RAMA UNIVERSITY

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FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

DR. SUHEL MEHANDI

ASSISTANT PROFESSOR

GENRTICS & PLANT BREEDING

UGE 223, COMMERCIAL PLANT BREEDING

Reproduction in Flowering Plants

Plants Sporogeesis, Gametogenesis and Fertilization:

It is in herent property of the living organisms to continue their race by mechanism of reproduction. The reproduction is a process by which the living beings propagate or duplicate their own kinds. There are three methods of reproduction.

1) Vegetative reproduction
2) Asexual reproduction and
3) Sexual reproduction

1) Vegetative Reproduction: The reproduction takes place through vegetative parts such as bulbils, corms, rhizome, bulbs, stem cutting, root cutting, etc.

2) Asexual Reproduction: In asexual reproduction, special cells or asexual reproduction units are produced by the parent body which grow themselves into new individuals. Therefore, the development of new individuals without fusion of male and female gametes is known as asexual reproduction. The asexual reproduction usually includes mitotic division of the body (somatic) cells, it is therefore, also known as somatogenetic or blastogenic reproduction. The asexual reproduction is common only in lower plants and animals and may be of fission, budding, gemmule formation and regeneration types.

3) Sexual Reproduction: In sexual reproduction development of new individual take place by the fusion of sex called male and female gametes. It is the most common type of reproduction among plants and animals. There are two types of sexual reproduction.

i) Isogamy
ii) Heterogamy

i) Isogamy: Union of two similar gametes which cannot be distinguished into male and female gametes is called Isogamy. Fusion of such gametes is called conjugation. It is observed in lower plants like mucor and spirogyra.

ii) Heterogamy: Union of two dissimilar gametes i.e male and female gametes is known as fertilization and the zygote is called Oospores.

This type of reproduction is common in flowering plants and can be divided into

A) Apomixis

B) Amphimixis

A) Apomixis: It is an abnormal sexual reproduction in which embryo develops from the egg cell, without fertilization and with or without meiosis. It is of various types- a) Parthenogenesis b) Apogamy c) Apospory

a) Parthenogenesis: In this case embryo develops directly from the egg cell or male gamete without fertilization. It gives haploid plants.

b) Apogamy: In this case embryo develops directly from haploid muclei other than egg cells i.e it develops from synergids or antipodal cells of the new embryo sac.

c) Apospory: In this case embryo develops directly from the somatic cell i.e. it develops from integuments of nucleus.

B) **Amphimixis:** This is normal sexual reproduction in which embryo develops from the union of male and female gametes in plants and sperm and egg or ovum in animals. The process of male gamete formation is known as microsporogenesis and female gamete formation as megasporogenesis in plants.

Male Gametophyte or Microsporogenesis:

Stamens are reproductive organs in flowering plants and are known as microsporophyll. Each anther of four pollen sacs called micro sporangia. It consists of outer wall, a single layer of nutritive cells called tapetur and central mass of pollen mother cells (PMC) or microsporocyte with 2n chromosome compliment. Each pollen mother cell undergoes meiosis and give rise to four microspores or pollen grains, consisting of haploid (n) chromosome compliment. This is known as microsporogenesis. Each pollen grain (Microspore) consists of two coats called exine and intine.

The nucleus of pollen grain divides mitotically and gives rise to two nuclei called tube nucleus and generative nucleus. The generative nucleus divides mitotically and produces two sperm nuclei called male gametes.

Female Gametophyte or Megasporogenesis:

The pistils are the female reprocutive organs called as megasporophyll in the flowering plants. The ovary of the carpel contains ovules (megasporangia). Each Ovule consists of megasporophytes or megaspore mother cells (MMC). Each megaspore mother cell undergoes meiosis and produces four haploid megaspores arranged in the linear row. Out of four megaspores, three degenrrates and one remains functional. This process of development of megaspores is known as megasporogenesis. The functional megaspore divides three times mitotically giving rise to eight nucleate structure called female gametophyte or embryo sac. One nucleus from each end passes to the centre to form polar nuclei. The three nuclei at micropylar region are organised into three cells forming egg apparatus. One of the largest called egg cell or female gamete. The other two cells called synergids or helpers. The three nuclei at chalazal end (region) are organised into three cells called antipodal cells. By this way embryo sac is developed.

