Topic- Bryophytes

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.1.Ecological significance of Bryophytes:-

Bryophytes has great ecological significance. Bryophyte ecology may be extended in a no of directions but there are certain topic which has got a great significance in bryophytes-

1.The topics are succession , tropical vegetation in India, Synchology, autecology,factors of habitat. As we know succession is orderly sequence of changes in vegetation as it proceed towards the natural climatic climax where some kind of stability or equilibrium is reached .This definition was given by Clement (1916) .Fritsch and Salisbury describe the pioneer role played by Bryophytes on burnt wealth, subsequent observer have also confirmed that Funaria hygrometrica is the pioneer colonizer to be followed in the sequence Creatoldon purpurea ,ploytrichum juniperum, and P. piliferum in association with lichens of the genus Caledonia. The first two phases in about a couple of season but 3rd phase commonly last for many years .Bard (1965) describe secondary succession of terrestrial Bryophytes, Piedmont of Newjersy of USA.

in India with south Asian countries extends from the tropics in south to temperate conditions. In north including Pakistan covers a area of large square miles .First comprehensive study of India liverworts of flora of India shows that epiphytes liverworts are hygrophilous and restricted to more humid places whereas xerophytic liverworts in habit the plains of south India compare to the liverworts. The ecology and distribution of mosses have been explode early a little. We saw in the synecology that includes definition and reorganization of Bryophytic community.

The most important significance of ecology given the habitats of Bryophytes and it throws a light of growth yield and mineral economy of mosses. Wartson (1946) described its significance that Bryophytes can serve as guides to the practical forester concerning the condition and character of land. Wartson (1964) describe a case in which remains of lost village ,a forest in Austria traces through the presence of moss. Hootman and Cazmiersky (1969) inform that epiphytic Bryophytes is influenced by macro climatic variation. Therefore Bryophytes is the director of climate These are the significance of Bryophytes in ecology.

Fossil Bryophytes

Due to the excess of lignified vascular tissue and non cutinized epidermis in stem and thallie, The Bryophytes are not well suited to fossilization .so far only afe are complete bryophytes have been discovered-

i. Hepaticopsida-In 1925 Walton published first account of upper carboniferous liverworts which bore evidence of relationship to the living hepaticopsida.fossil hepaticopsida from the Devonian are rare except for hepaticities devonicus which has been discovered by Huber in 1961 from the Devonian rock in Newyork State.During the Mesozoic more fossil hepatics have been reported .A single fossil hepaticopsida Amarus from Triassic of greenlands.these fosiil described by Harris also seem allied to the macro gynous Jungermaniales ..as different time Light has been shade on the remote past of Liverworts group Marchantiales.Ther

are a few Mesozoic fossil which can be brought fairly closely into ine with modern genera of Marchantiales.

ii . The earliest records of Bryopsida fossil are two sps of mosses , muscite, and ploytrichus from upper carboniferous. In recent years the researchers of new Berz name shade a flood on the past history of two groups of mosses. Now Berz has erected a new order protosphagnales , It contains three fossil genera by her to the sub class sphagnidae . Geological record of bryophyte indicate that there are ancient that group however they do not throw any light on the origin and evolution of group. The study of fossil also point out that their did not exist in Paleozoic and Mesozoic lines .

Evolution of Gametophyte in Bryophyte

In Bryophyte gametophyte stage originates in very primitive stage .It is spore ie Sporophytic condition metamorphosed into gametophytic stage of Bryophte. For its evolutution and origin there are two thoughts of school ,one is reterogressive school of thought and other is progressive school of thought.

Reterogressive evolution of thought-

This thought was widely supported by S.R.Kashyap, westian,Evans, Mehra, Jingermanns and Uddar etc. According to this theory the primitive bryophytes has erect leafy shoot and were radial in symmetry like that of mosses. From Mosses the evolution procede through acrogynous Jungermaniales , anacorgynous jungermaniales ,anthocerotales and Marchantiales. Mehra (1957) proposed a common origin of anthocerotales and psilophytales through a common anthrorhyniaceae stalk. Kashyap explain the regressive evolution of theory in Marchantiales which can be summarized under following heading-

i. Loss of assimilatory filament in their air chamber.

ii. Dumertina is the typical example of Marchantiales.The air chambers and rudimentary pores are absent.
iii. Marchantia have well developed barrel shaped pore present on both the thallus but in Riccia ell developed pores are absent.

