DIVERSITY OF BRYOPHYTES

Contents

Topic: Diversity of Bryophytes

Objectives

In this lecture we will learn the followings:

- a clear idea of the features that separate bryophytes from other plants
- skills in identifying them in our environment
- importance of the bryophytes
- contributions to our lives

Reading Assignment

In addition to the discussion in this lecture read current textbooks in the library and visit: ilearn.bupoyesiku.net for the online lecture.

Lecture

In previous lecture we discussed about algae. You have learnt about the concept of algae. In our today's discussion, you will be taken to the next level of understanding biodiversity with particular reference to bryophytes. Bryophytes are one of the non-vascular photosynthetic plants. They are important not only for academic teaching, but also for their unique source of medicine and ability to monitor environmental pollution. Furthermore, your knowledge of the field (Bryology) will makes you more conscious of their abundance and important roles to humans. Especially for those of you that are going to become famous bryologists, as well as those that require the knowledge in their field of study.

Introduction

Bryophytes are primarily producers that trap sun energy directly from the atmosphere and convert it to food. They form the primary producer in terrestrial food web in typical ecosystems. It is also important for you to know that Bryophyte is a collective term (English) use for mosses, liverworts (English: liver-like +small plant=wort), and hornworts (English: horn-like +small plant=wort). Of the three groups, mosses are the largest, and the hornwort ranks the least with 100 spp. and six genera). Hornwort is rare. Only one species (*Phaeocerous carolinianus*) have so far been published, in Nigeria

Main Content

Background of Bryophytes

Bryology is the study of bryophytes. They probably evolved from the advanced green algae at about the same time as the first vascular plants (Pteridophytes). Both bryophytes and pteridophytes are embryophytes, because they share multicellular sex organs, but bryophytes lack vascular tissues. It is important for you to know that bryophytes occupied an evolutionary dead end and they stand alone on the evolutionary ladder.

Reproduction in Bryophytes

Asexual

In a bryophyte asexual reproduction is majorly by regeneration of broken pieces from any part of the plant. Other descriptive methods include:

- Progressive death and growth of gametophytes
- Branching of the leafy stem through development of leaf axial bud
- Formation of stolons from stem base.
- Tubers
- Gemmae

These are just the common examples. There are more complex and diverse methods that their discussion is beyond the scope of this lecture.

Sexual

Sexual reproduction in a bryophyte as illustrated by the conceptual plan (Fig.1.1 A-J) starts with a formation of gametangia i.e. reproductive organs (Fig 1.1A, B) located at the tips of the gametophytes, often on special branches. Both male and female organs i.e. gametangia (Fig 1.1C, D) are commonly found on the same plant. In most bryophytes matured archegonium i.e. female gametangium (Fig 1.1C) is somewhat flask-shaped with narrow neck in which a single egg cell is produced while the matured male antheridium (Fig 1.1D) is a sausage shaped to roundish supported on a short stalk. It contains millions of coiled or comma-shaped sperms (the antherozoid). The sperms possess a pair of flagella (Fig1.1E). The sperms require film of water to swims to the female gametangium where it fertilized the egg. When this is done a diploid zygote (Fig 1.1F) grows rapidly into spindle-shaped embryo (Fig 1.1G). The basal portion of the embryo penetrates the gametophyte body and form a swollen knob that form the future foot of the mature sporophyte. The matured sporophyte (Fig 1.1H) is made up of a foot buried inside the gametophyte body, an unbranched thin stalk (seta) and a capsule at the top.

