Lichens

Reproduction

and

Economic importance

Reproduction in Lichens:

Lichen reproduces by asexual and sexual.

Asexual reproduction: It takes place by vegetative methods and sporulation.

I). Vegetative methods of asexual reproduction:

(a) Fragmentation:

It takes place by accidental injury where the thallus may be broken into fragments and each part is capable of growing normally into a thallus.

(b) By Death of Older Parts:

The older region of the basal part of the thallus dies, causing separation of some lobes or branches and each one grows normally into new thallus.

c). Soredium (pi. Soredia):

These are small greyish white, bud-like outgrowths developed on the upper cortex of the thallus. They are composed of one or few algal cells loosely enveloped by fungal hyphae. They are detached from the thallus by rain or wind and on germination they develop new thalli. When soredia develop in an organised manner in a special pustule-like region, they are called **Soralia** , e.g., *Parmelia*, *Physcia* etc.

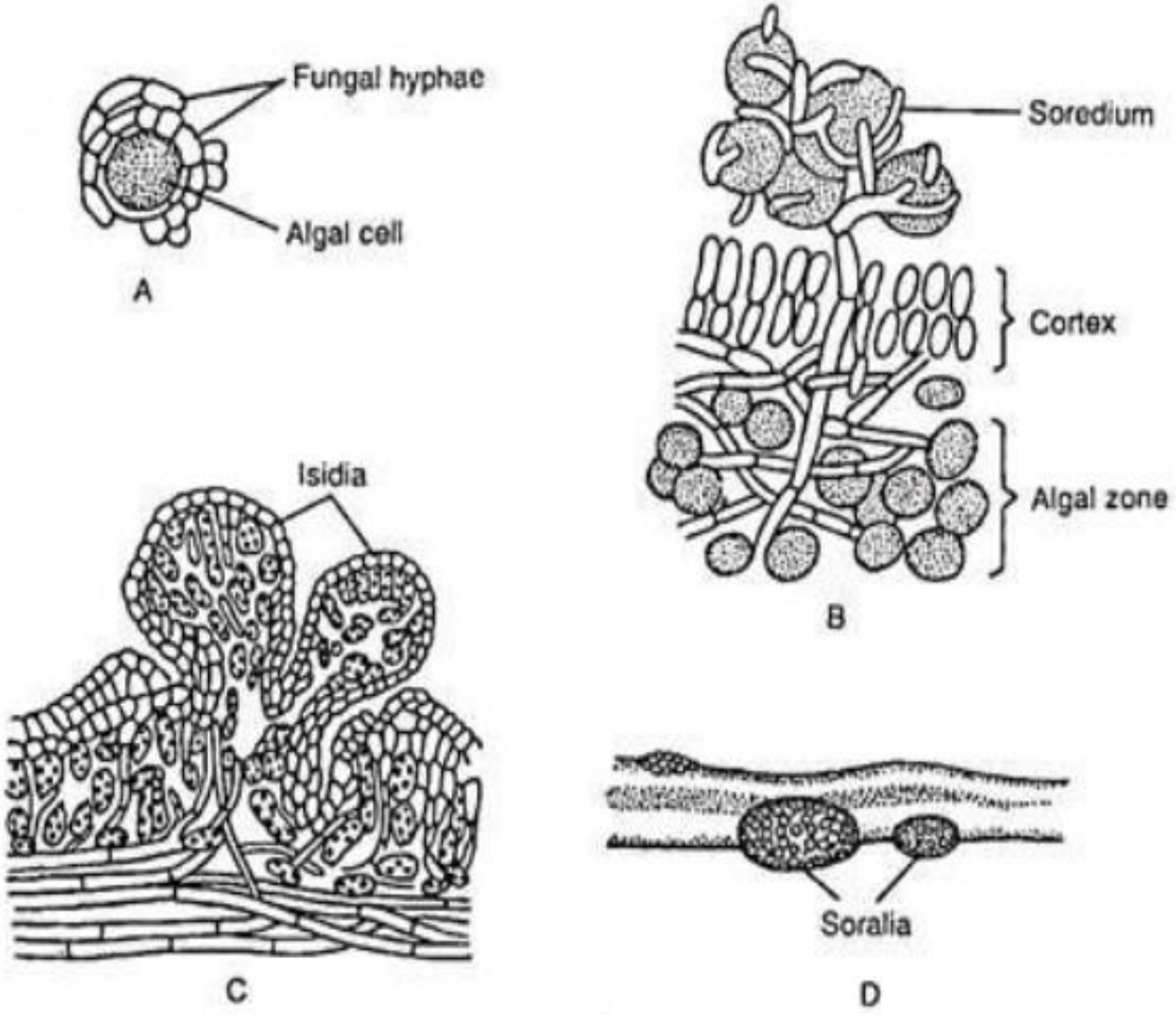


Fig. 4.115 : Asexual reproductive structures : A. Soredium of *Physcia pulverulenta* with single algal cell, B. Soredium of *Parmelia* with many algal cells, C. Isidia of *Peltigera* and D. Soralia on thallus

d) Isidium (pl. Isidia):

These are small stalked simple or branched, greyish-black, coral-like outgrowths, developed on the upper surface of the thallus. The isidium has an outer cortical layer continuous with the upper cortex of the mother thallus which encloses the same algal and fungal elements as the mother.

They are of various shapes and may be rod-like in *Parmelia*, cigar-like in *Usnea*, scale-like in *Collema* etc. It is generally constricted at the base and detached very easily from the parent thallus. Under favourable condition the isidium germinates and gives rise to a new thallus. In addition to asexual reproduction, the isidia also take part in increasing the photo-synthetic area of the thallus.

