Sexual Reproduction in Flowering Plants

CHAPTER 2

NCERT FOCUS

ANSWERS

Topic 1

1. Development of male gametophyte takes place from microspore or pollen grains which develop inside the microsporangium or pollen sac of an anther.
Development of female gametophyte takes place in the nucellus of ovule.

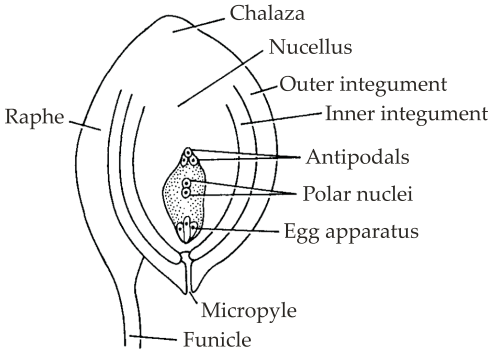
2. Differences between microsporogenesis and megasporogenesis are as follows :

S. No.	Microsporogenesis	Megasporogenesis
(i)	It is meiotic formation of haploid microspores from diploid microspore mother cell.	It is meiotic formation of haploid megaspores from diploid megaspore mother cell.
(ii)	The arrangement of microspores in a tetrad is generally tetrahedral.	The arrangement of megaspores in a tetrad is commonly linear.
(iii)	All the four microspores of a spore tetrad are functional.	Only one megaspore of a spore tetrad is functional.

During microsporogenesis and megasporogenesis meiotic cell division occurs which results in haploid gametes – the microspores or pollen grains and megaspores.

3. The correct developmental sequence for the formation of male gametes is :
Sporogenous tissue → Pollen mother cell → Microspore tetrad → Pollen grain → Male gametes.

4. Structure of a typical ovule of angiosperms is as follows:

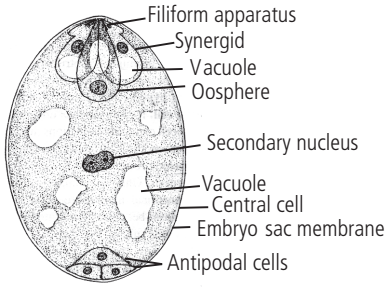


An angiospermic ovule consists of the following parts :–

– The ovule is attached to placenta by means of a stalk called funicle or funiculus.
– The point of attachment of funiculus to the body of ovule is called hilum.
– The main body of ovule is made of parenchymatous tissue called nucellus.
– Nucellus is covered on its outside by one or two coverings called integuments and hence ovule is rightly called as integumented megasporangium.
– The integuments cover entire nucellus except a small pore at upper end, which is called micropyle. Micropyle is formed generally by inner integument or by both integuments.
– The place of junction of integuments and nucellus is called chalaza.
– In inverted ovules (most common type), the stalk or funiculus is attached to the main body of ovule for some distance to form a ridge like structure, called raphe.
– In the nucellus of ovule, a large oval cell is present at micropylar end, which is known as embryo sac (female gametophyte), which develops from megaspore.

5. In majority of flowering plants one of the megaspores is functional while the other three degenerate. Only the functional megaspore develops into the female gametophyte or embryo sac. This method of development of embryo sac from a single megaspore is called monosporic development.

6. Normal or *Polygonum* type of embryo sac is as follows:



Embryo sac is an oval multicellular structure. It is covered by a thin membrane derived from the parent megaspore wall. The typical or *Polygonum* type of embryo sac contains 8 nuclei but 7 cells – 3 micropylar, 3 chalazal and one central. The three micropylar cells are collectively known as egg apparatus. One cell is larger and is called egg or oosphere. It bears a central or micropylar vacuole and a nucleus towards the chalazal end.

The remaining two cells are called synergids or help cells. Each of them bears a filiform apparatus in the micropylar region, a lateral hook, chalazal vacuole and a central nucleus. The egg or oosphere represents the single female gamete of the embryo sac. The synergids help in obtaining nourishment from the outer nucellar cells, guide the path of pollen tube by their secretion and function as shock absorbers during the penetration of pollen tube into the embryo sac.