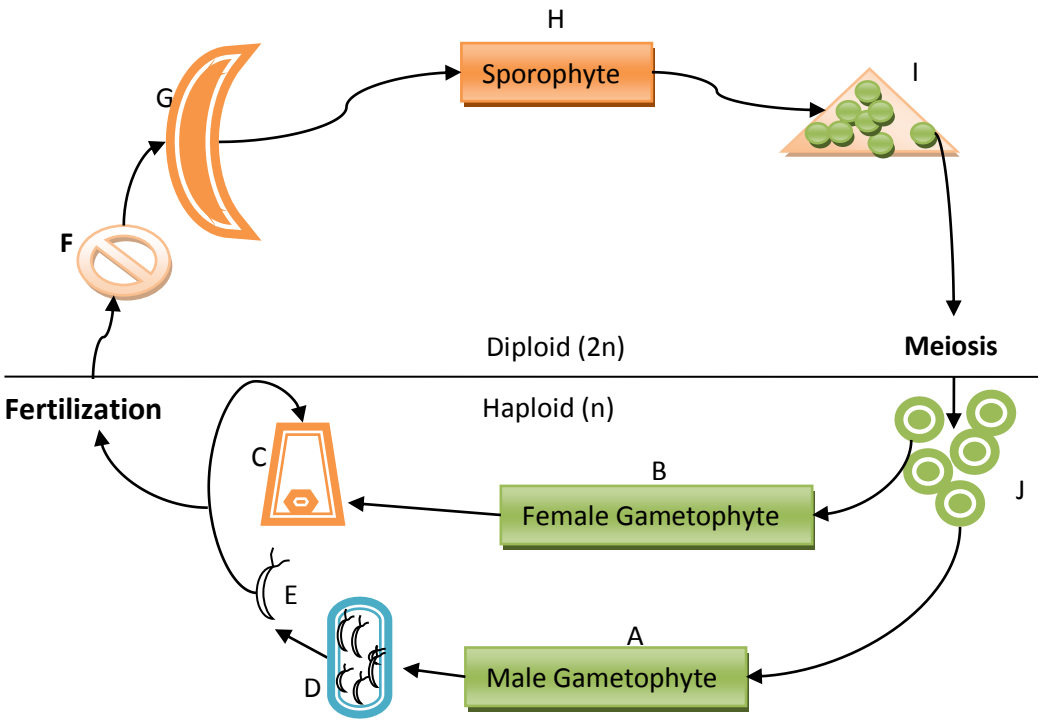

Figure 1.1Conceptual plan of life cycle of typical mosses. Male gametophyte (a), female gametophyte (b), archegonium with a cell (c), antheridium with sperms (d), antherozoid (e), zygote (f), embryo (g), sporophyte (h), capsule with sporocytes (i) and haploid spores (j).

The capsule (Fig 1.1 I) contains sporocytes, which undergo meiosis to produce millions of haploid spores (future male and female gametophytes). With the aids of peristome teeth the spores (Fig 1.1J) are dispersed from the capsule. As they landed on suitable substrate the spores germinate into either male or female protonema, which later develops buds that in turn grow into mature gametophytes. At this stage the life cycle repeat itself and life goes on with increasing chances of diversity among the bryophytes.

Classification of bryophytes

Bryophytes fall into three major divisions:

- Anthoceratophyta (hornworts)
- Bryophyta (mosses)
- Marchantiophyta (liverworts)

It will interest you to know that many plants out there share resemblance with mosses. The true mosses which are classified under the bryophyta are genetically unrelated to these "fake" mosses. Examples of the "fake" mosses are

- Irish moss, a red algae (*Chondrus crispus*)
- Reindeer moss, a lichen *(Cladonia* spp.*)*
- Club moss, a pteridophyte (*Lycopodium* spp.)
- Spanish moss a plant in pineapple family (*Tillandia uneoides*)

To remember the names of fake mosses use this rhyme: "Irish-**re**nt-**cl**ub in –**Sp**ain".

Characteristics of Bryophytes

Hornwort

- Circular greenish undulating gametophyte
- Wrinkled thallus
- ventral surface lack scales
- Tapering horn-like or needle-like spore capsules grow out from thallus
- Pseudo-elaters to disperse spores
- Seta absent
- Single large pyrenoid
- Rhizoids are mostly unicellular
- Stomata present on gametophyte

