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THE LIFE CYCLE OF BRYOPHYTA

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ABSTRACT

The group of plants known as bryophytes includes liverworts, mosses, and hornworts. Bryophytes are terrestrial plants that include gametophytes that are photosynthesis-dependent and permanent, and sporophytes that are photosynthesis-dependent and ephemeral. Bryologists recognize a few lower groups in addition to the two categories of monoicous and dioicous plants, which are classified according to the sexual system of these plants. There seems to be a connection between the sexual systems of bryophytes and their breeding systems. In dioicous species, out-crossing occurs, whereas in monoicous species, self-fertilization takes place. The low frequency of fertilization and the rarity of sporophytes that are associated with dioicous species may be attributed to a number of factors, including biassed sex ratios, geographical separation of sexes, and the lack of males or the inability of males to express sex among populations. Following fertilisation and the growth of sporophytes, bryophytes generate spores, which are responsible for the creation of new plants. Bryophytes, on the other hand, are capable of alternative types of reproduction, including asexual structures such as gemmae, propagules, and the regeneration of pieces that are capable of forming new plants.

Keywords: - *bryophytes, monoicous species, self-fertilization, geographical separation.*

INTRODUCTION

Bryophytes, which are plants that do not have vascular tissue, are the only embryophytes (plants that generate an embryo) that have a dominant gametophyte (haploid) stage in their life cycle. They belong to a classification of non-vascular plants that is both old and diversified. Bryophyta is a division of the kingdom of plants, derived from the Greek words bryon, which means bulk, and phyton, which means plant. Mosses, hornworts, and liverworts are together referred to as plantae. They are groupings of green plants that are located in a location that is intermediate between the vascular cryptogams (Pteridophytes) and the thallophytes (Algae). However, bryophytes do not have seeds or circulatory structures, but they do create embryos. They belong to the category of Embryophyta that is the most basic and fundamental. Bryophytes are classified as amphibians of the plant kingdom since they can be found growing in both water and land environments. The early land plants, also known as non-vascular land plants, are thought to have been in existence. These organisms are unable to reproduce in the absence of enough moisture because, in the absence of water, their sexual organs do not develop or dehisce.

The existence of swimming antherozoids is proof that their ancestors originated in watery environments. Mosses (Bryophyta), liverworts (Marchantiophyta or Hepatophyta), and hornworts (Anthocerotophyta) are the three primary taxonomic categories that they belong to. These classes have developed in a manner that is completely distinct from one another. In contrast to the majority of bryophytes, which have stems that are either upright or creeping with small leaves, hornworts and some liverworts have just a flat thallus and no leaves. There are over 25,000 different species of liverworts and mosses that may be found all over the world.

Bryophytes

Plants that do not have circulatory tissues are categorized as belonging to the kingdom Plantae. Bryophytes are a subgroup of non-vascular terrestrial plants. The gametophyte takes precedence over the sporophyte in several generations, which is a characteristic of these organisms. Spores are produced by the gametophyte, which is a haploid organism. For the most part, they are autotrophs. Bryophytes thrive in habitats that are damp and gloomy. Consequently, they are classified as amphibians under the Plantae kingdom of the animal world. The phenolic chemicals that bryophytes make are effective in warding off animals. Furthermore, the water that bryophytes gather is beneficial to a variety of other plant species.

The height of the plant ranges from a millimeter to large strands that range in length from around one meter to about one meter. It is not possible to distinguish the base, stem, and leaves from the body of the plant. Rhizoid structures, which are similar to roots, are what allow the plant to attach itself to a surface. Rhizoids, on the other hand, are not water-absorbing units. A plant's body is responsible for the absorption of water, which is then carried via the plant's internal structure. Through the process of fragmentation and the formation of tiny aggregations known as gemmae, bryophytes are able to reproduce asexually. Sperm are transported to the eggs by water during the process of sexual reproduction. The formation of the zygote, which later develops into a sporophyte on the female gametophyte, is the result of the fertilization of gametes. The spores that are produced by the saprophyte are then spread by the wind.

Classification of Bryophytes

Three divisions of bryophytes are known as Marchantiophyta, which includes liverworts, Bryophyta, which includes mosses, and Anthocerotophyta, which includes hornworts. Liverworts are leafy plants that have been flattened and resemble mosses. A absence of costa can be found in the leaves of liverworts. However, liverworts have cilia that are located at the margins. There are liverworts that do not have chlorophyll; as a result, they must obtain their nutrition from a fungal partner. Simply said, mosses are made up of basic leaves that are only one cell thick and are linked to a stem. They tend to grow in massive bunches of green. The sporophyte of hornworts is elongated and shaped like a horn, and it is attached to the gametophyte. The illustration depicts mosses that have capsules that contain crimson spores.

OBJECTIVES OF THE STUDY

1. To study on bryophyte's life cycle classification.
2. To study on bryophyte's Ability to Reproduce Reproduction.

Figure: Mosses with red spore capsules

Distribution

It is possible to find bryophytes in every location of the planet, from the arctic and alpine regions to the tropical countries. In order for the sperm to be able to swim to the egg, there inevitably has to be water present in the environment at some time. Although bryophytes do not exist in areas that are very dry or in saltwater, there are some that can be found in settings that are perpetually moist inside desert regions, and there are also a few that can be found on seashores that are above the intertidal zone. Of the bryophytes, only a handful are aquatic. It is in conditions that are consistently humid and equable that bryophytes are found in the greatest abundance. The latitudes that are tropical and subtropical have the highest levels of biodiversity. To a large extent, the vegetation of peatland in the colder regions of the Northern Hemisphere is dominated by bryophytes, particularly the moss known as Sphagnum.

Despite the fact that there are numerous genera and families of bryophytes, as well as a few species of bryophytes that are practically universal, the regional distribution patterns of bryophytes are comparable to those of terrestrial vascular plants. Indeed, there are a few species that have an exceptionally broad range.

- **HABITAT:** Additionally, bryophytes create thick carpets or mats on wet soils, rocks, and the bark of trees, particularly during the rainy season. Bryophytes grow abundantly in regions that are moist and covered in shade. Despite their little size, they have the ability to become quite noticeable when they grow in large mats in forests, as cushions on walls, rocks, and tree trunks, and as pioneer colonists in ecosystems that have been disturbed.

- **LIFE CYCLE:** During the course of their life cycle, bryophytes go through two unique phases: the haploid gametophytic phase and the diploid sporophytic phase. These phases continue to alternate with one another. There is a representation of the gametophyte in the mature plant body. The gametophyte is the host for a parasite that is a sporophyte, which has a brief lifespan.

- **GAMETOPHYTE:** A phase of the bryophyte life cycle that is characterized by the alternating of generations for the organism. It is a multicellular creature that originates from a haploid spore that only has one pair of chromosomes. It is a haploid organization. When it comes to bryophytes, the sexual phase of their life cycle is known as the gametophyte. Gametes are haploid sex cells that engage in fertilization to generate a diploid zygote, in which each cell has two sets of chromosomes. It takes place during the development of sex organs, which are responsible for the production of gametes. There is a new diploid multicellular creature that is produced as a consequence of cell division of the zygote. This organism is the sporophyte, which is the second stage in the life cycle. The sporophyte's role is to create haploid spores via the process of meiosis.

- **SPOROPHYTE:** Zygote is the initial cell that develops during the sporophytic phase of development. A sporogonium, which is a sporophytic plant body, is formed as a result of its division and development. On the other hand, it does not enter the resting phase and does not function independently of the parent gametophyte. In each of these characteristics, it is distinct from the zygote of green algae. The ventr of the archegonium is where the continuing development of the zygote into the embryo takes place. The zygote passes through the process of segmentation straight into the multicellular, undifferentiated structure known as the embryo without any resting time. An embryo undergoes further segmentation and differentiation, which ultimately results in the development of a fully-fledged sporophyte known as a sporogonium. Calyptra is the name given to the protective covering that the wall of the ventricle creates for the sporogonium. The sporogonium seen in bryophytes is devoid of both leaves and roots. In most cases, the sporogonium is separated into three distinct parts: the foot, the seta, and the capsule. With the assistance of its foot, it maintains its attachment to the gametophytic host during its whole development. The gametophyte is the source of the nutrients that it takes in directly. In some bryophytes, the foot is significantly decreased, and the haustorial collar, which forms from the junction of the shortened foot and the seta, is responsible for performing the function of the foot.

The Life Cycle of Bryophytes and Their Ability to Reproduce Reproduction

In addition to sexual reproduction, bryophytes can reproduce vegetatively. Through the process of sexual reproduction, the genes of two parents are combined, which has the potential to result in the generation of young plants that are genetically distinct from both of their parents. The process of vegetative reproduction does not include any mixing of the offspring, and each new plant is generated from a single parent plant.

It is solely via sexual and vegetative processes that bryophytes may reproduce.There is no evidence of asexual reproduction in these.

When it comes to bryophytes, vegetative reproduction:

There is a quality that distinguishes bryophytes, and that is their propensity to engage in substantial vegetative reproduction. During the seasons that are most conducive to vegetative development, the vegetative reproduction process takes place. The majority of bryophytes reproduce by vegetative means, and this process may be accomplished in a variety of ways.

- **By Persistent Apices:**

The whole thallus of some bryophytes, such as Riccia, Anthoceros, and Cyathodium, dries up and is killed, with the exception of the growth point, when the dry conditions persist for an extended period of time, throughout the summer, or at the conclusion of the growing season. As time passes, it penetrates the earth to a great depth and becomes thick. It is possible to evolve into a new thallus when certain circumstances are favorable.

- **By Tubers:**

The formation of tubers occurs in those species that are subjected to desiccations, which are caused by the drying impact of the air. At the conclusion of the growth season, the underground branches get inflated at their tips due to the underground tubers. This occurs because the underground tubers are growing. Hyaline cells come into existence on the perimeter of a tuber, which is comprised of two to three layers of water-resistant corky. Starch, oil globules, and albuminous layers are all included inside the inner cells, which are surrounded by these tissues. While the thallus perishes as a result of the harsh circumstances, the latent tubers continue to maintain their state of existence. The restoration of favorable circumstances causes each tuber to germinate, resulting in the formation of a new plant, such as Riccia, Anthoceros, Fossombronia, and another plant. Additionally, tubers perform the function of an organ of perennation.

- **By Gemmae:**

Green, multicellular reproductive organisms that may take on a variety of forms are called gemmae. It is possible for them to be formed inside the cells themselves, on the surface of the leaves, on the stem apex, or even in gemma cups. When they fall on a suitable substratum, gemmae give birth to a new individual either directly (for example, Marchantia) or indirectly (for example, Mosses). They get separated from the parent plant and then develop into new individuals.

- **By Adventitious Branches:**

Riccia fluitans and Anthoceros are two examples of plants that have adventitious branches that emerge from the ventral surface of the thallus. Following their separation from the parent plant, these branches progress into the formation of new thalli. When it comes to Marchantia and Dumortiera, these branches originate from the archegoniophore, but in Pellia, they originate from the dorsal surface or the edges of the thallus.

- **By Regeneration:**

The liverworts have an incredible capacity for regeneration when used properly. There are parts of the plant or any live cell of the thallus that have the ability to regenerate the whole plant, such as the rhizoid or the scales. Examples of such plants are Riccia and Marchantia.

- **By Innovation:**

The growth of Sphagnum is characterized by the fact that one of the branches in the apical cluster grows more vigorously than the rest and continues the development upwards. On the other hand, the other branches in the cluster either produce branches that are weaker or branches that diverge from one another. This is in contrast to the situation described above. This long upright branch is exceedingly long, and it has all of the characteristics that are associated with a main axis. In this context, we refer to it as progress. Because of the prolonged death and deterioration of the parent plant, these innovations ultimately become different from the parent plant and establish themselves as parent plants. This occurs as a consequence of the gradual death and degradation of the parent plant.

- **By Primary Protonema:**

It is the filament-like stage that is created by the growing spores of the mosses, and it is called the primary protonema. Leafy gametophores are produced by this organism. As a result of the death of cells at regular intervals, it fragments into a small strand of cells. Each detachable piece develops into a new protonema, which is characterized by the presence of a crown of leafy gametophores, such as Funaria bacteria.

- **By Secondary Protonema:**

Secondary protonema are protonema that are created by processes other than the germination of spores but are still considered protonema. Any live cells of the leafy gametophore, such as those found in the leaf, stem, rhizome, wounded section of the leafy gametophore, antheridium, paraphysis, or archegonium, have the potential to germinate and grow into this condition. As is the case with primary protonema, such as Funaria and Sphagnum, this results in the development of leafy gametophores or lateral buds.

- **By Bulbils:**

Rhizoids are the sites where these tiny buds that are resting develop. Although they are devoid of chlorophyll, bulbils are loaded with starch. As a result of germination, bulbils generate a protonema that contains gametophores that are leafy.

- **By Apospory:**

In the absence of meiosis, the formation of diploid gametophytes from unspecialized sporophytes is referred to as apospory. For example, Anthoceros is an example of this process. Protonemal filaments that are green in color may originate from the unspecialized cells that are seen in the different regions of the sporogonium in Funaria. Protonemal filaments are responsible for the development of lateral buds, which eventually become leafy gametophores.

- **By Rhizoidal Tips:**

An example of a gemma-like clump of cells is the Riccia glauca, which is formed when the apical portion of the juvenile rhizoids split and then divide again. These cells are capable of developing into new thallus and include chloroplasts and other chemical components.

Sexual Reproduction

In the process of sexual reproduction, genes from two separate parents are combined in order to produce kids who have a genetic make-up that is similar to that of one parent but distinct from that of the other parent. Pollen, which consists of male gametes, is normally transported from one flower to another by some means, most often the wind or insects, in blooming plants. Flowers play an important role in the sexual reproductive cycle of flowering plants. After it has been placed, the pollen will fertilize the eggs that are present in the plant that is receiving it.

The gametophyte is the predominant form of life in bryophytes, in contrast to the vascularization that occurs in plants. It has been discovered that gametophyte is not independent of sporophyte. Spores that are formed in sporophytes are responsible for the sexuality of the organism. Therefore, a significant number of the bryophytes are capable of being dispersed throughout broad regions. With regard to reproduction, bryophytes are dependent on water, in contrast to more evolved plant species. It is necessary for the flagella sperm to be carried to the archegonium when water is present in order for fertilization to take place.

Archegonia and bryophytes both have structures that are quite similar to one another, and the same is true for bryophytes. Depending on the species, the antheridia may range in size and form from globose to fairly cylindrical. However, the figure that is shown above depicts the essence of every antheridium, which is a short and thin stalk that supports a swelling organ that produces sperm. In a similar manner, archegonia may vary in size, as well as in the relative lengths of the neck, the venter, and the length of the supporting foot; nonetheless, the figure that is shown above illustrates the key characteristics that are shared by all archegonia.

Sporophyte:

1. Without a time of rest, the zygote proceeds through a series of divisions, which ultimately results in the formation of a multicellular structure known as the embryo.

2. At every stage of development, the zygote undergoes a transverse division, and the outer cell eventually transforms into the embryo. This kind of embryogenesis is referred to as exoscopic.

3. The embryo eventually transforms into a sporogonium or a sporophyte.

4. The sporophyte is often divided into three distinct parts: the foot, the seta, and the capsule. There are certain instances in which it is just represented by a capsule (for example, Riccia) or also by a foot and a capsule (for example, Corsinia).

5. For the whole of its existence, the sporophyte remains linked to the parent gametophytic plant body. It is either entirely or partly dependent on it for its nutritional needs.

6. The foot is a bulbous feature that is basal. The parent gametophyte's tissue contains it imbedded inside its cells. The most important thing that it does is take in the food material that is coming from the parent gametophyte.

7. In the space between the foot and the capsule, seta may be found. In addition to elongating the capsule, it also forces it past the protecting layers. Additionally, it transports the food to the capsule that is absorbed by the foot.

8. At the very end of the sporogonium lies a structure called the capsule, which is responsible for the production of spores.

9. Bryophytes are all homosporous, which means that their spores are exactly the same in terms of their form, size, and structure.

10. The capsule is responsible for the production of sporogenous tissue, which either completes the development of spore mother cells (as in the case of Riccia) or differentiates into spore mother cells and elater mother cells (as in the case of Marchantia and Anthoceros).

11. In order to create four haploid spores that are grouped in tetrahedral tetrads, spore mother cells divide diagonally. This results in the production of asexual spores.

12. Mother cells that undergo elatation may evolve into either elaters (such as Marchantia) or pseudo elaters (such as Anthoceros), both of which are hygroscopic in nature. In liverworts, elater are found, however in mosses, they are totally missing.

13. Through the process of sporogonium development, the venter wall expands, resulting in the formation of a protective multicellular layer known as calyptra, which is gametophytic tissue that encloses the sporophyte.

Young Gametophyte:

1. The first cell that forms during the gametophytic phase is the meiospore, which is a spore that is generated following meiosis.

2. Each spore is unicellular, haploid, and germinates into a young gametophytic plant (such as Riccia or Marchantia). Alternatively, the spores may first germinate into a filamentous protonema, which then produces buds that may give birth to a young gametophytic plant (such as Funaria).

Life Cycle

The expression of keystone characteristics of taxa that are independent of their evolutionary links takes place via the emergence of life syndromes, also known as "functional types," and adaptive qualities through the process of parallel evolution under comparable environmental conditions. Due to the fact that they include interconnections between the morphological-anatomical functioning of the plant and environmental conditions, they have been used effectively in the process of characterization of organisms, communities, and the specific ecological niches that they inhabit. The term "co-evolved adaptive traits" was coined by Stearns in 1976. These attributes highlight the primary adaptive characteristics that are necessary for effective dispersion and establishment, as well as for the preservation of the species' environment.

CONCLUSION

In conclusion, the life cycle of bryophytes, which includes mosses, liverworts, and hornworts, is a component of their biology that is both fascinating and essential. A gametophyte stage that is dominant and a sporophyte stage that is dependent on the gametophyte are both distinct characteristics of these plants, which demonstrate a unique alternation of generations. By means of the process of mitosis, the gametophyte generates gametes, which then combine to form a zygote. During the process of meiosis, the zygote transforms into a sporophyte, which continues to be linked to the gametophyte all the while producing spores. During the course of the life cycle, these spores will disseminate and germinate, resulting in the formation of new gametophytes. The study of the life cycle of bryophytes offers significant insights on the evolution of plants, reproductive biology, and the interactions across ecosystems. Conducting additional research in this field has the potential to improve our understanding of the diversity of plants and their ability to adapt to terrestrial conditions.

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