Fertilization and Significance of Fertilization in Flowering Plants

Fertilization: After formation of both the gametophytes, the pollens grains are pollinated on the stigma of the ovary. The pollen grain germinates on the stigma and produces pollen tube. The pollen tube carrying two male gametes passes thorugh micropyle and reaches are liberated into the embryo sac. One of the male gametes moves towards the female gamete (egg) and fuses with it to and form zygote. This fusion of male and female gametes is known as fertilization. The other male gamete passes to the centre of the embryo sac and unites with secondary nucleus, which develops into endosperm. Here union of three haploid nuclei take place, it is known as triple fusion. Endosperm contain triploid chromosome (3n) compliment. The fusion of one male gamete with egg along with fusion of second male gamete with polar nuclei is together called double fertilization.

Significance of Fertilization:

1) Fertilization ensures diploid of the organism by fusion of haploid male and female gametes.
2) Fertilization provides new genetic constitution to the zygote.
3) Fertilization process increases the metabolic activities and the rate of protein synthesis of the egg.
4) Fertilization initiates embryogenesis.

Modes of Reproduction in Plants:

A mode of reproduction determine the genetic constitution of crop plant and provides the basis for understanding the mechanism of heredity, which are required for handling the desired characters during breeding work. This is the inherent property of the living organism to continue or maintain their races by the mechanism of reproduction. It is the process by which living being propagate or duplicates their own kinds. The modes of reproduction in crop plants are broadly grouped into asexual and sexual. Asexual: It does not involve the fusion of male and female gametes. In this new plants may develop from vegetative part of the plant (vegetative reproduction or may develop from embryos without fertilization (apomixis).

A) Vegetative Reproduction: In this new plants developed from a portion of the plant body. This may be occurred thorough modified underground and subarea stems or through bulbs, for example Rhizome –Ginger, Tuber potato, Bulos- onion, corm-gladious, while sub aerial stems gives rise to new plants in strawberry rose etc. Similarly artificial vegetative methods stem cutting (Sugarcane, Durant a), Root cutting (Lemon, citrus) ;layering, budding, gooties (Grapes, lichi) and grafting (mango) are common methods in propagation of fruits and ornamental horticultural crops.

B) Apomixis: It is the type of asexual reproduction in which seeds are formed and embryo developed without fertilization. Thus plants developed are dentical in genotype to the parent plant. In apomixis, reproduction is either suppressed or absent. When it occurs, the apomixis is said to be facultative, but when absent it, referred to as obligate. Many crops species show apomixis but it is generally facultative.

Apomisis may be of following type:

i) Adventive Embryony: Embryo directly developed from vegetative cells of the ovule such as integuments and chalaza. Development of embryo sac of embryo does not involve production of embryo sac E.g, Mango, Citrus.

ii) Apospory: Some vegetative cells of ovule developed into unreduced embryo sacs after meiosis. Embryo may be developed from egg cell or other cell of embryo sac. E.g Crepis.

iii) Displospory: Embryo sac is developed from the megaspore, which may haploid or diploid.

a) Parthenogenesis: In this embryo is directly developed from egg cell with fertilization. Depending upon whether the embryo sac is haploid or diploid termed as haploid or diploid parthenogenesis.

Haploid parthenogenesis are:

1) Natural Selection: In nature there is a continuous selection by natural forces. E.g temp, soil, humidity, pest, disease, etc. As a result the genotype more suited to a given environment leaves behind more progeny than the less adapted one, this process is known as natural selection.

