

Sexual Reproduction in Flowering Plants

CHAPTER 2

**EXAM
DRILL**

ANSWERS

- (c)** : Each pollen mother cell undergoes meiotic division to produce 4 pollen grains. So, for generation of 8000 pollen grains, $8000/4 = 2000$ pollen mother cells will undergo meiotic division.
 - (b)** : Sometimes, fertilisation fails for one or the other reasons, the ovary may develop into the fruit without fertilisation. This type of fruit development by unfertilised ovary is known as parthenocarpy and the fruits as parthenocarpic fruits.
 - (d)** : Hypocotyl is the part of embryonal axis in between cotyledonary node and radicle. The terminal end of hypocotyl is radicle. In epigeal germination hypocotyl elongates so that cotyledons come out of soil.
 - (c)**
 - Fusion of male gamete with diploid secondary nucleus to form triploid primary endosperm nucleus is called as triple fusion as it involves fusion of three nuclei. It takes place in embryo sac during double fertilisation.
 - The process of removal of anthers from the flower is called as emasculation. It is done before dehiscence to prevent contamination of stigma with any undesired pollen and to ensure cross-pollination by desired pollens. Emasculation is useful in artificial hybridisation to pollinate stigma with selected pollens only.
 - Wind-pollinated flowers do not have the properties required to attract pollinating insects. They are not showy, do not have nectar and also do not produce edible pollen or scent. They produce large quantities of light, dry pollen that can be carried by the wind. Therefore, these flowers are not visited by honeybees.
 - Self-incompatibility is a condition where pollen is not able to fertilise the stigma of same flower or other flower on the same plant due to presence of similar self sterile gene (S_1S_3 in pistil and S_1 or S_3 in pollen grain) leading in to inhibition of the growth of the pollen tube in the stigma and style, thereby preventing delivery of male gametes to the ovules.
 - The strategies evolved to prevent self-pollination in flowers are:
 - Dichogamy : The maturation of anthers and stigma at different time in a bisexual flower which prevents self-pollination.
 - Self-incompatibility: The pollen grains of a flower are not capable of completing growth on the stigma of the same flower.
 - (b)**
 - (c)** : *Butea monosperma* is pollinated by birds.
 - (b)**
 - (a)**
 - (d)** : Due to triploid nature, endosperm is physiologically very active and grows faster and accumulates nutrients.
- OR**
- (b)**
 - (i) (a)** : Pollination carried out by snails (U) is called Malacophily, e.g., *Arisaema*.
(ii) (b) : *Zostera* is a hydrophilous plant, i.e., it is pollinated by water (Q). In *Zostera*, the marine angiosperm, the pollen grains are long ribbon-like.
 - (iii) (a)**
 - (iv) (a)** : *Kigelia pinnata* and *Bauhinia megalandra* are bat pollinated (T) plants.
 - (v) (a)**
 - (i) (d)** : Dicliny (Unisexuality) : Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers, e.g., Maize) or dioecious (bearing male and female flowers on different plants, e.g., Mulberry, Papaya).
(ii) (c) : Herkogamy : It is a mechanical device to prevent self pollination and promote cross pollination. (a) Extrorse dehiscence of anthers. (b) In Pansy, stigma lies inside a flap while in *Kalmia* the anther occur inside.
(iii) (b) : In *Salvia*, protandry is observed i.e., anthers mature earlier than stigma of the same flower.
(iv) (c) : In *Gloriosa*, protogyny is observed i.e., stigmas mature earlier than the anther of the same flower.
(v) (a) : Homogamy is the contrivance to ensure self pollination. It means that flowers are bisexual and both the sexes mature at the same time.

17. 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 nonfunctional for seed. | It is protective covering and also helps in dispersal and nutrition. |
| (v) | Perisperm is present in only a few seeds. | It is found in all fruits. |

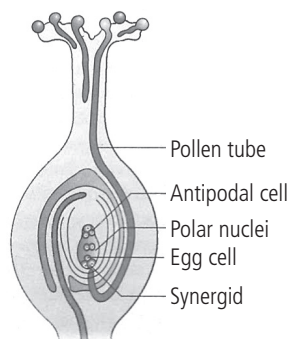
18. *Alstonia scholaris* (devil tree) blooms in the spring season, when pollens fill the surrounding air. The dust like pollen grains enter the respiratory tract easily and absorb moisture to swell up and block the tract. This causes breathing problem. People prone to asthma may feel uncomfortable while inhaling the air carrying pollen. This is also known as pollen allergy.

OR

Jasmine flower is entomophilous (insect pollinated), so it has developed characters to ensure pollination by its pollinating agents. The white colour of the flowers of jasmine make them more readily visible at night to insects, *i.e.*, pollinating agents. These flowers produce fragrance, so, insects detect them easily when they follow the scent trail to flowers. As the flowers are small, a number of flowers remain clustered to appear like inflorescence to make them conspicuous to insects.

