APOGAMY AND APOSPORY AND PARTHENOGENESIS

1.APOSPORY

What is apospory?

In some pteridophyte the are produced directly from the cells of the sporophyte, without any meiotic division and formation of spores. Such types of the gametophyte are diploid and this phenomenon of their formation is called apospory. APOSPORY is therefore a phenomenon the formation of gametophyte from a sporophyte directly without the formation of spores.

The phenomenon of apospory was first discovered by Druery (1884) in *Athyrium filix-foemia var. clarissima.* Since then the APOSPORY has been reported in many pteridophytes by different researchers like Bower (1888), in *Trichomanes*, Farlow (1889) in *Pteridium aquilinum* and *Asplenium dimorphum*, Gairdener (1933) in *Scolopendrium vulgare*, and Munroe and Bell (1970) in *Pteridium aquilinum*.

Antheridia are formed directly on the leaves of *Trichomanes*. In another case Gairdener (1933) reported the antherozoids developing in the sporangia, besides the normal sporangia having spores in *Scolopendrium vulgare*. Lang (1898) reported apospory in *Osmunda regalis* while Steil (1944) reported the formation of many gametophytes from the hairs of the petiole of the first leaf of Tectaria.

Sarbadhikari (1936) observed the formation of aposporous gametophytes in *Osmunda javanica*. In such gametophytes he observed that the antheridia were developed and bore normal antherozoids, but there was no sign of archegonia. He further observed that in such gametophytes the embryo developed as an outgrowth of the gametophyte, i.e. apogamously.

Apospory is not a phenomenon of regular occurrence in fern, and it can be induced under artificial conditions. Bristow (1962) and Kato (1965) worked on the phenomenon of induced apospory in two species of *Pteris*, i.e., *Pteris cretica* and *Pteris vittata*.

Digby (1905) Sarbadhikari (1939) and Mehra and Sulkyan (1969) are some of the workers who have worked on the cytology of apospory, while Munroe and Bell (1970) have worked on the electron microscopic studies of the apospory in the root cells of *Pteridium aquilinum.*

Regarding the cases of apospory Bristow (1962) has mentioned that in *Pteris cretica* mineral nutrition is responsible for the aposporous development of gametophyte. The development of prothalii on the leaves of *Drynaria rigidula and Polypodium aureum* is mainly due to the effect dim light on the leaves.

2. APOGAMY

WHAT IS APOGAMY?

Apogamy is a phenomenon in which sporophytes are directly produced from the gametophytes, without any sexual fusion or syngamy. It was first discovered by Farlow (1874). One interesting and noteworthy feature of apogamy is that from the non-vascular gametophyte develops the vascular sporophyte.

Apogamous sporophytes develop in direct continuity with the gametophyte. *In vitro* origin and development of apogamous sporophytes in *Pteridium and Cheilanthes* have been studied in details by Whittier (1962,1965,1970). First of all, a 1-3 celled meristematic centre originates in the most thickened part of the gametophyte. It divides in various planes and form a meristematic mound of cells. Shoot apices differentiate on this mound, on which some multicellular hairs may also develop. Usually the first root arises adventitiously from the stem. After the formation of stem and leafy regions the first xylem elements appear. The vascular tissues differentiate acropetally.

TYPES OF APOGAMY

In some pteridophyte the occurrence of apogamous sporophyte is a constant feature. In such cases it may be either because of the non-functional nature of male or female sex organ, or because of the total absence of one or both these sex organs. Such type of apogamy is called ***obligate apogamy.*** Recent experimental studies shown that the apogamous sporophytes can be induced on the gametophytes having both the functional sex organs. Such type of apogamy is called induced apogamy or facultative apogamy.

ARTIFICAL INDUCTION OF APOGAMY

Lang (1898) induced apogamy in many ferns by growing the gametophyte exposed to the direct illumination. The important factor for apogamy, during summer is high light intensity (Heilbronn, 1910). Freeburg (1957) induced apogamy in *Lycopodium cernuum, L. companatum, and L. selago.* Insufficiency of water for fertilization is responsible for the formation of apogamous sporelings in *Lycopodium.* Growth of roots and buds in *Lycopodium* can be induced by adding coconut milk and sucrose in the nutrient medium (De Maggio, 1964). Whittier (1964) studied induced apogamy in *Pterdium aquilinum and Cyrtomium falcatum,* while Kato (1970) worked on the “induced apogamous sporophyte” in *Pteris vittata*. The production of apogamy in *Pteris vittata* is promoted by addition of gibberallic acid, indole acetic acid, tryptophane or yeast extract in the medium.

