Chapter - 4
Special Methods of Plant Reproduction

Reproduction in angiospermic plants generally takes place by vegetative and sexual methods. But in many plants there are some such methods of sexual reproduction in which new plants are developed without fertilization. Such methods are known as special methods of reproduction. Some authors call these as asexual reproduction.

Following are the special methods of reproduction in plants:

(1) Apomixis

(2) Agamospermy

(3) Micropropagation

(4) Vegetative propagation

(1) Apomixis

According to Hans Vinkler (1908) "Replacement of general sexual reproduction by any such method in which meiosis and fertilization do not occur is termed apomixis".

Embryologists have included vegetative propagation and agamospermy in apomixis. According to the above definition apomixis is of two types –

1. Sporophytic apomixis :- This is also known as adventive embryogeny. In this type of apomixis, embryo may develop from any diploid cell of nucellus or integuments. During this process meiosis and fertilization are not involved.

2. Gametophytic apomixis :- In this type of apomixis, embryo is developed from any haploid cell of embryo sac. This is of two types – (i) When embryo is developed from unfertilized egg cell, then this process is known as parthenogenesis and when embryo is formed from any haploid cell of embryo sac like synergid or antipodal cell, then this process is called **apogamy**.

Apomixis in flowering plants has been divided into two main types by Professor Panchanan Maheshwari (1950) – (i) Non-recurrent apomixis and (ii) Recurrent apomixis. These have further been divided into many types. We shall briefly study the following four types: -

(1) Non recurrent

(2) Recurrent apomixis

(3) Adventive embryony

(4) Vegetative apomixis

(i) Non recurrent apomixis : In this type of apomixis, one haploid embryo sac is formed from a megaspore mother cell by meiosis. If an embryo develops from its haploid egg without fertilization, this type of apomixis is called haploid parthenogenesis. This process in plants was first studied by Jorgensen in 1928. On the other hand if embryo is developed from any other cell of female gametophyte except the egg cell, then it is called Haploid apogamy. This condition is found in datura and maize.

(ii) Recurrent apomixis : This type of apomixis is also known as Gametophytic apomixis. Due to failure of meiosis, the number of chromosomes in the female gametephyte remains diploid similar to that of mother plant. This is of two types –

(a) Generative apospory :- In this type of apomixis, the embryo sac is developed from the diploid cells of archesporium and from the diploid cells of embryo sac embryo is formed. Hence the embryo formed from these cells is diploid.

(b) Somatic apospory :- In this type of apomixis diploid embryo sac develops from diploid cells of nucellus or integuments and from the diploid cells of the embryo sac, diploid embryo is developed.

(iii) Adventive embryony :- The process of embryogeny in which development of embryo takes place, from any diploid cell of ovule such as a cell of nucellus or integuments situated outside the embryo sac, is called adventives embryony. This is also known as sporophytic apomixis. Example – lemon and mango.

(iv) Vegetative apomixis :- In this type of apomixis, bulbils or vegetative propagaules are formed in place of flowers in plants and these germinate while they are still present attached to the plant on which they are formed. This type of apomixis is found in onion and *Agave*.

Importance of Apomixis

(1) Meiosis does not occur in the process of apomixis, so that separation and recombination of chromosomes do not happen. Therefore the plants formed by this process possess all its characters exactly similar to the characters of the mother plant. Due to this reason, apomixis may be used to prepare clone.

(2) In the process of apomixis, seeds are formed by asexual reproduction, so the clonal offsprings similar to the mother plant may be prepared.

(3) Useful characters can be conserved in crops plants by this type of reproduction.

(4) Hybrid seeds may easily be produced by this type of reproduction because apomixis checks degeneration of specific characters of hybrid plants.

2. Agamospermy

In agamospermy the reproductive unit or propagule is seed, like in other plants but this seed is not a product of normal sexual reproduction. When seed is formed from any diploid (2n) cell of ovule or abnormal diploid embryo sac, without fertilization, it is called agamospermy. Such a seed is diploid but its all the genes are like that of mother plant. Agamospermy may happen by various ways. It is one main type is adventives embryo, which has been describe previously in this chapter.

3. Micro propagation

Microprapagation is most useful method of large scale propagation of wild plants, medicinal plants and commercially important plants. Details of this method are provided in unit IV of this book.

In this modern technique of plant breeding protoplasts, cells, tissues, organs of plants are cultures on suitable culture medium under aseptic and controlled conditions. By *in vitro* culture of the plant cells or tissues callus or shoots are formed. By differentiation of callus and root formation in the shoots, plantlets are developed. The plantlets developed by *in vitro* culture technique can be established in natural habitats after hardening and acclimatization. This method of plant breeding is called as micropropagation because by this method a large number of plants can be developed in a short time and limited space. There is no effect of external atmosphere in this technique. By this method disease free and economically important plants such as **orchids**, *Gladiolus, Chrysanthemum* etc. are successfully produced on large scale.