19. The given figure represents bagging step of artificial hybridisation technique. During emasculation, stamens are removed to prevent self fertilisation. This is done just before the flower would naturally open by itself. Since the flower has not yet opened, there is less chance that fertilisation has taken place. If someone forgets to bag the flower, it will allow the flowers to get pollinated by the pollen from some nearby undesirable flower of the same plant. This can result in undesirable hybridisation.

20. Longitudinal section of a flower showing growth of pollen tube is as follows :



21. Similarities between apomixis and parthenocarpy:

(i) In both apomixis and parthenocarpy, there is no fertilisation involved. So, both produce offsprings similar to parents. In both cases, there is no chance of diversity in genes.

(ii) Since both the types of phenomenon do not involve fertilisation, they are both used as asexual means or vegetative propagation methods. Though both methods are asexual, they still use the sexual organs of the plant - the ovary and the ovules.

Differences between apomixis and parthenocarpy:

(i) Apomixis is the formation of seeds whereas parthenocarpy is the formation of fruits without fertilisation.

(ii) Apomixis produces genetically identical seeds whereas parthenocarpy produces seedless fruits.

22. Eelgrass is a common submerged aquatic plant. In the plant, the female flowers reach the surface of water by long stalk. The pollen grains from the male flower are carried by water currents to female flower. After reaching the female flower, fertilisation takes place. During summer, eel grass flowers produce seeds which float in water until they sink to the bottom.

23. Wheat porridge is made from whole wheat. As the wheat is fed into the mill, the rollers flake off the bran and the endosperm containing starch is cracked into coarse pieces in this process. During cooking, starch mixes with the cooking medium making it gooey and slimy. Thus, due to the presence of slimy starch, it seems sticky.

24. Autogamy is the transfer of pollen grains from the anther to the stigma of the same flower. Geitonogamy is the transfer of pollen grains from anther to the stigma of a different flower present on the same plant. Xenogamy is the transfer of pollen grains from the anther of one flower to the stigma of genetically different flower.

Both autogamy and geitonogamy lead to inbreeding depression because the pollen grains are genetically similar resulting into inbreeding. Continuous inbreeding reduces vigour.

25. (a) In the given figure X, Y and Z represent endosperm, wheat germ and bran layer, respectively. X (endosperm) develops from the fusion of the secondary nucleus and one male gamete.

Y (wheat germ), it is actually a mature ovule and Z (bran layer), the wall of the ovary develops into the wall of fruit.

(b) X-Triploid (3n), Y-Diploid (2n), Z-Diploid (2n)

26. (a) Chiropterophily is cross pollination performed by bats. Bats are nocturnal flying mammals which can transport pollen over long distance, sometimes over 30 km.

Chiropterophilous flowers are dull-coloured with strong fermenting or fruity odour abundant nectar and pollen

grains. Chiropterophilous flowers secrete even more abundant nectar than the ornithophilous flowers. Pollen grains are also produced in more abundance.

Example of chiropterous plants are *Kigelia pinnata*, *Adansonia*, *Bauhinia megalandra*.

(b) Ornithophily is the mode of allogamy performed by birds. Two common types of tropical pollinating birds are sun birds (Afro-Asia) and humming birds (America). Some other pollinating birds are Crow, Bulbil, Parrot and Mynah. Common bird pollinated plants are *Bombax*, *Erythrina*, *Callistemon*, *Butea monosperma*, *Bignonia*.

27. Coevolution is the evolution in two that interact extensively with one another so that each acts as a major force of natural selection on the other. When one evolves a new feature or modifies itself, the other evolves new adaptations in response of it. This constant mutual feed back modification between the two species is known as coevolution.

The coevolution of the flower and its pollinator species are tightly linked with one another. Flower parts are modified, shaped by mutations and natural selection into a form that enhances pollination. The first group of insects that evolved as pollinators of ancient angiospermic flowers were beetles. Majority of insect pollinated flowers are beautifully coloured, fragrant, rich in nectar, large in size or if small, they are grouped into an inflorescence to make them conspicuous. To sustain animal visits, flowers have to provide rewards to the animals. Nectar, pollen grains, shelter and edible floral parts and young seeds are the usual floral rewards for pollinators and juicy and nutritious fruits for seed dispersers so that insects/animals regularly visit them to feed or take shelter. For harvesting the rewards from the flower, the animal visitor comes in contact with the anthers and the stigmas of the flower. The sticky pollens of insect pollinated flowers, get adhered to the body of pollinator. When this pollinator carrying pollen on its body come in contact with the stigma, it brings about pollination.

