Topic: Evolution of Gametophytes in Bryophytes

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Evolution of Gametophytes in Bryophytes

The evolution of thalli in bryophytes is a much disputed problem. There are no substantial fossil evidences of bryophytes that support to the sequential evolution theory of gametophytes among bryophytes.

There are two theories regarding evolution of gametophyte in bryophytes-

1. Upgrade or the Progressive evolution theory
2. Downgrade or the Regressive evolution theory.

1. Progressive Evolution Theory:

The supporters of this hypothesis, the primitive gametophyte was a simple, a dorsiventral, prostrate thallus that showed no external differentiation. Such a simple thallose gametophyte was originally suggested by Schiffner, and chiefly supported by Cavers (1910), Campbell (1918, 1940), Fritsch (1935), Bower (1908) and Smith (1955). The evolution of gametophytes took place from liverworts to mosses in an ascending series of gradually increasing complexity with regard to the organisation of internal tissue and sex organs.

Cavers suggested that the ancestor gametophyte resembles the present day *Sphaerocarpos* and *Marchantiales* has been considered as a blind line of evolution from the hypothetical *Sphaero- Riccia*. While Campbell suggested that thalli of the present day Riccardia and Metzgeria resemble the simplest ancestral gametophyte. From the simple thallus, the evolution of complex gametophytes took place in two different lines.

In the first line, the gametophyte retained its external simple, thallose form as found in *Marchantiales.* Simultaneously there was a gradual increase in complexity in cellular organisa-

tions. This has been evidenced by the nature of pores, air chambers and the aggregation of sex organs in a definite receptacle (e.g. *Marchantia*).

The sexual receptacles show a wide range of organisation. In *Riccia*, the individual sex organs are scattered over the median portion of the thallus. In *Marchantia*, the sex organs are borne on a complex stalked receptacle called gametophore.

An intermediate condition in between the *Riccia* and *Marchantia* has also been observed where sex organs are aggregated into a cushion-like or ridge-like receptacle. These receptacles are borne on the thallus dorsally or terminally. In the second line, the gametophytes retained their simple internal structure (lack of airpores and air chambers). But there was a gradual elaboration of the external part of the gametophyte leading to the formation of the appendicular organs.

Further, the thalloid forms were replaced by the leafy forms. This has been observed in the members of *Jungermanniales* and *Calobryales*. These leafy forms finally led to the establishment of the higher degree of internal differentiation of the tissue in Bryopsida. The schematic representation of the progressive evolution of gametophytes in liverworts has been given in fig. 1.

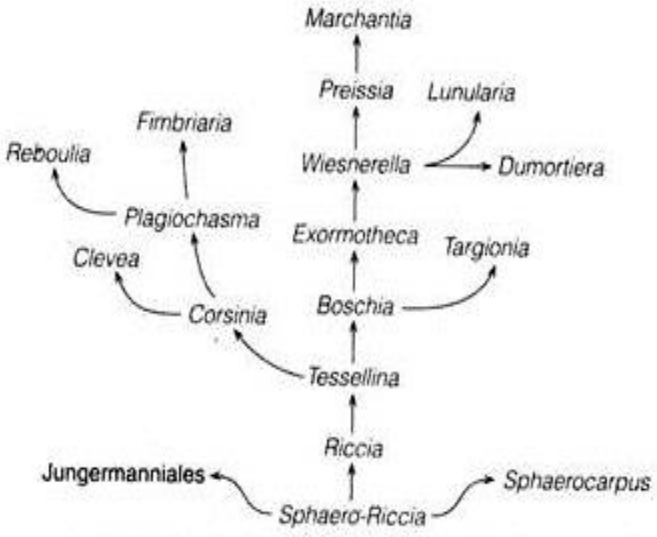

Fig 1. Progressive evolution of gametophyte in liverworts

2. Regressive Evolution Theory:

According to the downgrade theory, the primitive gametophyte was an erect leafy shoot having radial symmetry (members of *Calobryales* and true mosses). From such ancestral forms the dorsiventral thalli of liverworts and hornworts got evolved in reverse direction i.e., regression of increasing simplicity. Among the proponents of the downgrade theory, Wettstein (1903-1908), Church (1919), Evans (1939), Goebel (1930) and Kashyap (1919) are the most prominent scientists. Kashyap (1919) advocated the regressive evolution from the results of his extensive studies of Indian *Marchantiales.*

The principal points in the reduction series from *Marchantia* as the basic type along the various phyletic lines have been summarized below:

(i) Reduction in the number of involucre:

In *Marchantia*, sex organs are well-protected by many involucres. A gradual reduction in the number of the involucres has been observed in *Conocephallum*, *Aitchinsoniella* and *Exormotheca,* which has been finally culminating in *Tarefionia* with a single involucre.