2. Sporulation: Pycnidiospores: The fungal partner produces small, non-motile asexual spores known as pycnidiospores. They are produced in large numbers in special, conical, flask-shaped cavities called the pycnidia, which are found on the upper surface of some lichen species. Each pycnidium opens to the surface through a small pore called an ostiole. The wall of pycnidium consists of sterile fungal hyphae. The pycnidiospores on germination produce fungal hypha which, after coming in contact with an appropriate alga, develops further into new lichen. .

II. Sexual Reproduction:

Only fungal partner of the lichen reproduces sexually and forms fruit bodies on the thallus. The nature of sexual reproduction in ascolichen is like that of the members of Ascomycotina, whereas in Basidiolichen is like that of Basidiomycotina members.

In Ascolichen, the **female** sex organ is the **carpogonium** and the **male** sex organ is called **spermogonium** (= pycnidium). The spermogonium mostly develops close to carpogonium.

The carpogonium is multicellular and is differentiated into basal coiled **ascogonium** and upper elongated multicellular **trichogyne**. The ascogonium remains embedded in the algal zone, but the trichogyne projects out beyond the upper cortex.

The spermogonium are flask shaped cavities immersed in small elevations on upper surface of thallus. They are similar to pycnidia and open outside by a small pore called as ostiole. The fertile as well as sterile hyphae line the cavity of spermogonium. The fertile hyphae cut off small uninucleate round cell known as spermatia on their tips.

