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Structure of the gametophytes of Pinus:

Male gametophyte:

The microspore is the first cell of the male gametophyte. Microspore begins to germinate within the microsporangium and produces an extremely reduced male gametophyte. The microspore first divides to form a very small first prothellial cell and a large cell. The large cell then cuts off a second prothellial cell adjacent to the first one and the remaining of the large cell forms the antheridial cell. The two prothellial cells soon degenerate. The antheridial cell again divides to form a small generative cell above and a large tube cell below. The nucleus of tube cell is known as tube nucleus which regulates the growth of the pollen tube.

The microspores are dispersed with the help of wind. Further development of microspores takes place when it reaches the ovule due to pollination. A number of microspores reach the megasporangium (ovule) where they are attached with sticky mucillagenous substance from the micropyle.

When mucillagenous substance dries up, some of the microspores are drawn inside on to the apex of the nucellus. Later on, the spore coats split between the wings. Then the tube cell protrudes and grows to form the pollen tube. Ultimately, the pollen tube penetrates the nucellus. The generative cell then divides to form a sterile stalk cell and a fertile body cell (spermatogenous cell). The body cell further divides to form two non-motile unequal male gametes (sperms).

Female gametophyte:

The functional megaspore is the first cell of the female gametophyte. It germinates within the megasporangium. The functional megaspore enlarges in size, its nucleus divides repeatedly by free nuclear divisions to form about 2,500 daughter nuclei. All the nuclei lie in the cytoplasm of the megaspore.

After that, a large central vacuole is produced, whereby the cytoplasm together with the nuclei moves towards the periphery. After pollination, development of the female gametophyte takes place again.

The walls are broken down around the nuclei and ultimately, a solid mass of thin walled cells are formed. The massive tissue thus formed within the megaspore. It is known as the female gametophyte. It is often referred to as the endosperm. The endosperm tissue is haploid (n).

A few flask shaped archegonia (2-3) are formed from the superficial cells (archegonial initials) that lie towards the micropylar end of the female gametophyte.

A mature archegonium consists of a neck of eight cells, one ventral canal cell and a large egg. There is no neck canal cell.

Fertilization:

After a year of pollination, fertilization occurs. The pollen tube moves downwardly and reaches the neck of the archegonium. It then penetrates the neck and the tip of which bursts to discharge the two male gametes. One of the male gamete unites with the egg to form a diploid zygote.

New Sporophyte

The zygote is the first cell of the sporophyte which germinates almost immediately after its formation. The zygote nucleus divides to form four free nuclei. These nuclei then moves to the bottom of the zygote where they divide again to form eight nuclei. Subsequently, walls appear between these nuclei except the upper two. Further divisions result in the formation of sixteen cells in four tiers; this sixteen celled structure is termed as the proembryo.

The upper most tiers of four open cells merges into the general mass of the cytoplasm to carry out nutritive function. The next tier of four cells is called rosette tier which is capable of forming abortive embryo; normally it supplies nutrients to the suspensor and the embryo.

The third tier of four cells constitutes the suspension tier. The lower most tier of four cells is the embryo tier. The cells of the suspension tier elongate to form four separate suspensors, each carrying an embryo cell at its tip. The cells of the embryo tier form the embryos. The elongated suspensors push down the embryos into the gametophytic tissue and thus help the later to receive their nutrients.

Each cell of the embryo tier divides to form four potential embryos and secondary suspensor. Formation of more than one embryo in each megasporangium is

referred to as polyembryony. In fact, only one of these embryos attains maturity and the others undergo degeneration.

After fertilization, the integument and the megasporangium are converted into seed coat and seed respectively. The seed contains embryo, the membranous nutritive layer perisperm and kernel. The nutritive tissue lies surrounding the embryo. A mature embryo consists of a radical, a hypocotyl, several cotyledons and a plumule. The seed germinates under favorable conditions to form a new sporophyte. This type of germination is called epigeal germination.