Mehra proposed a condensed theory to explain the course of evolution .He believes that after regressive deviation of Marchantiales , the line of progressive evolution terminate.The significant reduction in sporophyte took place as following-

i. reduction in chlorophyllous cells from capsule
ii. Disappearance of stomata and intercellular spaces.
iii. Disappearing of thickening of all type of cells.
iv. Gradual elimination of seta and capsule.
v. Simplification of dehiscent mechanism.

Progressive theory

The supporter of this hypothesis presume that the present day liverwort originated from dorsal , dorsiventral prostrate thallus that showed no external differences such as a simple thallose.Gametophyte is originally proposed by Schiffner and supported by Cavers, Smith, Fritsch, Bower and Cambell.The table shows entire progressive theory proposed by Cavers

fig evolution of bryophyte proposed by cavers

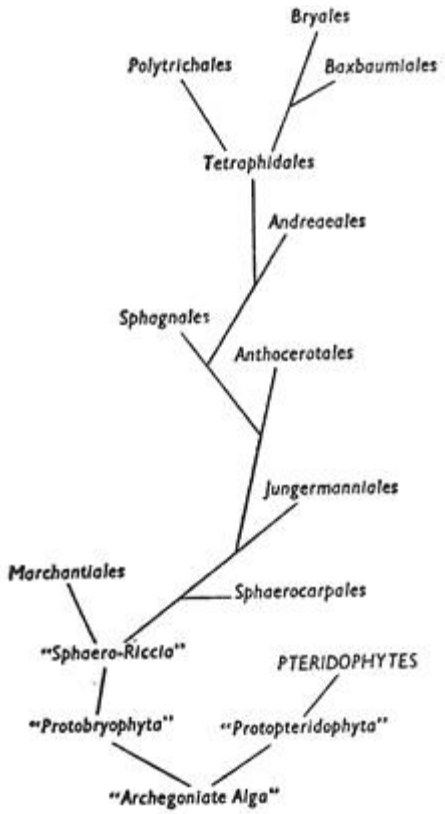

Fig. 497. Phylogeny of Bryophytes according to Cavers (1911).

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These two theories are give a puzzling answer regarding the evolution of gametophyte in Bryophytes. spore is the first cell of gametophytic generation .It is specialize structure with potentiality of developing into a new individual.spore are formed in tetrad as a result of meiotic division of a spore mother cell.The spore formation in Hepaticopsida and Bryopsida is by simultaneously development of nucleus of sporophyte . However in anthocerotopsida due to addition of new sporogenous at the base.

In the Marchantiales the spore complexities reachesits zenith.Marchantiales is the most highly evolved order of Hepaticopsida.The spores are largest in Bryophyte. Marchantiales present at the end point of hepatic evolution in respect of adaptation to expose condition of life and they have developed as part of this adaptability,a thick exile ,it is variouslu ornamented and in addition another covering ,the pairing in several of its members simultaneously

with this,there has been an increase in sie of spore coupled with reduction in their no in contrast to small sized spore producing large no in acrogynous Jungermaniales. This complexity in spore is also visible at least a certain extent in another offshoot of leafy liverworts.The acrogynous Jungermaniales , the anthocerotales retain primitive spore type .Thus trend of evolution in respect of morphology in hepaticopsida has been traced from globose , non destructive and acro gynous jungermaniales to trillate spores with thick resistant and ornamented exine and with pairing developed in still more and advance cases.

Light as a factor in the biology of Bryophytes

The role of light in Bryophytes plays a very important role in Bryophyte physiology.In Bryophytes photosynthesis take place and light plays important role in photosynthesis. Photosynthesis is the light driven evolution of oxygen from water and storage of resulting reducing power in the numerous carbon components which constitute living matter.

In Mosses all the cell of protonema contain enough chloroplast to be able to assimilate CO_2 in the manner of thallie of liverworts and leaves of higher green plants. The protonema of Liverworts often consist only a small cluster of cells and it never has such independent existence as that of mosses .The physio ecology study of the community of epiphytic mosses on forestries by no Japanese worker like as Hosokeva and Odane in 1957 and 1962 have lead to the following conclusion as regards the importance of light intensity in Bryophytes.

I. The upper limit of ventral distribution of epiphytic mosses on forest trees is restricted primarily by water and lower limit by light.
II. The photosynthetic efficiency and chlorophyll content of some dominant epiphytic mosses are similar to those of higher green plants especially the ever green in temperate region.

III. Light saturation curve indicates that mosses of the lower layer have Sciophytic characteristics , those of higher level of halaeophytic ones , and those at intermediate level have intermediate characteristics.

