Notes

Programme: Bachelor of Science (Second Year– III Semester)

Subject: Botany

Paper Code: BOC 103

Paper Title: Plant Anatomy and Embryology.

Unit VII: Embryo and Endosperm, Seed structure.

Module Name: Structure of dicot and monocot embryo.

Name of the Presenter: Ms. Lynette Fernandes

Structure of dicot and monocot embryo

A mature seed has a diploid (2N) embryo which develops from a fertilized egg or **zygote**. It results from the union of a sperm (1N), from a germinated pollen, with a female egg (1N) in the embryo sac. It is the embryo that ultimately gives rise to a new plant.

Post fertilization changes –

- **Zygote** – develops into the embryo
- **Primary endosperm nucleus** – forms the nutritive endosperm.
- **Ovule** - develops into the seed
- **Integuments** - develops into the seed coat
- **Ovary** - develops into the fruit

Embryo is the baby plant, enclosed in a seed. **It consists of two parts:**

i. Cotyledon - Their number is either one (monocotyledons) or two (dicotyledons). Sometimes they store food and become fleshy. But in some cases, they do not store food, remain thin and papery.

ii. Embryonal axis.

<u>Dicot embryo</u>

Development of dicot embryo.

The process of development of the embryo from the zygote is called embryogenesis.

After fertilization, the oospore or zygote undergoes a period of rest which may vary from a few hours to a few months. In general, the primary endosperm nucleus divides first and the zygote divides later. Primary endosperm nucleus does not undergo any resting period.

There are no much differences In the early stages of development of the embryos of monocots and dicots but in the later stages, marked differences between the two are observed.

The zygote divides transversely, forming a small apical cell (embryo cell) which lies towards the inner side and a large basal cell (suspensor cell) which lies towards the micropylar end of the embryo sac. The basal cell undergoes a transverse division and the apical cell divides vertically thus forming a four celled, inverted T shaped pro embryo. Each of the apical cells divide by vertical walls resulting in a quadrant. The quadrant cells in turn become partitioned by a transverse wall, so as to form octants. The lower 4 cells of the octant are destined to give rise to the stem tip and cotyledons and the upper 4 to the hypocotyl. All the eight cells divide periclinally. The outer derivatives form the dermatogen, while the inner ones undergo further divisions to give rise to the periblem and plerome initials. The cells of the dermatogen divide anticlinally and eventually produce the epidermis of the embryo, while the inner cells by further divisions produce the ground meristem and procambial system of the hypocotyl and cotyledons.

Meanwhile the 2 upper cells of the 4 celled pro- embryo, divide to form a row of 6 to 10 suspensor cells of which the uppermost cell, close to the micropyle becomes swollen and vesicular and probably serves a haustorial function. The distal most cell of the suspensor, which is contiguous with the spherical, distal part of the proembryo, functions as hypophysis.

This cell enlarges, and projects a little into the spherical distal region and divides by a transverse and two vertical walls at right angles to each other, and produces a group of eight cells. Of these, the 4 distal cells form initials of the root cortex and the proximal group of 4 cells produce the root cap and root epidermis.

At the same time, further divisions take place in the embryo proper, especially at two points in the lower tier which are destined to form the two cotyledons. A plumule initial is flanked by the two cotyledon initials. Growth in the cotyledonary zones is much faster than in the plumular zone. As a result, in the mature embryo the plumule is enclosed at the base of the two cotyledons. At this stage the embryo appears more or less cordate in longitudinal section. The cotyledons and the hypocotyl elongate mainly by transverse divisions of their constituent cells.

The enlarging embryo bends itself in the curved embryo sac.

Structure of mature dicot embryo

- The embryo consists of embryonal axis with two large lateral cotyledons attached to it.
- At the other end is the swollen suspensor.
- The portion of embryonal axis which is above the level of cotyledons is called epicotyl and the portion below the level of cotyledons is called the hypocotyl.
- The epicotyl is a tiny shoot from which the entire plant shoot system develops. The growing tip of the epicotyl is the plumule.
- The epicotyl terminates into the plumule (embryonic shoot)
- The hypocotyl is the transition zone between the rudimentary root and shoot;
- Lower end of hypocotyl forms the radicle (embryonic root).
- In the hypocotyl region, the central cells become somewhat elongated and form the procambial strand.
- The pronounced curvature of the cotyledons is due to their own enlargement and also of the hypocotyl.

Monocot embryo

The main difference between the mature embryos of monocots and dicots is the number of cotyledons. In monocots a single cotyledon is present, and the shoot apex is lateral in position in somewhat cylindrical embryo and cotyledon is lateral to the embryonic axis.

After fertilization, the diploid zygotic cell divides by a transverse division to form upper larger cell (basal cell) and a lower smaller cell (terminal cell). The basal cell does not divide further and it simply enlarges to be transformed into a large vesicular structure called haustorium (helps in absorption of nutrition). The lower smaller cell (terminal cell) called embryonic cell, undergoes a transverse division to form a cell at the tip called top cell and below that a middle cell.

Middle cell divides and redivides to gives rise to almost all parts of the embryo – plumule part (coleoptile), radicle (coleorhiza), epicotyl and hypocotyl and also the suspensor.

Terminal/ top cell divides by longitudinal and transverse divisions to form a globular embryo which later gives rise to the cotyledon which is thin and papery. The digested material from the endosperm, first comes to the cotyledon and is then passed on to embryo.

Later, the suspensor and basal cell degenerates.

Structure of mature monocot embryo.

Monocots have a single cotyledon which is lateral in position and is called scutellum. It is present on one side of the embryonal axis. A few species may show a remnant of the second cotyledon represented by a small outgrowth which is not functional - **epiblast** present on the other side of the embryonal axis. The portion of the embryonal axis below the level of the scutellum is the radicle, which bears an apical meristem and a root cap at the lower end. The radicle and the root cap are enclosed in coleorhiza which is undifferentiated lower part of the proembryo. The portion of the embryonal axis above the level of the scutellum is the epicotyl. It comprises the shoot apex with some leaf primordia, enclosed in a hollow foliar sheath, the coleoptile.