APOMIXIS

COMPILED AND CIRCULATED BY
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INTRODUCTION-

- Apomixis, derived from two Greek word "APO" (away from) and"mixis"(act of mixing or mingling).

- APOMIXIS is a type of reproduction in which sexual organs of related structures take part but seeds are formed without union of gametes.

- The first discovery of this phenomenon is credited to Leuwenhock as early as 1719 in *Citrus seeds.*

- The genotype of the embryo and resulting plant will be the same as the seed parent.

- This is clonal seed production.

MODES OF REPRODUCTION-

1.Sexual

2.Asexual

a)Vegetative

b)Apomixis

i)gametophytic

ii)sporophytic

If the unreduced cells give rise to a mega gametophyte,then gametophytic apomixis occurs,if the unreduced cells give rise directly to an embryo,then sporophytic apomixis occurs.

WHAT IS APOMIXIS?

- Development of embryo without sexual fusion
- Sexual life cycle is "short-circuited"
- Genotypes of developed plants are identical to the parental plant.
  - Discovered by Leuwenhock (1719) in *citrus seed*.

Types of apomixis-

GAMETOPHYTIC-
unreduced cells give rise to a mega gametophyte

the embryo sac originates from the megaspore mother cell either directly by mitosis and/or after interrupted meiosis- Diplospory

the embryo sac originates from nucellar cells the most common mechanism of apomixis in higher plants characterized by the presence of multiple embryo sacs- Apospory

SPOROPHYTIC-

- unreduced cells give rise directly to an embryo
- Adventitious embryony
- Perthenogenesis
- Apogamy
- **SEMIGAMY-**

The haploid sperm nucleus enters the egg but does not fuse with the haploid egg nucleus. Each nucleus divides independently creating a haploid embryo that contains sectors of male and female origin.

Gametophytic apomixis-

- If the unfertilized cells give rise to a mega gametophyte
- Diplospory – MMC cells give rise to a megagametophyte
- Apospory - the embryo sac originates from the any diploid cell except megaspore mother cell either directly by mitosis and/or after interrupted meiosis
- Androgenesis - the embryo sac originates from generative nucleus of pollen tube cells the most common mechanism of apomixis in higher plants characterized by the presence of multiple embryosacs.

Sporophytic apomixis-

If the unfertilized cells give rise directly to an embryo

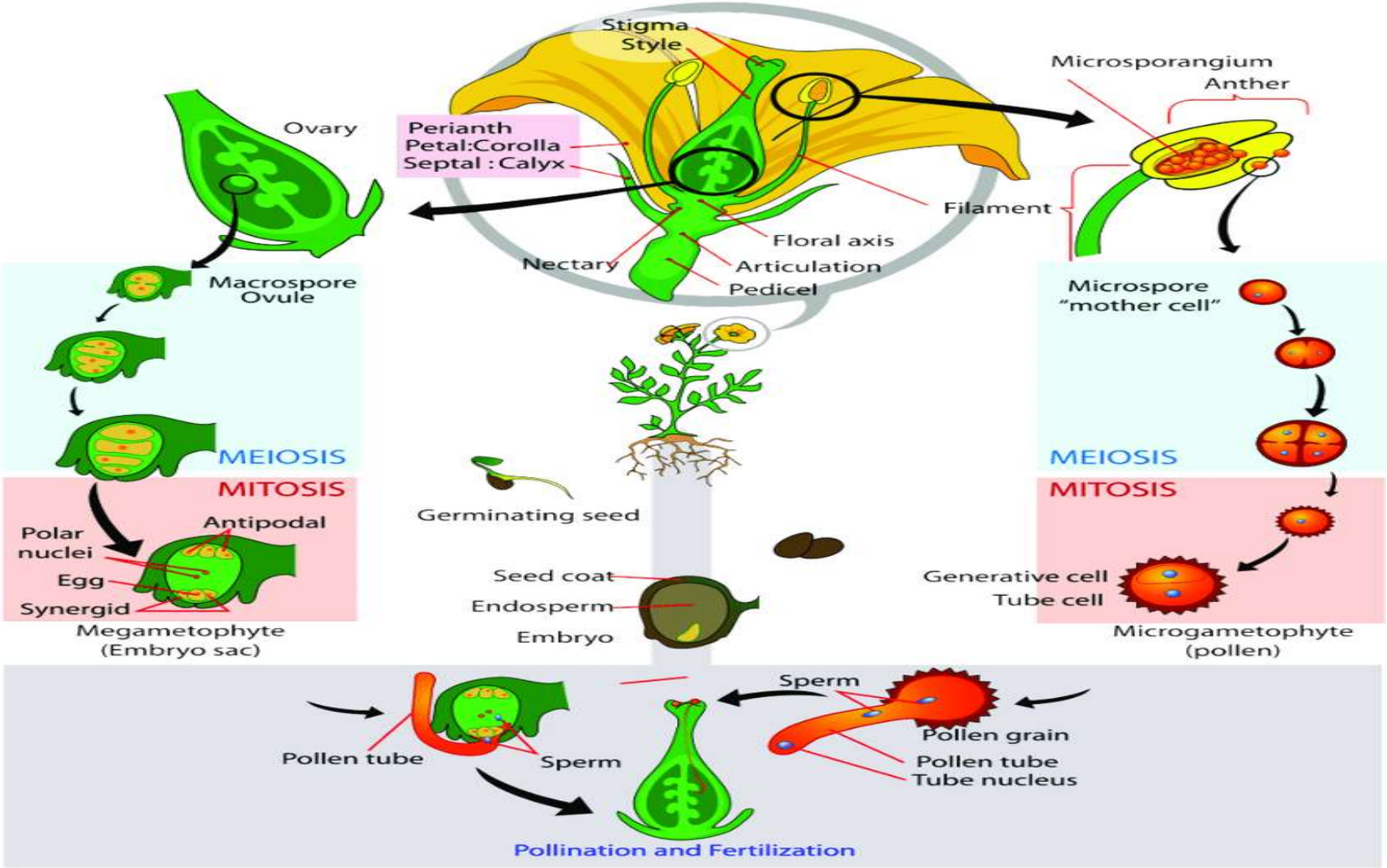
- Haploid parthenogenesis : embryo developed from egg cell
- Haploid apogamy (pseudogamy) : embryo developed from synergids or antipodal cells
- Adventitious embrony (sporophytic budding) : embryo directly develop from nucellus or integuments (no production of embryosac) e.g. mango , citrus