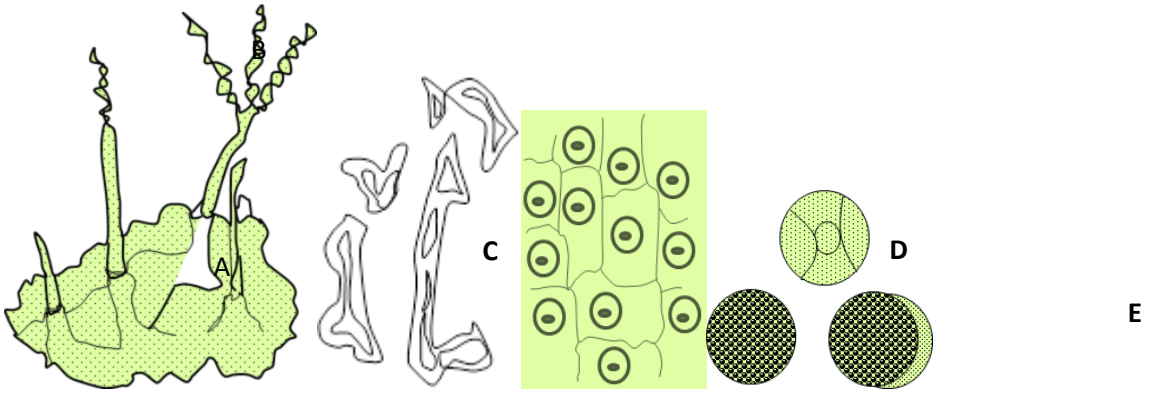

Fig.1.2 *Phaeocerous carolinianus*. A=Gametophyte, B=Sporophyte, C=Pseudoelater, D=Spore, E= single large chloroplast with pyrenoid in cells. Growing on cliff side in Obudu Cattle Ranch, Nigeria © 2013 Bup Oyesiku.

Moss

- ❍ Gametophyte is leafy(leaves growing from stem)
- ❍ Leaves cells contain chloroplasts
- ❍ Oil bodies are absent in the cells
- ❍ Rhizoids, multi-celled, and branched
- ❍ Protonema (filamentous, algal-like) well developed (from germinating spore)
- ❍ Sporophyte comprises foot, seta, capsule, and spores
- ❍ Stomata present on the green capsule of the sporophyte

❍ Capsule mouth equipped with peristome teeth for spore dispersal

❍ Lack elaters or pseudo-elaters in the capsule

Liverwort

Thalloid gametophytes

- ❍ Small greenish sheet of thallus grows from germinating spores
- ❍ Cryptothallus is a white thallus lack chloroplast (a parasitic liverwort)
- ❍ Thallus is somewhat wrinkled at the margin or lobed
- ❍ Thin translucent (simple) to opaque (complex) thallus

- marginal role of scales on the underside of thallus
- Capsule is usually embedded in the thallus
- Rhizoids are unicellular and unbranched
- Sporophyte is short lived

Leafy gametophytes

- Leaves growing from stem in leafy species
- Leaves cells contain chloroplasts and oil bodies
- Leaves have single sheet of cells except the “mid rib” with two or more sheets
- Stems have more than two layers of cell sheets
- Tiny brownish root-like rhizoids, single, unbranched and colorless cell wall.
- Rhizome-like is only found in genus, *Haplomitrium*
- Sporophyte is short lived
- Capsule is either embedded in the thallus or stalked in leafy species
- Capsule is spherical to cylindrical, blackish when mature, split open to release the spores
- Elaters (spiral-like) aid dispersal of spores (twist and untwist depending on humidity)
- Seta is weak.

Diversity of Forms in Bryophytes

Bryophytes have two alternating plant bodies the gametophyte and sporophyte.

Gametophyte (independent plant)

- Hornwort (thalloid plant)
- Liverwort (thalloid and leafy plant)
- Moss (leafy plant)

At this point you should know that mosses of the three bryophytes is the most diverse and advance group. We shall briefly look at the outline of the most common habits found in mosses.

Acrocarpous moss (upright habit)

- Mat-like (individual plants tightly packed together)
- Cushion-like (composed of dead older leaves, leaving a living green layer above

Pleurocarpous moss (creeping habit)

- Creeping stems above substrate with off-shoots (upright, lateral, short leafy branches)
- Creeping stems under substrate with short erect leafy branches above substrate (*Gigaspermum repens*)
- Pendulous with long creeping stem with small area of attachment to the substrate, e.g. *Papillaria flavolimbata*)

Sporophyte (dependent plant) comprises

- Foot (inside the gametophyte)
- Seta (stalk)
- Capsule (contains spores)