The three chalazal cells of the embryo sac are called antipodal cells. They are the vegetative cells of the embryo sac which may degenerate soon or take part in absorbing nourishment from the surrounding nucellar cells. Internally, they are connected with central cell by means of plasmodesmata.

The central cell is the largest cell of the embryo sac. It has a highly vacuolated cytoplasm which is rich in reserve food and Golgi bodies. In the middle, the cell contains two polar nuclei which often fuse to form a single diploid secondary nucleus. Thus, all the cells of the embryo sac are haploid except the central cell which becomes diploid due to fusion of polar nuclei.

7. Chasmogamous flowers are those flowers which are open with exposed anther and stigma. Cleistogamous flowers are those flowers which do not open at all. In these flowers, the anthers and stigma lie close to each other. When anthers dehisce in the flower buds, the pollen grains come in the contact with stigma to accomplish pollination. So, these flowers are invariably self-pollinated as the flowers remain closed and there is no chance of cross pollen landing on the stigma. Pollination and seed setting are assured even in the absence of pollinators.

8. Continued self pollination results in inbreeding depression. So, flowering plants have developed following devices to discourage self pollination and to encourage cross pollination:

(i) Dicliny (unisexuality) : Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers on the same plants, *e.g.*, maize) or dioecious (bearing male and female flowers on different plants, *e.g.*, mulberry, papaya).

(ii) Dichogamy : Anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination.

(a) Protandry – Anthers mature earlier than stigma of the same flower. Their pollen grains become available to stigmas of the older flowers, *e.g.*, sunflower, *Salvia*.

(b) Protogyny – Stigmas mature earlier so that they get pollinated before the anthers of the same flower develop pollen grains, *e.g., Mirabilis jalapa* (four o' clock), *Gloriosa, Plantago*.

9. Tapetum is the innermost wall layer of anther. The cells of this layer have large nuclei and dense cytoplasm. This layer is of great physiological importance as most of the food material from outside passes through this layer. At maturity, these cells degenerate and provide nourishment to developing microspores or pollens inside. Tapetum is the layer, which secretes both enzymes and substances of hormonal nature.

The main function of tapetum is to provide nutrition to pollens but it also secretes some substances of utmost importance like :

(i) Callase enzyme : Tapetum secretes callase enzyme which dissolves callose substances by which four pollens of a pollen tetrad are united, hence separating microspores or pollens of a tetrad.

(ii) Ubisch bodies : These bodies of lipid nature are also secreted by tapetum. Ubisch bodies get covered with sporopollenin and thus increase thickness of exine (i.e., outer layer of pollen wall). Ubisch bodies are spheroidal and have diameter of only few microns. These are produced only by glandular tapetum (not by amoeboid tapetum).

(iii) Pollen kit substances : Tapetum also secretes pollen kit, outer most oily, thick, viscous, sticky, electron dense homogeneous coating of pollen grains of many entomophilous plants.

10. If a pistil carrying functional female gametes fails to set seeds following pollination with viable and fertile pollen, capable of bringing about fertilisation in another pistil, the two are said to be incompatible, and the phenomenon is known as sexual incompatibility. Sexual incompatibility may be interspecific (between individuals of different species) or intraspecific (between individuals of the same species). The latter is also called self-incompatibility. Self-incompatibility is a gene-physiological process. Incompatibility reactions are controlled by a single gene, called S-gene, which has several alleles. Pollen grains that possess the S-allele common to any one of the two alleles present in the cells of the pistil, will not be functional on that particular pistil. However, every pollen grain having no common S alleles with pistil would be functional on the pistil of a that plant. As self pollens are unable to fertilise the egg to form embryo, hence seeds are not formed in self-incompatible species.

Topic 2

1. If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation. Emasculated flowers have to be covered with a bag of suitable size, generally made up of butter paper, to prevent contamination of its stigma with unwanted pollen.

This process is called bagging. When the stigma of bagged flower attains receptivity, mature pollen grains collected from anthers of the male parent are dusted on the stigma, and the flowers are rebagged, and the fruits are allowed to develop. This process allows plant breeders to use desired varieties of pollen to obtain desired seeds.