Types of apomixis based on occurrence :

1. Non reccurent :- embryo develop from any cell of embryosec (haploid cell)
   - Haploid parthenogenesis : embryo developed from egg cell
   - Haploid apogamy (pseudogamy) : embryo developed from synergids or antipodal cells
2. Recurrent apomixes : embryosec develop without meiosis from diploid cell
   - Diplospory : embryo sec develop from MMC
   - Apospory : embryo sec develop from any vegetative cell of ovule than embyo is developed from diploid egg cell.
3. Adventitious embrony (sporophytic budding) : embryo directly develop from nucellus or integuments (no production of embryosac e.g.mango,*citrus*.

The Ideal Apomictic System-

- All the progeny of plants should be apomictic so that progeny have the same genotype as the maternal parent.
- The apomictic genotype should preferably be fully male fertile and self-incompatible, and reproduce via pseudogamy.
- In case of diplospory, chromosomes should not pair or recombine during first meiotic division. which may give rise to variation among the progeny.
- Apomixis should be dominant over sexual reproduction. Usually, apomixis is governed by two or more genes.
- Expression of apomixis should be little affected by the environment.


Stigma
Style
Microsporangium
Anther
Ovary
Perianth
Petal:Corolla
Septal : Calyx
Filament
Floral axis
Nectary
Articulation
Pedicel
Macrospore
Ovule
Microspore
"mother cell"
MEIOSIS
MEIOSIS
MITOSIS
MITOSIS
Germinating seed
Polar
nuclei
Antipodal
Egg
Synergid
Seed coat
Endosperm
Embryo
Generative cell
Tube cell
Megametophyte
(Embryo sac)
Microgametophyte
(pollen)
Sperm
Pollen grain
Pollen tube
Tube nucleus
Pollen tube
Sperm
Pollination and Fertilization

Development of Apomictic Lines-

Apomictic lines can be developed by the following three different approaches:

- **Gene Transfer from wild species:** Genes controlling apomixis can be transferred into a crop species from a related wild species, e.g., from *Tripsacum dactyloides* into maize, from *Pennisetum orientate* into pearlmillet.
- **Induced Mutations:** This approach aims at developing apomictic forms in normally sexually reproducing species by utilising induced or even spontaneous mutations.

These efforts have focused primarily on sorghum, where two mutant lines showing facultative apospory have been isolated.

- **Isolation of Apomictic Recombinants from Interspecific Crosses:** Sometimes apomictic recombinants can be recovered from segregating generations of crosses between two sexually reproducing species. For example, seed formation has been reported in the intergeneric hybrids between *T. aestivum* and *Avena sativa*, *H. vulgare* and *T. aestivitm* etc...

ROLE IN PLANT BREEDING-

- Rapid production of pure lines Apomixis is an effective means for rapid production of pureline.
- Maintenance of superior genotypes Apomixis is useful in maintaining the characteristics of mother plant from generation to generation.
- Conservation of heterosis In some cases, hybrid vigour may be conserved for many generation by using recurrent apomixis.

Advantages of apomixis in plant breeding-

- Rapid multiplication of genetically uniform individuals can be achieved without risk of segregation.
- Heterosis or hybrid vigour can permanently be fixed in crop plants, thus no problem for recurring seed production of F1 hybrids.
- Efficient exploitation of maternal effect, if present, is possible from generation to generation.
- Homozygous inbreed lines, as in corn, can be rapidly developed as they produce sectors of diploid tissues and occasional fertile gametes and seeds.

Advantages of Apomixis-

- Obligate apomixis permits fixation of heterosis in the hybrids. Therefore, farmers can resow the seeds produced by apomictic hybrids generation after generation.

- The new hybrid variety could be multiplied from few hybrid seeds in the same manner as purelines. This greatly simplifies hybrid seed production.

- Even such parents that flower at different times may be crossed in a greenhouse to obtain few hybrid seeds, which can be used to establish the new hybrid variety.

- The nucleus seed of hybrid varieties can be conveniently maintained as hybrid varieties.

Problems in Utilization of Apomixis-

Apomixis is a very complicated phenomenon.

- Estimation of the level of facultative apomixis, is tedious and time consuming.
- In case of facultative apomicts, the proportion of sexual progeny is affected by environmental factors like day length and temperature.
- In the absence of morphological markers linked with apomictic development, maintenance of apomictic stock becomes difficult.
- The genetic basis of apomixis is not clear in most cases.

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