2) Artificial Selection: The selection by man often permit only the selected plants to reproduce, the progeny from the remaining plants are generally discarded. The natural selection considerably retains variability in the species while artificial selection gradually reduces the variability accidentally and reported in solanum, nigrum, Nicotiana and maize, diploid parthenogenesis in many grasses like taraxacum. In many plants like Datura, Rice, Nicotiana, pollen grains are induced in vitro to produce haploids called androgenesis. The phenomenon in which the fruit is developed due to parthenogenesis is called parthinocrpy.

b) Apogamy: Embryo develops from haploid nuclei other than egg cell i.e synergids or antipodal which may be haploid or diploid. E.g Allium cepa (onion).

Sexual Reproduction: It involves fusion of male and female gametes to form a zygote, which develops into an embryo. It may be

a) Isogamy: Union of two similar gameties is called Isogamy and uniting undistinguishable gametes are isogametes E.g Mucor spirogyra, etc.

b) Heterogamy: Union of two dissimilar gametes is called fertilization or syngamy and the gametes called heterogametes. In crops plants, male and female gametes are produced in a specialized structure called flower which consists of four whorls viz calyx, corolla, androecium and gynoecium. A flower containing all whorls's called complete flower while incomplete flower lacks one or other parts. A flower containing both stamens and pistil is said to be perfect flower or hermaphrodite flower. It may be imperfect flower, when stamens are absent (pistillate) or carpeles absent (staminate) flowered. The male gamete is produced in stamen while the pistil produces the female gamete.

Fertilization: It refers to the fusion of one of the two sperms with egg cell to form a zygote.

Double Fertilization: One male gametes unite with the eggs cell known as syngamy or fertilization and another male gamete fuse with the pollar nuclei known as triple fusion, when these two processes occurs simultaneously known as double fertilization.

Sporogenesis: Production of microspore and megaspore is known as Sporogenesis. Microspore i.e pollen grains are produced in anther, while megaspore produced in ovules.

a) Microsporogenesis: Each anther has four pollen sac and each pollen sac contains numerous pollen mother cells (P.M.C) which undergoes meiosis. i.e two meiotic division to produce four haploid cells or microspore. This process is known as microsporogenesis. The microspores mature into pollen grains mainly by thickening of their walls.

b) Megasporogenesis: It occurs in ovule, which are present in ovary. A single cell in each ovule differentials into Megaspore mother cell (M.M.C). Each megaspore mother cell undergoes meiosis

to produced four haploid megaspore. Out of these three- megaspore degenerate and only one functional megaspore is remaining per ovule.

Gametogenesis: Production of male and female gametes in micro and mega spores is known as Gametogenesis.

a) Microgametogenesis: It refers to the production of male gametes or sperm cells. The pollen grain consists of two coating, in which outer is exine and inner is intine. After maturation of pollen grain nucleus divides mitotically into two nuclei known as generative nuclei and vegetative or tube nuclei. As soon as pollen reaches to stigma, they swell up by absorbing moisture and due to this exine burst and intine continue to grow in the form of tube called as pollen tube. The pollen tube penetrative into stigma and style and at the stage only generative nuclei undergoes a mitotic division to produce two male gametes. The pollen tube finally enters into the ovule through micro Pyle and discharge, the two male gamete into embryo sac and then fertilization take place. The pollen along with pollen tube and two sperms is called micro gametophyte.

b) Megagametogenesis: Development of embryo sac from a megaspore is known as Megagametogenesis. The nucleus of functional megaspore divides mitotically to produce two nuclei, which again divide mitotically then to produce eight nuclei. Out of these two nuclei, moves toward one pole i.e micropyle pole (produced one eggs cells and two synergids) another three nuclei migrate towards the opposite pole i.e chalazal pole (produced these antipodal cells) and two nuclei migrate at the centre to form polar nuclei. Finally, the megaspore is developed into the embryo sac which contains one eggs cell, two synargids, two polar nuclei and three antipodal cells.