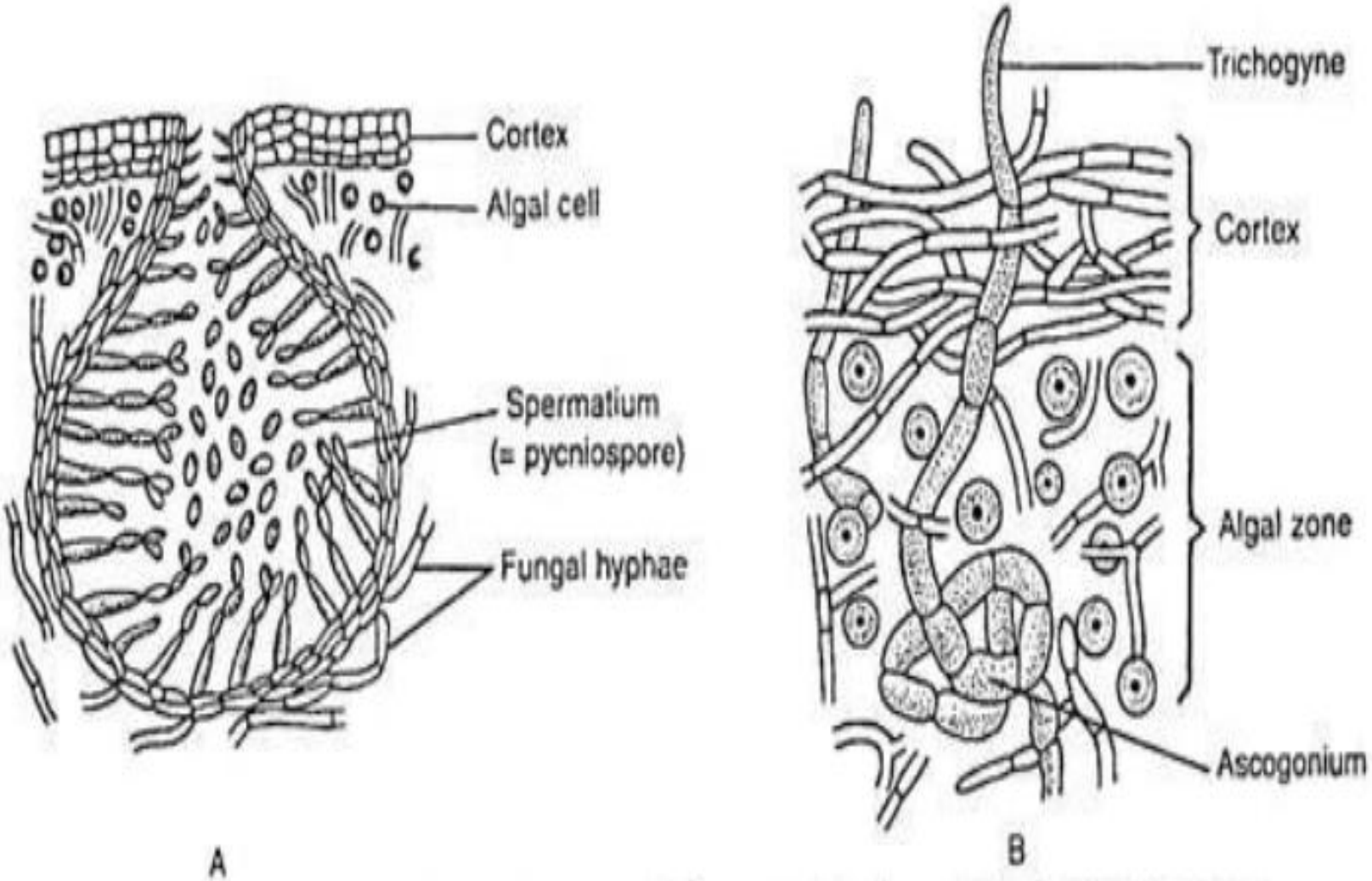


Fig. 4.116 : Sexual reproductive structures : A. Spermogonium (= pycnidium), B. Carpogonium

The spermatium, after liberating from the spermogonium, gets attached with the trichogyne at the sticky projected part. On dissolution of the common wall, the nucleus of spermatium migrates into the carpogonium .

Many ascogenous hyphae develop from the basal region of the fertilised ascogonium. The binucleate penultimate cell of the ascogenous hyphae develops into an ascus.

Both the nuclei of penultimate cell fuse and form diploid nucleus (2n), which undergoes first meiotic and then mitotic division — results in eight haploid daughter nuclei. Each haploid nucleus with some cytoplasm metamorphoses into an ascospore.

