (xix) A flagellum appears before nuclear division and develop into ciliated bands that are attached to the nuclear tips which form a small beak each.
  - (xx) The spiral bands gets wound around the tip of the nucleus to form few spiral turns.
  - (xxi) The Pollen tube grows through the nucellus and may branch.
  - (xxii) The multiciliated sperms in Ginkgo are not separated by any wall formation with in the body cell.



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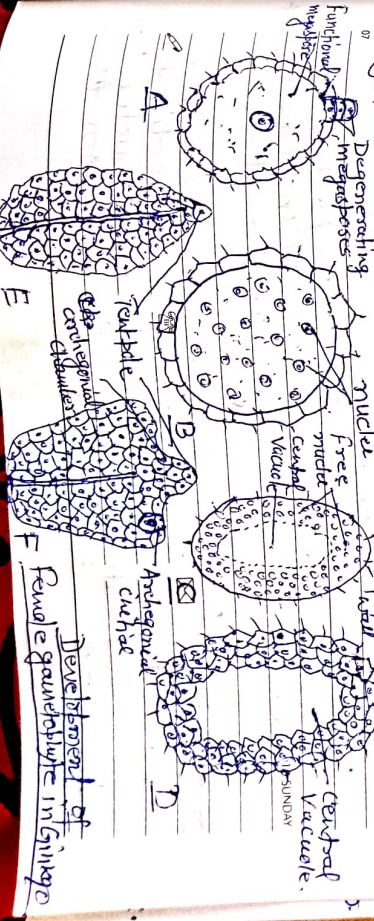
Female gametophyte

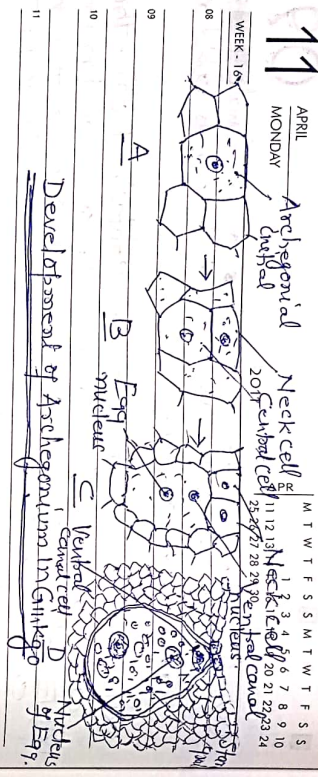
- (i) The megaspore is the pioneer structure of the female gametophyte. It enlarges and assumes a spherical shape.
- (ii) The megaspore nucleus undergoes repeated meiotic divisions until 256 free nuclei are formed. Such a condition is similar to the cycadale.
- (iii) These nuclei are embedded in a thin peripheral cytoplasmic layer that surrounds a central vacuole which later starts diminishing.
- (iv) The wall formation is centripetal i.e. it starts from the periphery and proceeds towards the center.
- (v) During wall formation, the outermost cells are completely surrounded by cell wall but the innermost cell has no wall towards the inner side. That faces the centre of the megaspore.
- (vi) The wall formation proceeds towards the centre from all sides.
- (vii) The cells in the central region of the gametophyte are not formed by common wall leading to the formation of definite spaces along which the gametophyte can be split into two.
- (viii) A characteristic beak like protuberance develops from the micropylar end of the female gametophyte and touches the base of Pollen chamber. This protuberance is called Foot pole.
- (ix) The ovules of Ginkgo resembles some Cordulata ovules.

M	T	W	T	F	S	S	M	T	W	T	F	S	S
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Characteristics features of the female gametophyte

- (i) That its cells develop chloroplasts and are green in colour.
- (ii) The female gametophyte contains two or three archegonia embedded in the micropylar end.
- (iii) Each archegonium consists of a large venter containing the female nucleus or the egg and a venter canal cell.
- (iv) The archegonium neck consists of two cells (Bierhorst-1971, Chamberlain-1995). According to Sporne (1969) there are four neck cells.
- (v) Lee (1955) observed that just before the division the central cell into ventral canal cell and egg cells the two neck cells divide to form four neck cells which swell to form a hemispherical protuberance.
- (vi) The neck protuberance into the crevice like circular archegonial chamber.
- (vii) Presence of a definite ventral canal cell in the archegonia that differentiates it from the archegonia of Cycads.
- (viii) The ventral canal cell degenerates before fertilization.
- (ix) The archegonia are situated in the micropylar end of the ovule.
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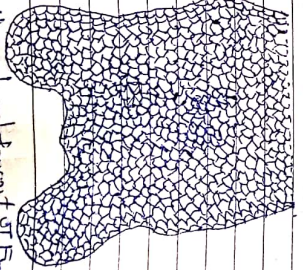
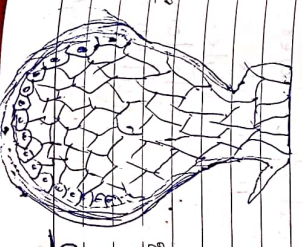
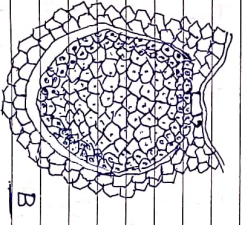
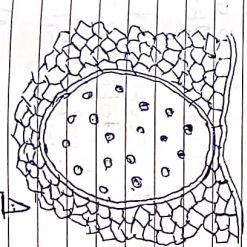




