Ecological importance of bryophytes

Athalamia etc.) and in some creeping mosses, all parts of the thallus except the growing apex becomes dry during the dry summer season. These apical parts remain dormant during dry season. These apices, on return of favourable environmental condition (rainy season), become active and form new plants.

Ecological Importance of Bryophytes

Bryophytes are important constituents of the ecosystem in temperate and tropical forests that have significant ecological importance. Bryophytes are important stabiliser of substrata that later become suitable for higher plants colonisation. Extensive bryophyte mats are significant in the water balance of the forest. They are capable of absorbing water and nutrients directly through the surface. They prevent soil erosion as they have trample-resistant structure and high regenerative capacity. Some bryophytes provide suitable substrata for the biological fixation of N_2 in association with blue green algae. The recent increase in atmospheric pollution has revealed the bryophytes as "bioindicators" of pollution and accumulators of heavy metals. The ability of bryophytes to grow on open and nutrient poor areas and their tolerance to desiccation can be exploited in successful stabilisation of soil on road sides and open areas. Bryophytes also harbour a number of invertebrates and provide them shelter, food and a place for deposition of eggs (Uniyal, 1999). The details are as :

(a) **Bryophytes and plant succession:** Among the bryophytes, the mosses are considered to be the most potent forms in successional process. They colonise over the nutrient-poor sites where no other plant can survive. After death and decay, they form humus, in other way increasing soil fertility. Thus, the accumulated organic matters become suitable for the microorganisms. The microorganism increases the nutrient availability and makes the site suitable for growth of higher plants. The important species under this category are *Cephalozia media, Isopterygium elegans, Lepidozia septans, Pellia epiphylla* and *Tetrapis pellucida*.

(b) **Bryophytes and animal association** : Bryophytes possess several attributes viz., inconspicuous forms, relative abundance in the community, ability to survive in extreme environmental conditions and water absorbing and retention capacity, which affect the distribution and abundance of dependent animals and microorganisms.

(i) *Bryophytes and animal succession* : While bryophytes participate in the early stages of plant succession, their associated animals form similar stages of faunal succession. For example, moss cushions developing on rock faces are first colonised by rhizopods, rotifers, nematodes and ciliates. As dead material form under the cushions, rotifers and tardigrades become abundant and arthropods begin to appear. As a thicker decomposition layer is formed, the composition of the fauna becomes similar to that of the soil fauna.

(ii) *Shelter* : Water retention is an unique feature that makes bryophyte community an attractive habitat for many invertebrates. Bryophytes provide food and nesting materials for small mammals and invertebrates. Indirectly, they serve as a matrix for a variety of interactions between organisms. Insects are the most richly represented on bryophytes. Many protozoa, rotifera, nematodes, earthworms, molluscs, arthropods like spiders, millipeds, centipeds and various crustaceans are found in bryophyte communities. Large pores of *Sphagnum* leaves facilitate the entrance of water and allow unicellular animals to enter the leaf cells and live inside them.

(iii) *Food* : Many invertebrates feed on bryophytes. Orthopterans, beetles, moth and caterpillars bite and chew whereas bugs, aphids and mites suck out the contents of moss cells.

(iv) *Ovipositor and pupation* : The animals which feed on bryophytes also ovideposit their eggs there. Snails and slugs are frequently depositing their eggs upon the gametophores. Water beetles appear to live preferentially among mosses and spend their dormancy period. Many insects associated with bryophytes deposit their eggs there, and the larval stages often browse on the gametophores. Pupation of the water beetle takes place within a small cell.

(v) *Camouflage* : Some insects have morphologies, surface patterns or appendages that permit them to blend in with their bryophyte habitat. A few insects paste the parts of gametophores on their wings and thus camouflage themselves against predation. Camouflage may be used by larvae that construct their cases from

blades of *Fontinalis*, *Hygrophynum*, *Anomobryum* and *Plagiochila*.

(c) **Bryophytes and Cyanobacteria** : In natural association, cyanobacteria typically grow in association with bryophytes. Nitrogen is often a limiting nutrient for plant growth. Even small contributions from biological nitrogen fixation may, therefore, be important to the ecosystem. Some mosses, hornworts and liverworts provide suitable habitats for the biological fixation of nitrogen in association with cyanobacteria (e.g., *Nostoc*). The ability of cyanobacteria to fix atmospheric nitrogen allow a few bryophytes to grow in areas that are naturally low in nitrogen and serve as fertiliser to soil.

(d) **Bryophytes as ion-exchanger** : The cell walls of *Sphagnum* function as ion-exchanger. They rapidly absorb cations, such as calcium and magnesium, supplied by rain water, and in exchange, release hydrogen ions into the water. Hydrogen ions make the soil acidic (pH 3-4). Therefore, *Sphagnum* creates as well as maintains a nutrient-poor, acidic environment that foster their own growth, but is mostly intolerable to other plants.

(e) **Bryophytes maintain water balance in the forests** : In forests, especially in the montane tropics, bryophytes (especially *Sphagnum*) absorb huge quantities of water and maintain humidity over dry periods, thus preventing rapid run-off and flooding. Without bryophytes, rainforest would be merely wet and mountain rocks would be barren. The huge bryophyte mats in the forest floor slow down and delay run-off during rain. It has been predicted that the excessive flooding in India is at least partly due to loss of bryophyte covers.

(f) **Bryophytes conserve soil and prevent soil erosion** : On bare and disturbed soil bryophytes are primary pioneers and they have the ability to stabilise soils. The soils in semi-arid regions are held in place by crusts predominantly composed of bryophytes, thus preventing the soil from blowing away. They also prevent soil erosion by slowing down and delaying run-off during rain. When clay-rich soil has been laid bare due to landslides or road making, the first colonisation and subsequent stabilisation are substantially by bryophytes. The soil surface rapidly becomes bound together by rhizoid production followed by rapid branching of prostrate stems, thus preventing further soil erosion.

(g) **Bryophytes as pollution indicator** : The investigations with bryophytes in relation to different pollutants prove their potential as bioindicators of pollution. Due to their habitat diversity, structural simplicity, totipotency and rapid rate of multiplication bryophytes appear to be ideal organisms for pollution studies both under field and laboratory conditions. Phytosociological and eco-physiological studies indicate that the decline and absence of mosses — especially epiphytic ones — in urban-industrial areas is a phenomenon primarily induced by air pollution caused by different gaseous and particulate pollutants. These plants can be reliable indicators and also monitor the air pollution.

Some bryophytes are very sensitive to pollution and show visible symptoms of injury even in the presence of minute quantities of pollutants. Such plants serve as good bio-indicators of the nature and degree of pollution. Some bryophytes have the capacity to absorb and retain pollutants in quantities much higher than those absorbed by other plant groups present in the same habitat. Their efficient absorbing capacity is due to the absence of cuticle, presence of single cell thick lamina and larger surface area as compared to the volume. These plants, therefore, act as effective sink of pollutants and prevent their recycling for a considerable period of time.