Polyembryony

Generally a single embryo is present in a seed but sometimes more than one embryos may develop in a single seed. Development of more than one embryo in an ovule, seed or fertilized ovum (egg) is called polyembryony. Polyembryony is found in both-plants as well as animals. Polyembryony was reported for the first time in 1719 by Antonne Von Leevenhock in the seeds of orange. Polyembryony is a general feature of gymnosperms but in angiosperms it is found only in few genera like lemon, Indian black berry (Jamun) tobacco, onion, *Crotalaria* etc. In majority of these plants, in the condition of polyembryony only one embryo matures in a seed while remaining embryos degenerate during different stages of embryo

development. In some plants such as orchids, which are epiphytes, more than one mature embryos are present during seed germination.

Fig. 4.1 : Polymbryony

Causes of Poyembryony in Angiosperms

Polyembryony is a general feature of gymnosperms while in angiosperms it may develop due to following reasons –

(i) By cleavage of proembryo

(ii) By development of embryo from any other cell of embryo sac simultaneously with that of egg cell

(iii) By development of more than one embryo sacs in an ovule

(iv) By activity of sporophytic cells of ovule

Polyembryony occurs due to above reasons in angiosperms which may be understood in details by the following classification:-

1. Cleavage Polyembryony: In this type of polyembryony by the cleavage of zygote or pro embryo more than one embryos develop in a seed. In *Eulophia* (an orchid) three types of cleavage polyembryony develops :

(i) By irregular divisions in the zygote cell, a mass of cells is formed. From the cells of this mass lying towards the chalaza a large number of embryos are formed.

(ii) Buds or outgrowths develop from the proembryo, which form many embryos.

(iii) Filamentous embryo- In this type of polyembryony the proembryo becomes branched and its each branch develops into an embryo.

2. Development of embryo from cells of embryo sac other than the egg cell : In this type of polyembryony, embryos develop from the fertilized or unfertilized synergid cells. Embryos developed by fertilized and unfertilized synergid cells are diploid in *Aristolochia bracteata* and haploid in *Argemone mexicana* respectively.

3. Development of more than one embryo sacs in the ovule : In some angiospermic plants such as *Casuarina montana* more than one embryo sacs are formed in an ovule and each egg cell present in the embryo sac, after fertilization forms embryo. In this way more than one embryos are formed in an ovule.

4. Sometimes the cells of nucellus or integuments present in the ovule become active and give rise to embryos. The embryos formed in this way are known as adventive embryos and this type of polyembryony is called adventive polyembryony.

Significance of polyembryony : Significance of polyembryony in the fields of horticulture, cytology, heredity and plant breeding is as follows: -

(i) Adventive embryos developing from nucellus are similar to the mother plant.

(ii) Plants obtained from the embryos developed by the nucellus are full of vigour.

(iii) Embryos developed from nucellus are disease-free. Therefore virus free clones of lemon varieties can be obtained by culture of nucellus.

(iv) Haploid embryos have an important role in the field of cytology.

(v) Homozygous lines can be developed by treating these haploid embryos with colchicine which plays an important role in plant breeding.

4. Vegetative Propagation

This method has been described in detail in chapter – 1 of this book.

Important Points

1. Development of embryo without fusion of male and female gametes i.e. without fertilization is called apomixis.
2. This may be sporophytic or gametophytic type.
3. Apomixis has been studied in details by the famous embryologist Professor Panchanan Maheswari. He has described its two main and many other types.
4. Important types of apomixis are – non recurrent, recurrent, vegetative apomixis and adventive embryony.
5. The characters of apomictic plants are similar to their mother plants. Therefore there is an important role of this method in the field of plant breeding.
6. Formation of seed without fertilization is called agamospermy.
7. Culture of plants on commercial level by tissue culture technique is called micro-propagation.
8. Formation of more than one embryo in a seed is known as polyembryony.

Practice Questions

Multiple Choice Questions –

1. Development of new plants without fertilization is called –
   (a) Syngamy (b) Parthenocarpy
   (c) Apomixis (d) Micropropagation
2. Development of embryo without fertilization is known as –
   (a) Gametophytic apomixis
   (b) Sporopytic apomixis
   (c) Adventive embryony
   (d) Polyembryony
3. Example of formation of more than on embryo sac in an ovule is –
   (a) *Argemone* (b) *Aristolochia*
   (c) *Casuarina* (d) *Calotropis*
4. Polyembryony is generally found in –
   (a) Monocots (b) Dicots
   (c) Angiosperms (d) Gymnosperms
5. Polyembryony due to division of pro-embryo or zygote is called –
   (a) Cleavage polyembryony
   (b) General polyembryony
   (c) Abnormal polyembryony
   (d) Adventive polyembryony

Very Short Answer Questions –

1. Define apomixis.
2. Explain polyembryony.
3. Write names of special methods of reproduction in plants.
4. Write any two importances of apomixis.

Short Answer Questions –

1. Explain non recurrent and recurrent apomixis.
2. Differentiate generative apospory and somatic apospory.
3. Write two causes of polyembryony.
4. Explain cleavage polyembryony.
5. Write importance of micro propagation.

Essay Type Questions –

1. Write a detailed note on apomixis.
2. Write a detailed account of polyembryony.

Answers Key-

1. (c) 2. (a) 3. (c) 4. (d) 5. (a)