Fertilization

- (i) At the time of fertilization, the archegonial chamber in Ginkgo is filled with a liquid.
  - (ii) When the pollen tubes discharge their sperms into the archegonial chamber, through the opening near the prothallial end of the Pollen tubes the sperms squeeze their way through the archegonial neck.
  - (iii) During their journey towards the female nucleus the sperms are stripped off their flagella and cytoplasmic membrane.
  - (iv) The naked male nuclei move towards the egg and one of them able to fuse with it and effect fertilization or Syngamy.
  - (v) Raney and Bellforth (1962) reported that the amount of total amino acid increases during fertilization and embryo development.
- Embryogeny :- (i) The zygote enlarges in the archegonial chamber and its nucleus divides repeatedly to form 256 ~~random~~ free nuclei that are distributed throughout the cytoplasm, there being no central vacuole.

- (ii) Lee (1955) reported the formation of a vesicle at the lower part of the Proembryo.
- (iii) Later as a result of centripetal wall formation the developing embryo becomes cellular throughout.
- (iv) The cells in the micropylar end of the embryo enlarge much more than those at the chalazal end.
- (v) The former forms into an indistinguishable Subpensor that grows about 1 milimetre out of the neck of archegonium and curves over and generally touches the tentacle.
- (vi) As both as the embryo matures, it germinates in June at the second nodus when adequate water and suitable temperature are present.
- (vii) The embryo matures without dormancy.

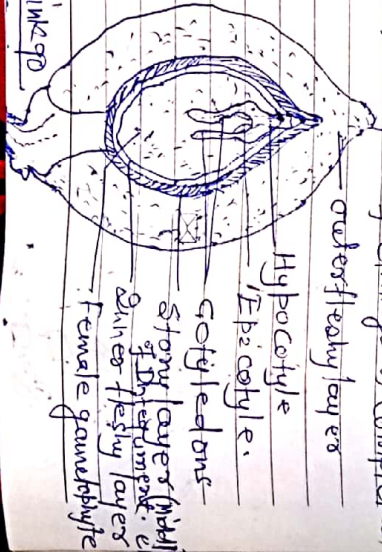


Stages in the development of Embryo

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11 12 13 14 15 16 17 18 19 20 21 22 23 24	11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30	25 26 27 28 29 30

Seed: The mature seeds are about the size of a small apricot and the seed coat is composed of an outer orange colored fleshy pericarp and the inner hard stony layers.

- (i) Next to the stony layer is the pectin inner layer made up of crushed mucellus and inner fleshy layers of the integument.
- (ii) On the centre is dicotyledonous embryo surrounded by abundant endosperm.
- (iii) The Pollen chamber and female have dissepiments.
- (iv) The nucellus is visible as a minute opening.
- (v) The reduced callus is also visible at the base.
- (vi) The germination of seed is hypogeal.
- (vii) During seed germination the primary root emerges early and penetrates the soil as a result of active cell division at the tip of the hypocotyl.
- (viii) The cotyledons remain within the seed coat, where they absorb food from the gametophyte and pass it on to the developing seedling axis.
- (ix) The first leaves that unfold are typically bilobed. Usually the reproductive cycle of Ginkgo is completed with in two years.



1. S. of seed of Ginkgo

MTWTFSS	MTWTFSS
1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16 17 18 19 20 21 22	9 10 11 12 13 14 15 16 17 18 19 20 21 22
23 24 25 26 27 28 29 30 31	23 24 25 26 27 28 29 30 31

Economic Importance:

- (i) Ginkgo is commonly grown as an ornamental tree in the gardens all over the world. It is also grown as shade tree.
- (ii) The tree is worshipped in China and Japan.
- (iii) The endosperm of the roasted seeds is edible.
- (iv) The tree has a remarkable property of resisting fungal and bacterial attacks.
- (v) The male trees are usually preferred in the city gardens.
- (vi) The tree is known in Hindi as Bad Kunwar.

Phylogeny: The Ginkgo biloba is the only surviving species of the ancient order has certain characteristics peculiar to itself. These include:

- (i) The fan-shaped and bilobed leaves with dichotomous venation.
- (ii) The presence of callus below the ovules. The ovules are borne on stalk like peduncles and these are, no structures likened to the megasporophylls.
- (iii) Presence of humul-like outgrowth at the tips of the male sporangioophores.
- (iv) The female gametophyte is produced into a female like structure at its apex.
- (v) The embryo lacks a well developed suspension.

Ginkgo resembles Cordatales and Cycadales in certain and many respects.

Resemblances with Cycadales:

- 1. The Pollen tubes are haustorial in function.
- 2. The spermatoblasts are large and multiflagellated.
- 3. Presence of a Pollen chamber and a distinct nuclear beak.
- 4. The female gametophyte is large and woody.
- 5. The large egg and the venter of the archegonium.
- 6. The embryo is endospermic and has two cotyledons.