Harsh & Miller (1966) have shown that chloroplast replication in polytrichum commune occurred in continuous red and white light of 15 minutes by six hrs.In continuous darkens and far red light of 15 minutes of six hrs the size of chloroplast increases but not their no.Miller and Machelis (1968)determine the effect of light in increasing the dry weight of thallie of liverworts , spharocarps donnallie.3-4 dichlorophyll and inhibitor of photosynthesis was effective in decreasing the growh of light brown but not for dark brown plants.

Algal and fungal association of liverworts

Fungal hyphae are quite commonly meet within the cells of midribin the older parts of many thallose form. In most cases fact is mentioned in liverworts under the various sps.The hyphae penetrate into thallus through rhizoids but in case of Marchantiales through smooth rhizoids .As the fungus often occurs in the older part of the thallus .It appears that union is not always symbiotic but the fungus is at least in many cases nearly in parasite in liverworts.

This phenomena microrhiza , this is reported by SR Kashyap .The thallose form excepting the few that occurs in very moist place and especially in marchantiales.The fungus attack on thallose .These are certain soil fungus which grow on the moist place have association of liverworts but they are not symbiotic , they are parasites.

Linger advocated that algae gave rise to primitive terrestrial type “Prohepatics”, through this prohepatics arises .Boer in his book “Origin of land flora” describe that aquatic ancestor inhibiting shallow water where algae were present gave the birth of liverworts because-

i. It has autotroph mode of nutrition.

ii. Presence of photosynthetic pigments.
iii. Starch as a metabolic product
iv. cellulose nature of cell wall
v. Occurrence of green filamentous algae like protonema.

According to modern bryologist a group of remote ancestor of algae migrated to sub aerial habitat due to increase competition in water .This later on develops into liverworts.Mehra agrees with the origin from chaetophorales as visualized by Fritsch.

Evolution of Sporophytes

In this article we will discuss about the evolution of sporophytes in bryophytes.

Evolution of Sporophyte in Bryophytes:

The sporophyte of bryophytes is called sporogonium which generally consists of a single, terminal sporangium (monosporangiate) with a bulbous foot and with or without an unbranched stalk or seta. The sporogonium is very delicate, short-lived and nutritionally dependent on its gametophyte.

The sporophytic phase begins with the formation of a diploid zygote within the venter of the archegonium. In the simplest form of sporophyte (e.g., Riccia) the entire zygote is taking part in the formation of stelile capsule wall and the central sporogenous cells. In complex forms, zygote differentiates and sporogenous cells form more sterile tissues.

There are two opposing theories regarding the evolution of sporophyte in bryophytes:

(i) Theory of Progressive evolution i.e., Evolution of sporophytes by the progressive sterilisation of potentially sporogenous tissue:

This theory was advocated by Bower (1908- 35) and supported by Cavers (1910) and Campbell (1940). According to this theory, the primitive sporophyte of bryophytes was simple and most of the sporogenous tissue was fertile (e.g., Riccia) and from such a sporophyte, the more complex sporophytes (e.g., mosses) have been evolved by the

progressive sterilisation of potential sporogenous tissue. This theory is also known as "theory of sterilisation".

The increasing sterilisation of sporogenous tissue from simple sporophyte of Riccia to the most complex type of Funaria can be arranged through the following stages:

First stage:

The simple sporophyte of Riccia consists of a single-layered sterile jacket enclosing sporogenous cells with a very few absorptive nutritive cells (nurse cells). The zygote divides by a transverse wall, followed* by a vertical wall to form a four-celled embryo. Subsequently 20-30 celled embryo is formed by further divisions, in which periclinal divisions differentiate a single layered outer amphithecium and the inner multicellular mass, the endothecium.

Here the zygote has no polarity. The amphithecium forms the sterile jacket while the whole sporogenous cells (endothecium) differentiates into spores with a very few sterile nurse cells, possibly the forerunners of elaters.

Second stage:

In this stage, the zygote divides transversely to form a hypobasal and an epibasal cells. A small foot is formed from the hypobasal cell. The epibasal cells differentiates into an outer amphithecium and inner endothecium.

The amphithecium forms a single-layered sterile jacket of the capsule, while the endothecium differentiates into fertile sporocytes and long sterile elater-like nurse cells without the thickening bands. Thus, the zygote has polarity showing more sterilisation of sporogenous cells like nurse cells and sterile foot. This stage has been noted in Corsinia.