2. Inside the embryo sac, one male gamete fuses with egg cell to form zygote (2n) and this is called syngamy or true act of fertilisation. This result of syngamy, *i.e.*, zygote (2n) ultimately develops into embryo.
The second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus and this is called triple fusion. The result of triple fusion, *i.e.*, primary endosperm nucleus (3n) ultimately develops into a nutritive tissue for developing embryo called endosperm.
The nuclei involved in this triple fusion are the two polar nuclei or secondary nucleus and the second male gamete.

3. Fertilised egg is known as zygote which gives rise to embryo. Before development, the zygote undergoes a resting period. This is because the zygote waits for the formation of certain amount of endosperm for the nourishment of embryo. This is an adaptation to provide assured nutrition to the developing embryo.

4. Removal of stamens or anthers of a bisexual flower without affecting the female reproductive organs is called emasculation. This technique is used in artificial hybridisation. In such crossing experiments it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination from unwanted pollens. This is achieved by emasculation and bagging technique. This technique is used to obtain desired variety of seeds.

Topic 3

1. (a) Differences between hypocotyl and epicotyl are as follows :

S. No.	Hypocotyl	Epicotyl
(i)	It is part of embryonal axis in between cotyledonary node and radicle.	It is part of embryonal axis in between plumule and cotyledonary node.
(ii)	During epigeal germination, hypocotyl elongates so that cotyledons come out of soil.	During hypogeal germination, epicotyl elongates so that cotyledons remain in the soil.
(iii)	Terminal end of hypocotyl is radicle.	Terminal end of epicotyl is plumule.

(b) Differences between coleoptile and coleorhiza are as follows :

S. No.	Coleoptile	Coleorhiza
(i)	The epicotyl bearing shoot apex and leaf primordia is enclosed in a foliar structure called coleoptile.	The radicle and root cap are enclosed in a sheath called coleorhiza.
(ii)	Coleoptile has a terminal pore for the emergence of first leaf.	Coleorhiza is a solid structure.
(iii)	Coleoptile after emergence from soil during germination, becomes green and does photosynthesis.	Coleorhiza does not come out of soil. It remains nongreen.

(c) Differences between integument and testa are as follows:

S. No.	Integument	Testa
(i)	It is the covering of the ovule.	It is outer covering of seed.
(ii)	It is thin, one or two layered.	It is quite thick and one layered.
(iii)	Its cells are living.	Its cells are dead.
(iv)	Sclereids are absent.	Cells are rich in sclereids.
(v)	It arises from chalazal end of ovule.	It is derived from outer integument of ovule after fertilisation.
(vi)	It is a pre fertilised structure.	It is a post fertilised structure.

(d) Differences between perisperm and pericarp are as follows :

S. No.	Perisperm	Pericarp
(i)	It is unused nucellus in the seed.	It is the covering of fruit that develops from ovary wall.
(ii)	It is a part of seed.	It is a part of fruit.
(iii)	It is usually dry.	It is dry or fleshy.
(iv)	It is often non-functional for seed.	It is protective covering and also helps in dispersal and nutrition.

2. Most fruits develop only from ovary and are called true fruits. When fruit develops from other floral parts other than ovary it is called false fruit. Apple is a false fruit where thalamus contributes to the fruit formation.

3. Parthenocarpic fruits are fruits which develop without fertilisation and hence are seedless. Parthenocarpy can

be induced through the application of growth hormones. Important fruits like banana, papaya, orange, grapes, guava, watermelon etc. can be made seedless by applying growth substances as they are economically important fruits and if made seedless they will be more valuable.

4. Normal type of sexual reproduction having two regular features *i.e.*, meiosis and fertilisation is called amphimixis. But in some plants this normal sexual reproduction is replaced by some abnormal type of sexual reproduction called apomixis. The term apomixis was first given by Winkler (1908). Apomixis may be defined as, abnormal kind of sexual reproduction in which egg or other cells associated with egg (synergids, antipodals, etc.) develop into embryo without fertilisation and with or without meiosis.