(ii) The loss of assimilatory filaments in the air chamber:

A gradual reduction series has been noted in many members. In *Marchantia* and *Preissia*, the thallia show complexity in having air pores and air chambers full of assimilatory filaments. There is a gradual reduction in the assimilatory filaments in *Conocephallum conicum* (the filaments are short in the air chambers), *Wiesnerella decundata* (the filaments rudimented into papillate cells). The assimilatory filaments ultimately disappear in the aquatic *Dumortiera hirsuta*.

(iii) Simplification of Pores:

In complex forms like *Marchantia* and *Preissia,* the pores are complex, barrel-shaped and present both on the thallus and the discs of the gametophores. In *Conocephallum and Reboulia*, discs bear only barrel-shaped pores, while thalli bear only simple pores. In *Exormotheca* and *Stephansoniella,* the pores are simple both on the thallus and in the discs. The well-defined pores are totally absent in *Riccia*.

(iv) The gradual shifting of the stalks of antheridiophores and archegoniophores from the terminal to dorsal position:

Mehra (1969) proposed the above hypothesis. In *Marchantia*, the antheridia and archegonia are borne terminally on the stalked gametophores. In *Preissia quadrata* and *Plagiochasma articulatum*, the stalk is initially terminal, but becomes dorsal by the further growth of the thallus. A further downward shifting of the stalk is observed in *Corsinia* and *Boschia*, where the female receptacle almost becomes sessile by the elimination of the stalk.

The schematic representation of the regressive evolution of gametophytes in liverworts has been given in fig. 2.

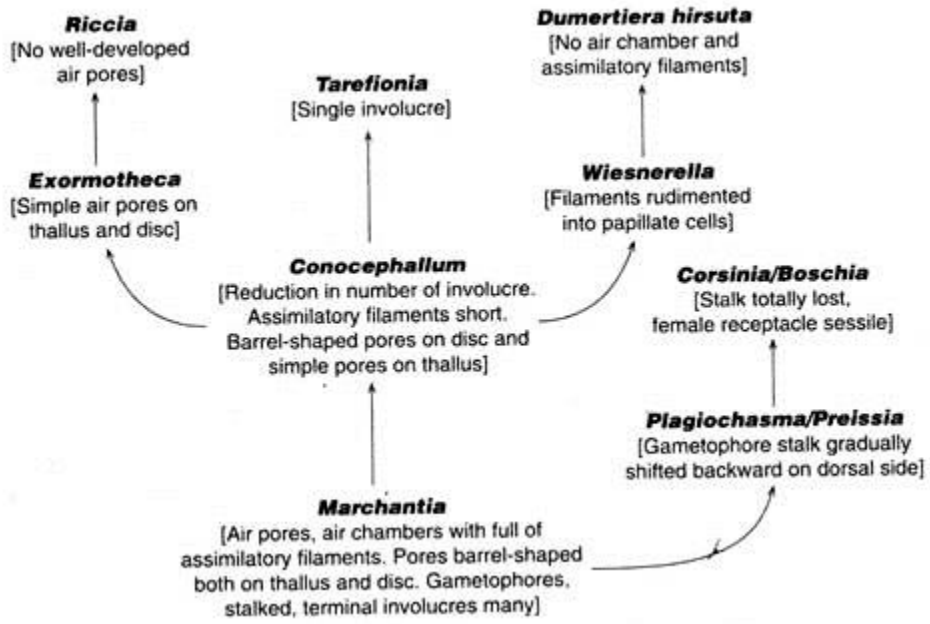

Fig 2. Regressive evolution of gametophytes in liverworts