28. Significance of fruit formation :

- (i) Protection : Developing fruits protect the developing seed from mechanical injury, insect and unfavourable climatic condition.
- (ii) Dispersal : Fruits help the seeds in dispersal to distant places.
- (iii) Food to Animals : Fleshy fruits provide food to animals who also act as dispersal agents of their seeds. Fleshy fruits generally have hard seed (e.g., Guava, fig) while hard shelled fruits have soft seeds (e.g., Almond).
- (iv) Nutrition to germinating seeds : Some fruits provide nutrition to germinating seeds and developing seedlings.

(v) Importance to Humans : Fruits are a source of food, protein, oil, organic acids, vitamins, minerals and sugars.

OR

Sexual incompatibility is the inability of certain otherwise viable gametes to fuse with each other and produce fertile offspring. Sexual incompatibility may be interspecific or intraspecific. Interspecific incompatibility is important as it prevents free cross pollination amongst members of different species. Intraspecific incompatibility, self-sterility or self incompatibility is inability of a plant producing functional male and female gametes to produce fertile offspring when self pollinated. It is a mechanism to prevent inbreeding and promote outbreeding. It can be due to morphological or physiological reasons.

1. Morphological self incompatibility. There are two three different mating types e.g., distyle (*Primula*), tristyle (*Lythrum*),
2. Physiological self Incompatibility. There is no morphological distinction amongst the different mating types found in the species. Physiological self incompatibility is of two types.
 - (i) Gametophytic self incompatibility (GSI). The incompatibility is due to genotype of pollen, e.g., Liliaceae, Solanaceae, Poaceae.
 - (ii) Sporophytic Self Incompatibility (SSI). The incompatibility is due to genotype of sporophytic or stigmatic tissues, e.g., Asteraceae, Brassicaceae.

29. Double fertilisation is the fusion of two male gametes brought by a pollen tube to two different cells of the same female gametophyte in order to produce two different structures. It is found only in angiosperms. One male gamete fuses with the egg or oosphere to form a diploid zygote or oospore. It is called generative fertilisation. The second male gamete descends down and fuses with the diploid secondary nucleus of the central cell to form a triploid primary endosperm cell. It is known as vegetative fertilisation.

Significance :

- (i) In angiosperms the growth of the female gametophyte or embryo sac stops at the 8-nucleate or 7-celled stage. The second act of fertilisation, called vegetative fertilisation, provides a stimulus to one of its cells to resume growth and form a nutritive tissue.
- (ii) Double fertilisation ensures that the nutritive tissue is formed only when the formation of embryo has taken place by fertilisation of the oosphere or egg.
- (iii) Double fertilisation provides the characteristics of the male plant as well to the nutritive tissue.
- (iv) Due to its triploid nature, endosperm shows high physiological activity, grows faster and accumulates nutrients.

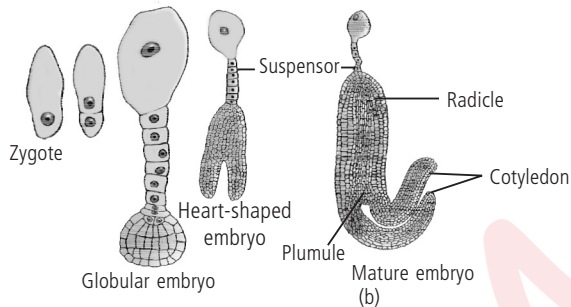
30. (a) Contrivances (Devices) to ensure self pollination :

- Flowers are bisexual and both sexes mature at the same time (homogamy).
- In some cases, flowers are bisexual and cleistogamous, *i.e.*, remain closed.
- Pollination occurs in bud condition before the opening (anthesis) of flower.

(b) Disadvantages of self pollination :

- New useful characters are seldom introduced.
- Vigour and vitality of the race decreases with prolonged self pollination.
- Immunity to disease decreases.
- Variability and hence adaptability to changed environment are reduce.

31. (i) Development of embryo after syngamy in a dicot is as follows:



(ii) The embryo development starts only after a certain amount of endosperm is formed. It is an adaptation for assured nutrition of the developing embryo. Therefore, endosperm development precedes embryo development.

OR

(i) Zygote in angiosperms mostly divide only after a certain amount of endosperm is formed as an adaptation strategy to assure nutrition for the developing embryo.

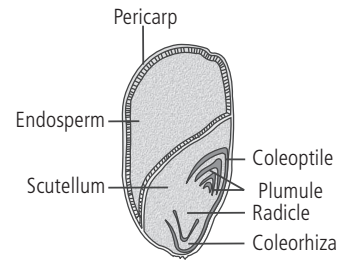
(ii) Bean seeds are exalbuminous because the developing embryo utilises the endosperm completely. So, there is no endosperm left in the seed. Maize seeds are albuminous because endosperm is not completely used up by the developing embryo. There is some amount of endosperm left in the seeds always.