Whittier and Steeves (1960) added glucose (1%-2.5%) sucrose in the medium for induction of apogamous sporophytes on the gametophytes of *Pteridium aquilinum.* It was observed by them that the number of the apogamous sporophytes increases by the increasing glucose or sucrose percentage from 1% to 2.5%, but a negative effect is seen, if the percentage decreases from 2.5%. Recently, Rashid (1976) has mentioned that sucrose is more effective than glucose for the production of apogamous sporophytes. He has further mentioned that carbohydrate and mineral nutrition, quality of the light and hormones are the main factors which regulate apogamy.

CYTOLOGY OF APOGAMY

Occurrence of apogamous sporophyte is a common feature of ferns. Apogamous sporophyte arises vegetatively from the prothali, and thus naturally omits the process of fertilization. However, the chromosome number remains the same because of the occurrence syndiploidy before meiosis. (Syndiploidy is process in which doubling of chromosome takes place before meiosis). Obligate apogamous members show a n alternation of 2n (sporophytic) and 2n (gametophytic) generations (Evans,1964), which involve syndiploidy and meiosis, while in normal sexual life cycle of a pteridophyte shows the alternation of sporophytic (2n) and gametophytic (n) generations. Rashid (1976) has mentioned that “syndiploidy followed by meiosis are, therefore, the characteristics of apogamous cycle”. These are, however, some well-established exceptions. It has been reported in Ophioglossum by Verma (1956) and in *Polypodium dispersum* by Evans (1964) that there is neither any formation of syndiploidy nor any change in chromosome number. The occurrence of simple meiotic division throughout the life cycle is the characteristic feature of such life cycles. There is neither any genetic recombination nor any process of syngamy or meiosis. Mehra and Singh (1957) reported the absence of pairing of chromosomes at meiosis in *Trichomanes insigne*, a case which has been reported by many other earlier and later workers of apogamy in pteridophytes.

What are difference between apospory and apogamy?

Apospory

1. The developmental process of Gametophytes.
2. The fusion of male and female gametes occurs.
3. The end product of this phenomenon is Gametophyte.
4. The Gametophyte is diploid in nature.
5. The embryo develops form embryo sac.
6. Seen in Anthoceros species.
7. It is a type of apomixis
8. Spore formation is not witnessed.
9. It is of two types namely haploid apospory and diploid apospory.
10. Meiosis cell division is absent.

Apogamy

1. The developmental process of the Sporophyte.
2. The fusion of male and female gametes doesn’t occur.
3. The end product of this phenomenon is sporophyte.
4. The sporophyte is haploid in nature.
5. The embryo develops from Synergids or antipodal.
6. Seen in Funaria species.
7. It is a type of apomixis.

PARTHENOGENESIS

The phenomenon in which the egg develops into the embryo without the act of fertilization is called **parthenogenesis. Hierononymous (1911)** reported this phenomenon in *Selaginella intermedia and S. langera.* Goebel (1915) observed in *S. anocardia and S. rubricaulis* that the archegonia failed to open and then also the eggs developed into embryos showing parthenogenetic development. Bruchmann (1919) reported the similar cases of parthenogenetic development in *Selaginella helvetica* and *S rubricaulis*.

In many polypodiaceous ferns (*Athyrium filix-foemia, Scolopendrium vulgare*), this phenomenon was reported for the first time by Farmer and Digby(1907). Strasburger (1907) reported in *Marsilea drummondii* the formation of diploid megaspore from some megaspore mother cells. These diploid megaspores developed into diploid gametophytes on which the archegonia also developed. Such archegonia never opened and thus fertilisation could never take place. But the diploid eggs of such archegonia produced diploid sporophytes showing the phenomenon of parthenogenesis. Gupta (1962) also mentioned the cases of parthenogenetic development of eggs into embryos in *Marsilea aegyptica, M. minuta and M. rajasthanensis*. Smith (1955) mentioned that some species of *Cyathea* also show the parthenogenetic development of an egg into a sporophyte.