Third stage:

The development of sporophyte is like that of Corsinia, but there is more sterilisation of sporogenous tissue. This condition is noted in Sphaerocarpus sporophyte which consists of a sterile bulbous foot, a narrow sterile seta developed from hypobasal cell and a fertile capsule developed from endothecium containing sporocytes and sterile nurse cells.

Fourth stage:

This stage is represented by Targionia, where the sporophyte consists of a sterile bulbous foot, a sterile narrow seta and a fertile capsule. Here about half of the endothecial cells produce fertile sporogenous tissue, while the remaining half gives rise to sterile elaters with 2-3 spiral thickening. Hence, in Targionia, more sterilisation of sporogenous tissue has been observed.

Fifth stage:

This stage is illustrated by Marchantia, where further sterilisation of sporogenous tissue has been noted in comparison with Targionia. In Marchantia, the sterile tissue consists of a broad foot, a massive seta, a single-layered jacket of capsule, sterile apical cap at the apex of capsule and a large number of long elaters with spiral thickening.

Sixth stage:

This stage is represented by some members of Jungermanniales like Pellia, Riccarclia, etc. Here more sterilisation of sporogenous tissue has been observed. Sporophyte is differentiated into foot, seta and capsule having multilayered jacket. The sporogenous tissues produce mass of sterile elatophores and diffuse elaters.

Seventh stage:

This stage is illustrated by members of Anthocerotophyta like Anthoceros. Here marked reduction in the sporogenous tissue has been noted. The multilayered capsule differentiates into epidermis with stomata and chlorophyllous cells.

The central columella derived from endothecium is composed of 16 vertical rows of sterile cells. The further sterilisation of sporogenous tissue has been observed in the formation of pseudoelaters which are elongated 3-4 celled, simple or branched structure without thickening band.

8TH **stage (Final stage):**

The members of Bryopsida like Funaria, Polytrichum, Pogonatum etc., show the highest degree of sterilisation. The sporophyte is differentiated into a foot, a long seta and a capsule. The sterile tissue of capsule consists of the apophysis, operculum, many-layered jacket, the columella, trabeculae, the wall of spore sac and the peristome. The sporogenous tissue is restricted to the spore sacs only, hence it forms a negligible portion in the sporophyte.

(ii) Theory of Regressive evolution i.e., evolution of sporophytes due to the progressive reduction or simplification:

This theory is known as regressive or retrogressive theory, and supported by several scientists like Church (1919), Kashyap (1919), Goebel (1930) and Evans- (19391 According to this theory, the most simple sporophyte of Riccia (comprised of a simple capsule) is the most advanced type which has been evolved by the simplification or progressive reduction of the complex sporophytes (foliose with complex assimilatory tissue and functional stomata) of mosses (e.g. Funaria, Pogonatum, Polytrichum etc.)

The stages of progressive reduction of the foliose sporophyte (primitive type) to the simpler sporophyte (advanced type) have been enumerated:

(a) The semiparasitic foliose sporophyte gradually lost its leaves and became embedded within the gametophyte.

(b) There is a gradual reduction of the assimilatory (photosynthetic) tissue in the sporophytes and subsequently this tissue is confined only to the jacket of capsule (e.g., Funaria, Anthoceros).

(c) Stomata are restricted in the apophysis region (e.g. Funaria, Polytrichum) that communicate with the intercellular spaces. In Sphagnum, the stomata of apophysis are non-functional and become rudimentary. In all liverwort members stomata are completely absent in sporophytes.

(d) The capsules of most mosses (Funaria, Polytrichum, Sphagnum, etc.), hornwort (Anthoceros) and some jungermanniales (Pellla, Porella) are multilayered which subsequently became single-layered (Marchantia, Plagiochas- ma, Riccia) by reduction.

(e) The foot and seta are well-developed in mosses (Pogonatum, Funaria, etc.) and some liverworts (Pellia, Marchantia, etc.). The seta became much reduced and form a narrow sterile part of the sporophyte (Corsinia, Targionia).

In hornworts, the sporophyte is made up of a foot and an elongated capsule only, seta is absent. Finally, in Riccia foot and seta are absent and the sporophyte is represented by a single capsule only, which is supposed to be the most simple as well as advanced sporophyte among bryophytes.

(f) The sporophytes of mosses show the highest degree of sterilisation with a negligible amount of sporogenous tissue. There has been gradual reduction in the sterile tissue of the capsule, with simultaneous increase in the amount of sporogenous tissue.

In hornworts, a good amount of sporogenous tissue is formed from the inner layer of amphithecium. In liverworts (Riccia, Marchantia) the entire endothecium gives rise to sporogenous cells.