(iii) Micropyle allows entry of water and oxygen during seed germination.

(iv) During unfavourable conditions, seeds become dormant. The loss of water reduces the metabolic activity of seeds and hardens the integuments.

(v) In strawberry, thalamus contributes in fruit formation. So, they are not called true fruits.

32. (a) Longitudinal section of an albuminous seed of maize is as follows :



(b) Importance of seeds to flowering plants are:

(i) Dependable method : Unlike bryophytes and pteridophytes, pollination and fertilisation of seed plants are free from requirement of water. Seed formation is, therefore, more dependable.

(ii) Perennation : Seed is dry (water content 10-15%) with dormant embryo and thick protective seed coat. It is most suitable for perennation through unfavourable periods.

(iii) Dispersal : Seeds have adaptive strategies to get dispersed to new habitats and colonise the same.

(iv) Reserve Food : Seeds have reserve food for nourishing the young seedling still they become nutritionally independent.

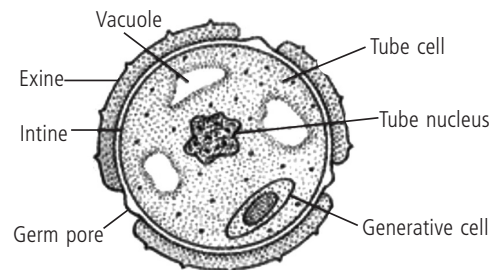
(v) Variations. As seeds are formed through sexual reproduction they carry a number of variations. Variations are essential for adaptability to diverse environmental conditions.

(vi) Storage : Seeds can be stored for later use. This is helpful for supply of food throughout the year and to overcome drought and famine conditions.

(vii) Agriculture : Seed is the basis of agriculture. Agriculture originated when humans learnt to eat, store and sow seeds. Agriculture proved to be the turning point for evolution of human civilisation, industrialisation, science and technology.

OR

The labelled diagram of a mature microspore of an angiosperm with its cellular components is as follows :



Functions of labelled parts are as follows:

(a) Exine provides protection.

(b) Intine grows out as pollen tube through one of the germ pores on the exine.

(c) Vegetative cell contain food reserves, *i.e.*, starch, protein, fat.

(d) Generative cell divides mitotically to produce two male gametes.

33. (a) Differences between unfertilised embryo sac and fertilised embryo sac are as follow:

| | Unfertilised embryo sac | Fertilised embryo sac |
|-------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| (i) | All the cells are haploid. | Zygote is diploid, PEN is triploid and other cells are haploid. |
| (ii) | Antipodals and synergids are distinctly present. | Antipodals and synergids gradually degenerate. |
| (iii) | The haploid polar nuclei may fuse to form a diploid secondary nucleus. | Diploid secondary nucleus. get fertilised with a haploid male gamete to form a triploid PEN. |
| (iv) | Egg cell is haploid. | Egg cell gets fertilised due to fusion with male gamete to form a diploid zygote. |

(b) The ability of seeds to retain the power of germination over a period of time is called viability of seeds. In a few species the seeds lose viability within few months. The seeds of large number of species live for several years. The oldest viable seed is that of lupine, *Lupinus arcticus* excavated from Arctic tundra. The seed germinated and flowered after an estimated record of 10000 years of dormancy. The recent record of 2000 years old viable seed is of the date palm, *Phoenix dactylifera* discovered during the archeological excavation at King Herod's palace near 'The Dead Sea'.

OR

The outbreeding devices are the devices or mechanisms to prevent self pollination and favour cross pollination to

overcome the problem of inbreeding depression (caused due to continuous self pollination). These are also called contrivances for cross pollination. The factors favouring cross pollination are :

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

(ii) **Dichogamy** : The bisexual flowers in which male and female reproductive parts mature at different times, so prevents self pollination and favours cross pollination. It is of two types –

(a) **Protandry** : Flower in which anther mature earlier to stigma to prevent self pollination. *E.g.*, sunflower, *Salvia*

(b) **Protogyny** : Flower in which stigma matures earlier to anther to prevent self pollination. *E.g.*, *Mirabilis jalapa*.

Pollen release and stigma receptivity are not synchronized due to dichogamy (protandry and protogyny).

(iii) **Herkogamy**: It is flower in which there are physical barrier between anther and stigma. *E.g.*, *Calotropis*.

(iv) **Heterostyly**: The flower with different length of styles and stamens that prevents self pollination. *E.g.*, Primrose, Jasmine.

(v) **Self sterility or self incompatibility**: The pollen grains do not germinate on stigma of same flower due to mutual inhibition. In this the genetic mechanism prevents the pollen germination on stigma. *E.g.*, Potato, Tobacco, etc.

(vi) **Suppression of one sex**: In bisexual flower stamen or carpel is completely suppressed and becomes sterile.