The asci remain intermingled with some sterile hyphae — the paraphyses. With further development, asci and paraphyses become surrounded by vegetative mycelium and form fruit body.

The fruit body may be ascohymenial type i.e., either apothecium as in *Parmelia* and *Anaptychia* or perithecium as in *Verrucaria* and *Darmatocarpon* or ascolocular type (absence of true hymenium), which is also known as pseudothecia or ascostroma.

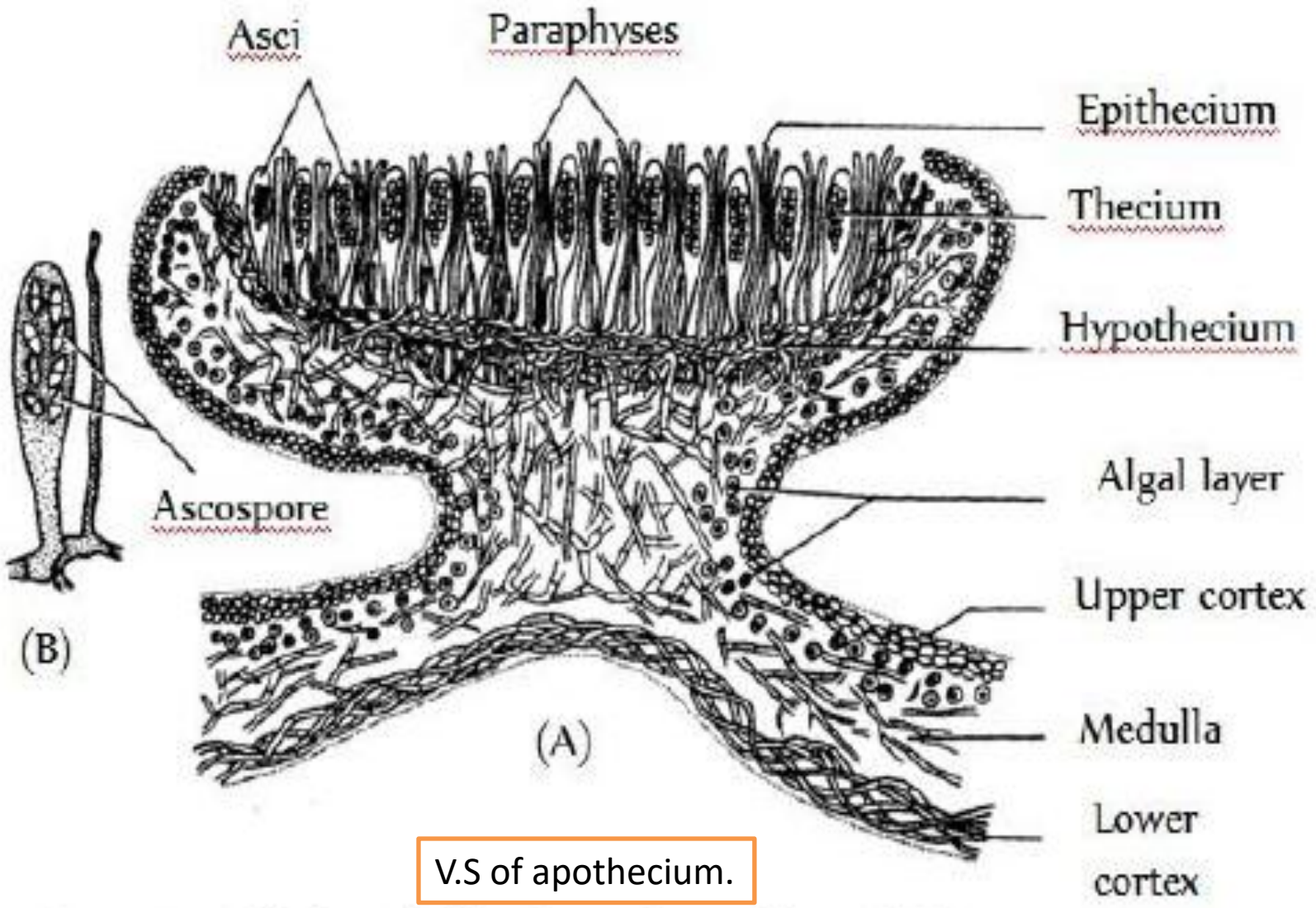
Internally, the cup-like grooved region of a mature apothecium consists of three distinct parts; the middle thecium (= hymenium), comprising of asci and paraphyses, is the fertile zone covered by two sterile zones — the upper epitheca and lower hypotheca. The region below the cup is differentiated like the vegetative thallus into outer cortex, algal zone and central medulla.

Usually the asci contain eight ascospores, but the number may be one in *Lopadium*, two in *Endocarpon* and even more than eight in *Acarospora*.

The ascospores may be unicellular or multicellular, uninucleate or multinucleate, and are of various shapes and sizes. After liberating from the ascus, the ascospore germinates in suitable medium and produces new hypha. The new hypha, after coming in contact with proper algal partner, develops into a new thallus.

In Basidiolichen, the result of sexual reproduction is the formation of basidiospores that developed on basidium as in typical basidiomycotina. The fungal member (belongs to Thelephoraceae) along with blue green alga, as algal partner forms the thalloid plant body.

The thallus grown over soil produces hypothallus without rhizines, but on tree trunk it grows like bracket fungi and differentiates internally into upper cortex, algal layer, medulla and lower fertile region with basidium bearing basidiospores.



V.S of apothecium.

Importance of Lichens:

A. Economic Importance of Lichens:

The lichens are useful as well as harmful to mankind. The useful activities are much more than harmful ones. They are useful to mankind in various ways: as food and fodder, as medicine and industrial uses of various kinds.

1. As Food and Fodder:

Lichens are used as food by human being in many parts of the world and also by different animals like snail, catterpiliars, slugs, termites etc. They contain polysaccharide, lichenin; cellulose, vitamin and certain enzymes.

Some uses of lichens are:

(i) As Food:

Some species of *Parmelia* are used as curry powder in India, *Endocarpon miniatum* is used as vegetable in Japan, *Evernia prunastri* for making bread in Egypt, and *Cetraria islandica* (Iceland moss) as food in Iceland. Others like species of *Umbillicaria*, *Parmelia* and *Leanora* are used as food in different parts of the world. In France, some of the lichens are used in the preparation of chocolates and pastries. Lichens like *Lecanora saxicola* and *Aspicilia calcarea* etc. are used as food by snails, caterpillars, termites, slugs etc.

(ii) As Fodder:

Ramalina traxinea, *R. fastigiata*, *Evernia prunastri*, *Lobaria pulmonaria* are used as fodder for animals, due to the presence of lichenin, a polysaccharide. Animals of Tundra region, especially reindeer and muskox use *Cladonia rangifera* (reindeer moss) as their common food. Dried lichens are fed to horses and other animals.

2. As Medicine:

Lichens are medicinally important due to the presence of lichenin and some bitter or astringent substances. The lichens are being used as medicine since pre-Christian time. They have been used in the treatment of jaundice, diarrhoea, fevers, epilepsy, hydrophobia and skin diseases.

Cetraria islandica and *Lobaria pulmonaria* are used for tuberculosis and other lung diseases; *Parmelia sexatilis* for epilepsy; *Parmelia perlata* for dyspepsia. *Cladonia pyxidata* for whooping cough; *Xanthoria parietina* for jaundice and several species of *Pertusaria*, *Cladonia* and *Cetraria islandica* for the treatment of intermittent fever.

Usnic acid, a broad spectrum antibiotic obtained from species of *Usnea* and *Cladonia*, are used against various bacterial diseases. *Usnea* and *Evernia furfuracea* have been used as astringents in haemorrhages.