Hybrid varieties of several food and vegetable crops are being extensively cultivated. Cultivation of hybrids tremendously increased productivity. One of the problems of hybrids is that hybrid seeds have to be produced every year. If the seeds collected from hybrids are sown, the plants in the progeny will segregate and do not maintain hybrid characters. Production of hybrid seeds is costly and hence the cost of hybrid seeds becomes too expensive for the farmers. If these hybrids are made into apomicts, there is no segregation of characters in the hybrid progeny. Then the farmers can keep on using the hybrid seeds to raise new crop year after year and do not have to buy hybrid seeds every year. Embryos formed through apomixis are generally free from infections.

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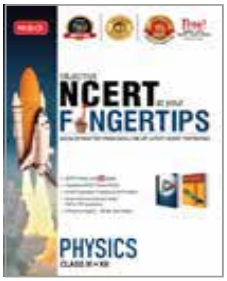

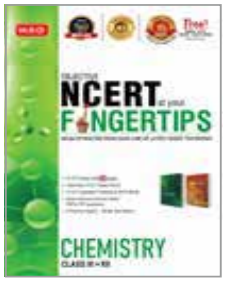

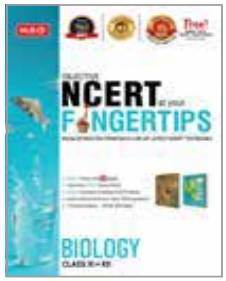

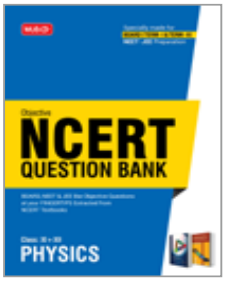

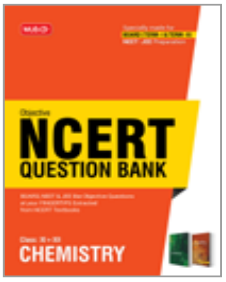

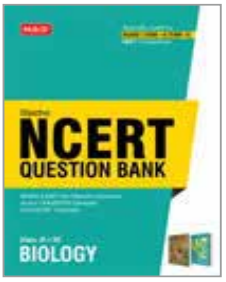

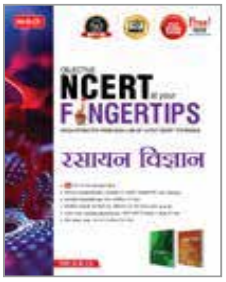

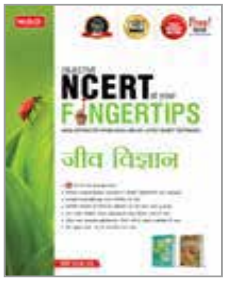

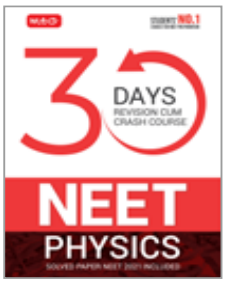

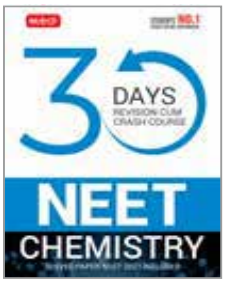

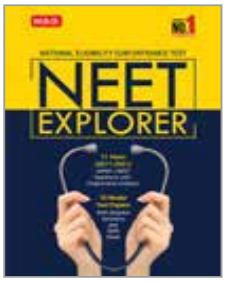

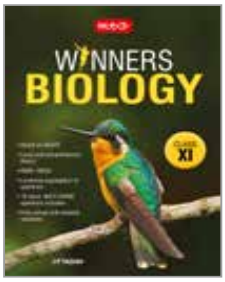

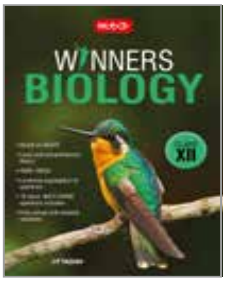

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