# BIO414 (CRYPTOGAMIC BOTANY II)

## WEEK 11

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# GENERAL FEATURES OF ANTOCEROTOPHYTA (HORNWORTS)

## Division: Anthocerotophyta

Anthocerotophyta is the least diverse phylum of the bryophytes, however its distribution is widespread, with Antarctica being the only continent in which they are not found.

Most species in this phylum typically grow on moist soil in shaded areas, but some are found growing in exposed sites, while a few others are epiphytic.

Hornworts are considered to be ecological pioneers as they often grow in areas where there is little to no competition, such as on mineral soils. Although they may superficially resemble a thalloid liverwort, they have gametophytic and sporophytic features that separates them from other bryophytes seen thus far.

All species have a thalloid gametophyte that is flattened and can occur in the form of a rosette or ribbon. In most genera, the thallus is multistratose in the center and thins out closer to the margins. The cells on the upper surface of the thallus are generally chlorophyllose, while those found in deeper layers do not contain chloroplasts. Most genera of this phylum have a single large chloroplast per photosynthetic as well as a pyrenoid associated with the plastid.

Hornworts cluster Rubisco in the pyrenoid, which is a trait that is also seen in algae. These features along with the absence of oil bodies aid in distinguishing these species with those in Marchantiophyta. The surface of the thallus is generally cutinized, however this cuticle layer does not prevent gas exchange from occurring. The thalli are attached to the substrata by smooth, thin-walled, unbranched and unicellular

While the thallus is primarily composed of parenchyma cells and has little tissue differentiation, there are often intercellular cavities, which are filled with mucilage, on the ventral surface.

These mucilage chambers, as seen in this picture, open to the environment due to the presence of stomata-like pores and are frequently invaded by small colonies of blue-green algae called Nostoc.

Nostoc are filamentous cyanobacteria that can easily fix nitrogen.

They are able to form symbiotic relationships with hornworts in which the alga receives carbohydrates and a protected shelter while the hornwort receives the fixed nitrogen.

Most species within this phylum are bisexual, having both the male and female sexual organ embedded in the upper surface of the thallus.

The antheridia, which develop in chambers within the thallus, are derived from a single initial.

Furthermore, this initial is capable of giving rise to several antheridia within the same chamber.

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The archegonia, which are also embedded within the thallus, are derived from an initial cell.

While only the upper portion of the neck rises from the surface of the thallus, the lower portion of the neck as well as the egg cell remain beneath the surface. Because the cells that surround the archegonia do not differ from those of the thallus, the sexual organ is

The Anthocerotophyta are characterized by their long, horn-shaped sporophyte, from which they get their name “hornworts”.

Although the sporophyte remains attached to its parent, like in other bryophytes, it differs significantly in that it possesses an meristematic region at its base.

This feature allows the sporophyte to have indeterminate growth, giving it the ability to differentiate new sporogenous tissues throughout its life.

Stomata similar to those found in vascular plants can be found on the sporangium, however, unlike those in higher plants, they do not open or close.

As the sporophyte grows, it not only becomes longer but the spores at different height within the sporangium differ in maturity.

The younger spores at the base of the sporangium typically remain in a tetrahedral arrangement, while the mature spores near the tip are separated.

The sporophyte lacks a seta but has a columella, and dehiscence occurs along one or two longitudinal lines, thus the spores are released along the halves as they mature.

Not only are there spores within the sporangium, but there is also the presence of pseudo-elaters.

These multicellular structures are filamentous and aid in the dispersal of the spores by changing their shape when dry.

Their cells walls can either be thin, spirally thickened or even.

Although they resemble the elaters seen in the liverworts, the difference in the cell division patterns sets them apart.

Although asexual reproduction is rare in hornworts, a few species produce marginal gemmae while others are capable of producing perennating tubers, which are able to tolerate some dessication.

A simple and effective means of asexual reproduction is by having the older parts of the thallus die off, leaving the younger and disconnected parts to continue to grow.

# GENERAL FEATURES OF MARCHANTIOPHYTA (LIVERWORTS)

Marchantiophyta are commonly known as the “liverworts” due to the shape of hepatic liverworts resembling the shape of the liver. According to an old medical doctrine, this resemblance indicated liverworts could cure illnesses of the liver. Liverworts are located on nearly every continent, inhabiting a diverse array of ecosystems. They may be found in harsh environments that many organisms find difficult to live and reproduce, however liverworts are not generally found in salty aquatic environments such as the ocean. Further, some species of Marchantiophyta rely on the photosynthate produced from other tracheophytes and mosses, as well as form symbiotic relationships with different groups of fungi (typically located on their rhizoids). However, this symbiotic relationship is not specific to species of

The morphology of the free-living gametophytic generation varies within Marchantiophyta.

There are many forms of gametophyte ranging from thalloid to leafy, and large to small.

The isodiametric cells of the gametophore contain trigones, chloroplasts, and typically have oil bodies.

The oil bodies are true membrane-bound organelles that vary in size, shape, number, color, and chemical composition among species. When liverworts are dried (such as for storage in a Herbarium) the oil bodies degrade at varying rates over time.

The function of oil bodies is currently unknown, but they may serve to deter herbivores or aid in protection from the cold or UV

There is not a well-developed conducting system composed of hydroids and leptoids, however, endohydric water conduction does occur in some groups. At the apical regions of active mitotic cell division, mucilage is produced to protect against dehydration.

Rhizoids are smooth and unicellular and serve to anchor and conduct water and minerals.

The sexual reproductive structures are generally different from those of Bryophyta. The archegonia are either contained within a modified region of the thallus known as an involucre (in thalloid liverworts) or a modified leaf known as the perianth (in leafy liverworts).

There are no paraphyses present in either the female or male gametophytic regions.

The sporophytic generation helps to classify Marchantiophyta. The unbranched sporophyte matures within the protective calyptra and female gametophyte. Once mature, the sporangium is elevated by the seta. Elongation occurs via water intake of thin-walled parenchymal cells within the seta. The increase in turgor pressure causes the cells of the seta to elongate.

Within the sporangium there are two types of cells developing from sporanogeous tissues, spore and elater mother-cells. Elater mother-cells develop into a single diploid cell with spiral wall thickenings, known as an elater. Spore mother-cells undergo meiotic divisions to become many haploid cells, known as a spores. The sporangium does not contain stomata, a columella, or peristome teeth.

The mature sporophytic generation is short-lived with a brief period of spore dispersal by longitudinal lines of dehiscence on the sporangium.

Spores may persist in the harsh environments liverworts may inhabit.

When the spores germinate, they develop into a new branched and free-living gametophyte.

# REFERENCES

Url1. https://blogs.ubc.ca/biology“Introduction to Bryophytes”