Some lichens are used as important ingredients of many antiseptic creams, because of having spasmolytic and tumour-inhibiting properties.

3. Industrial Uses:

Lichens of various types are used in different kinds of industries.

(i) Tanning Industry:

Some lichens like Lobaria pulmonaria and Cetraria islandica are used in tanning leather.

(ii) Brewery and Distillation:

Lichens like Lobaria pulmonaria are used in brewing of beer. In Russia and Sweden, Usneaflorida, Cladonia rangiferina and Ramalina fraxinea are used in production of alcohol due to rich content of “lichenin”, a carbohydrate.

(iii) Preparation of Dye:

Dyes obtained from some lichens have been used since pre- Christian times for colouring fabrics etc.

Dyes may be of different colours like brown, red, purple, blue etc. The brown dye obtained from *Parmelia omphalodes* is used for dyeing of wool and silk fabrics. The red and purple dyes are available in *Ochrolechia androgyna* and *O. tartaria.*

The blue dye "Orchil", obtained from *Cetraria islandica* and others, is used for dyeing woollen goods. Orcein, the active principal content of orchil-dye, is used extensively in laboratory during histological studies and for dyeing coir.

Litmus, an acid-base indicator dye, is extracted from *Roccella tinctoria, R. montagnei* and also from *Lasallia pustulata.*

(iv) Cosmetics and Perfumery:

The aromatic compounds available in lichen thallus are extracted and used in the preparation of cosmetic articles and perfumes. Essential oils extracted from species of Ramalina and Evernia are used in the manufacture of cosmetic soap.

Ramalina calicaris is used to whiten hair of wigs. Species of *Usnea* have the capacity of retaining scent and are commercially utilised in perfumery. *Evernia prunastri* and *Pseudevernia furfuracea* are used widely in perfumes.

Harmful Activities of Lichens:

1. Some lichens like *Amphiloma* and *Cladonia* parasitise on mosses and cause total destruction of moss colonies.

2. Lichen like *Usnea*, with its holdfast hyphae, can penetrate deep into the cortex or deeper, and destroy the middle lamella and inner content of the cell causing total destruction.

3. Different lichens, mainly crustose type, cause serious damage to window glasses and marble stones of old buildings.

4. Lichens like *Letharia vulpina* (wolf moss) are highly poisonous. Vulpinic acid is the poisonous substance present in this lichen.

B. Ecological Importance of Lichens:

Lichens have some ecological importance.

1. Pioneer of Rock Vegetation:

Lichens are pioneer colonisers on dry rocks. Due to their ability to grow with minimum nutrients and water, the crustose lichens colonise with luxuriant growth. The lichens secrete some acids which disintegrate the rocks.

After the death of the lichen, it mixes with the rock particles and forms thin layer of soil. The soil provides the plants like mosses to grow on it as the first successor, but, later, vascular plants begin to grow in the soil. In plant succession, *Lecanora saxicola*, a lichen, grows first; then the moss *Grimmia pulvinata*, after its death, forms a compact cushion on which Poa compressor grows later.

2. Accumulation of Radioactive Substance:

Lichens are efficient for absorption of different substances. The *Cladonia rangiferina*, the 'reindeer moss', and *Cetraria islandica*, the 'Iceland moss' are the commonly available lichens in Tundra region. The fallout of radioactive strontium (90Sr) and caesium (137CS) from the atomic research centres are absorbed by lichen. Thus, lichen can purify the atmosphere from radioactive substances.

3. Sensitivity to Air Pollutants:

Lichens are very much sensitive to air pollutants like SO2, CO, CO2etc.; thereby the number of lichen thalli in the polluted area is gradually reduced and, ultimately, comes down to nil. The crustose lichens can tolerate much more in polluted area than the other two types. For the above facts, the lichens are markedly absent in cities and industrial areas. Thus, lichens are used as “pollution indicators”.

THANKS.....