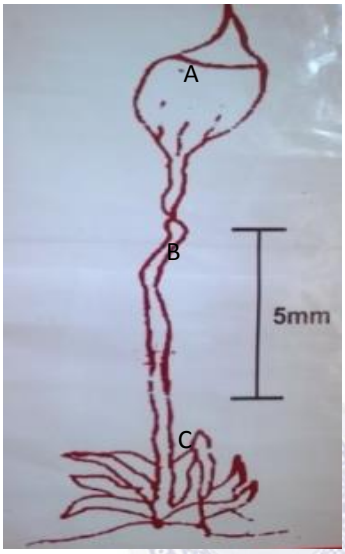

Fig.1.3 Sporophyte. A=Capsule, B=Seta, C=Foot inside gametophte

Habitats of Bryophytes

As you have learnt in algae lecture bryophytes are also native citizen of the whole world. They are nicknamed as “amphibians” of the plant world, because they are the first plant to explore the land, and remain in shady, moist humid habitats. They grow in great diverse habitats except in the marine Ocean. Major groups of substrate on which bryophytes grow are as outline here.

- Trees (leaves, twigs, branches, trunks, and exposed roots)
- Rock (spaces and surface)
- Decaying woods, leaves litters, and plant debris on forest floor
- Bare ground
- Organic waste (animal dung, and bones)
- Artificial structures (culvert, and old fences, sculptures, old metal and glass)

Ecology of Bryophytes

As discussed in algae lecture, bryophytes are also important key plants occupying the base of ecological food chain (or web). Among the bryophytes hornwort is unique in terms of functional stomata on the gametophyte and cell cavity filled with mucilage. Hornwort is the only plant with endophyte Cyanobacteria, particularly Nostoc. Cyanobacteria that live in cavity filled with mucilage in hornworts fix nitrogen gas into nitrate for other plant use. It may interest you that it has never been reported of any plant fixing nitrogen gas into nitrate by itself using endophyte. Hence hornwort is unique for this reason. Other ecological importance of bryophytes is enumerated here.

- Bryophytes capture and recycle nutrients wash with rainwater from the atmosphere.
- Bryophytes bind soil to prevent erosion
- Bryophytes provide seed beds for higher plants
- Bryophytes are important in regeneration of disturbed habitats (succession)

Economic uses of Bryophytes

Besides the ecological role, bryophytes have a great economic value. Current trend in the use of bryophytes have stimulated interests in the field of bryology; bryophytes may now be used as monitors of environmental pollution and vegetation disturbances by humans. Some of the economic values are stated here.

- Peat moss (compressed *Sphagnum*) provide heat and electricity energy
- Peat moss improves the water holding capacity of soil
- Peat moss, acidic in nature, prevent growth of bacteria
- *Sphagnum* is used as an alternative to cotton wool, sanitary pad and diapers
- Bryophytes are eaten by some animals
- Bryophytes are sensitive indicators of atmospheric pollutants

Conclusion

At the end of this lecture you must have learnt how to recognize, and where to find the bryophytes. Current trend in research focus on the usefulness of bryophytes. If encouraged, in near future the use of bryophytes as biomonitor of environmental pollution and vegetation disturbances will be a wise decision. It can alert us of impending danger in our immediate environment.

Summary

Having study this lecture note, you should:

- Have some understanding of types of bryophytes
- Have a better skills of the characteristics that separate them from other groups of plants
- Be ready to look around your environment for the common members
- Better aware of the future uses of bryophyte plants.

References/Further readings/Links

Test Yourself Questions (TYQ)

Matric No	Department	Attendance Code	Session/Student's Level
		AC_____	

Question	TRUE	FALSE
1. Bryophytes can be found in all habitat		
2. Bryophytes evolved into an isolated position		
3.Irish moss is a bryophyte		
4. Hornwort belong to the division Anthroceretophyta		
5. Hornwort is found in Nigeria		
6. Liverworts exist in two forms		
7. Sporophyte of a moss consist of capsule, seta and gametophyte		
8. Nostoc is an endophyte in all bryophyte		
9. Hornwort fixes nitrogen in nature		
10. Alternation of generation is well demonstrated in bryophyte		

Comment: