

they are **haploid** and are produced in **tetrads**. The spores give rise to haploid **gametophytes** (N) or **prothalli**.

The gametophytes are **monoecious**, ie. the male and female sex organs are produced in the same prothallus. The male sex organ is called **antheridium** and the female sex organ is called **archegonium**. The antheridium produces **antherozoids** (N) while the archegonium produces a **single egg** (N). An antherozoid fuses with the egg to form a **diploid zygote** (2N). The zygote on germination gives rise to a **diploid sporophytic plant**.

In this life cycle the gametophytes and sporophytes are morphologically dissimilar. Therefore it is called **heteromorphic alternation of generations**.

#### Economic Importance

1. In the homeopathic system of medicine *Lycopodium* is used to treat many diseases.

2. The spores of *Lycopodium inundatum* contain about 50% oil. This oil is used as a **coating of pills** and as a **diluent**.

3. The powder of spores is used as a **dusting powder** and to make **moldings**.

#### Life Cycle of Lycopodium

*Lycopodium* is a **pteridophyte**. It is included under the order **Lycopodiales** of Lycophyta.

*Lycopodium* is commonly called **creeping pine**, **trailing pine** or **club moss**. It includes about 200 species. Of these, 33 species are found in India. Eg. *Lycopodium selago*, *Lycopodium phlegmaria*, *Lycopodium clavatum*, etc.

*Lycopodium* is **cosmopolitan** in distribution. It prefers tropical and sub-tropical regions for their growth. Some species prefer cold climates.

The tropical species are **pendulous epiphytes**. They hang from the trunks of large trees. Eg. *Lycopodium phlegmaria*. The temperate species are **creeping plants** with erect branches or erect plants. Eg. *Lycopodium cernuum*. *Lycopodium volubile* is a **climber**.

*Lycopodium* is a **diploid sporophytic plant**. It is differentiated into **stem**, **leaves** and roots.

The stem is **dichotomously branched**. The two branches of a dichotomy are almost equal and form further dichotomies. The **strobili** are produced at the **tips** of the branches. In the members of the sub-genus **Rophalostachya**, the branches are **unequal**, ie. one branch is long and the other is short and ended with a **strobilus**. This type of branching is called **pseudomonopodial**. In the members of sub-genus **Urostachya**, the stem branches dichotomously and the sporophylls are arranged singly on the stem.

The leaves are small, simple, sessile and **lanceolate** with a broad base. The leaf has a **midrib** that does not reach the extreme tip of that leaf. Such leaves are called **microphyllous leaves**. The leaves are arranged **spirally** on the stem, but in some species the leaf arrangement is **decussate**.

Some species are **heterophyllous**. eg. *Lycopodium volubile*. It has **four rows** of leaves on the stem. The two lateral rows bear large sickle-shaped leaves. The ventral row has **hair-like leaves** and the dorsal row has **medium sized leaves**.

The roots are **adventitious**, and develop from the base or branching of the stem. They are **dichotomously branched** and **fibrous**. They arise from the cortex of the stem, so that they are called **cortical roots**.

*Lycopodium* grows by means of an **apical meristem** at the tip of the branches.

In *Lycopodium*, the sporophytic plant reproduces by two methods. They are-

- i) Vegetative reproduction
- ii) Asexual reproduction

The vegetative reproduction takes place by **gemmae, fragmentation, resting buds, adventitious buds** and **tubercles**. By these methods, the sporophytic plants reproduce new **sporophytic plants** directly.

The asexual reproduction takes place by **spores**. *Lycopodium* is **homosporous**. The spores are produced inside the **sporangium** which is borne on a fertile leaf. The fertile leaf bearing sporangium is called a **sporophyll**. In primitive species, the sporophylls are produced singly here and there on the stem. But, in advanced species the

sporophylls are arranged in a definite cluster called *cone* or *strobilus*. Usually, strobilus is produced at the tip of the branches.

A strobilus consists of a *central axis* and many *sporophylls*. The sporophylls may be similar to the normal leaves or smaller than the normal leaves.

The sporangium is a *kidney-shaped* structure attached to the sporophyll with a short *stalk*. It consists of a *multilayered sporangial wall* and *numerous spores* inside that wall. The outer sporangial wall is sterile and protective in function. The inner wall layer is called *tapetum*. It is nutritive in function.

Inside the sporangial wall, there is a mass of *sporogenous tissue*. The sporogenous tissue gives rise to *spore mother cells*. The latter are *diploid*. These cells undergo *meiosis* and form *haploid spores*. The spores are produced in *tetrads*.

When the sporangial wall dries up, a line of cells in the wall ruptures. The spores are released out through the ruptured sporangial wall. These spores are carried to different regions by *wind*.

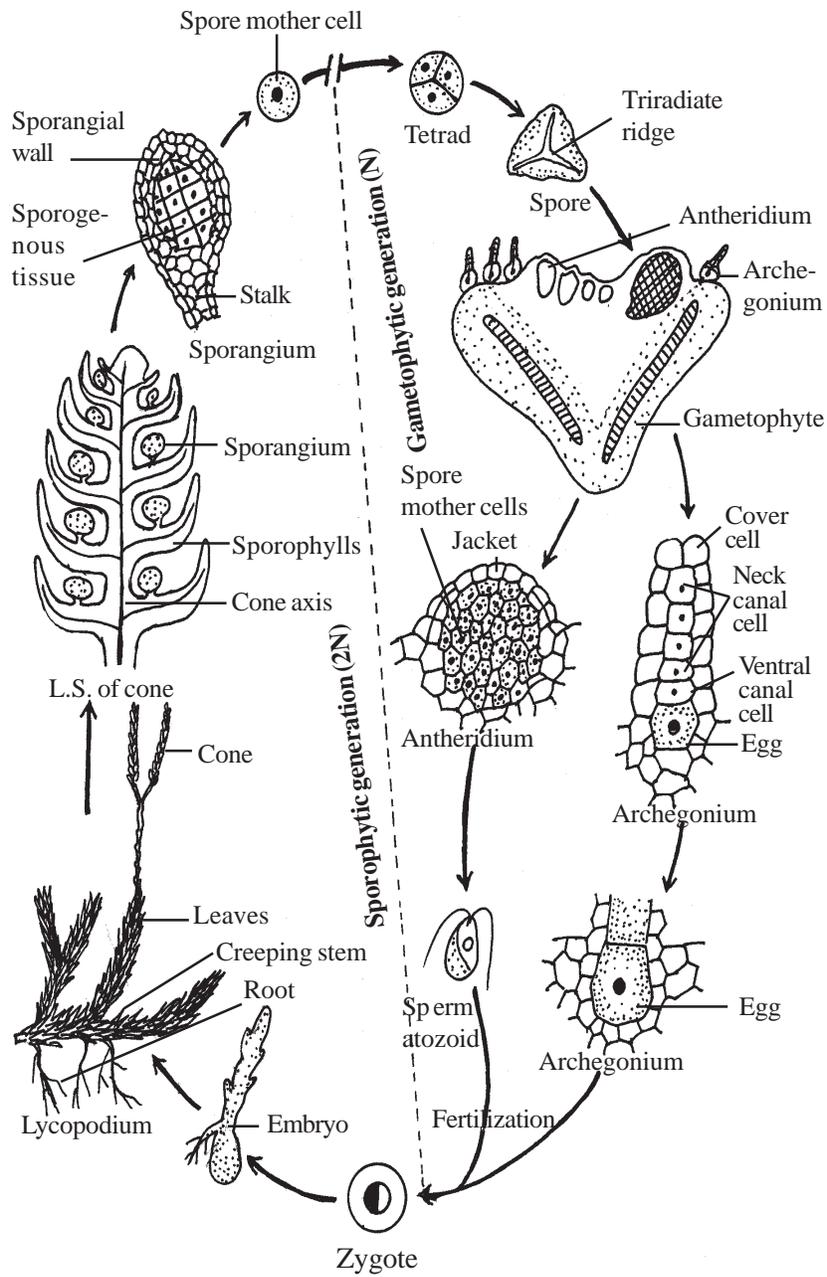
The spore has a *triradiate ridge* on the outer wall. The outer wall is *thick* and it may be smooth or sculptured. The inner wall is thin and smooth. The spore contains a *haploid nucleus* and *dense cytoplasm*.

The spore germinates and gives rise to a haploid *prothallus* or *gametophyte*. The prothallus is concerned with the *sexual reproduction*.

The prothallus may be *green and aerial* or *subterranean* or *partly aerial* depending upon the species. It may be cylindrical, top-shaped or lobed in structure. Its cells are parenchymatous. It has several *rhizoids*. The cells contain *endophytic mycorrhizae*.

The prothallus is *monoecious*, ie. the male and female sex organs are produced on the same prothallus. The sex organs are produced on the upper surface of the prothallus. The male and female sex organs may be produced in separate patches or intermingled with each other.

The male sex organ is called *antheridium*. It is a *globular structure* sunken in the upper surface of the prothallus. It consists of a single layered *jacket* and a mass of *spermatogenous tissue* inside. At maturity the spermatogenous cells become *sperm mother cells*. The latter metamorphose into *biflagellate sperms* or *spermatozoids*.



**Fig.4.27: Diagrammatic life cycle of Lycopodium.**  
 The antheridial wall ruptures, when it absorbs water. As a result the sperms are released out to fertilize the egg.

The female sex organ is called *archegonium*. It is made up of *neck* and *venter*. The venter is sunken on the prothallus and the neck remains exposed. The neck encloses a *neck canal* that contains 3-5 neck canal cells. The venter has a single *ventral canal cell* and an *egg*.

At maturity the neck and ventral canal cells disintegrate and the neck breaks away. As a result a *narrow passage* develops in the archegonium. The sperm enters through the passage and fuses with the egg. As a result a *diploid zygote* (2N) is formed.

The zygote is the starting cell of the sporophytic generation. It germinates into an *embryo*. The embryo grows into a *sporophytic plant*.

### Conclusion

*Lycopodium* is a diploid sporophytic plant. It produces *haploid gametophytes*, asexually. The gametophytes undergo *sexual reproduction* and give rise to sporophytic plants. Thus there is a regular *alternation of asexual sporophytic generation* and *sexual gametophytic generation* in the life cycle. Both the sporophytes and gametophytes are necessary to complete the life cycle. The sporophytes and gametophytes are morphologically dissimilar. Hence, the life cycle is known as *heteromorphic alternation of generations*.

