16 Oscillatoria

Class	:	*Cyanophyceae*
Order	:	*Nostocales*
Family	:	*Oscillatoriaceae*
Genus	:	*Oscillatoria*

Oscillatoria is a ***blue-green alga***. It is included in the class ***Cyanophyceae*** or ***Myxophyceae***. It is placed in the order ***Nostocales.*** It exhibits ***oscillatory*** movement. Therefore, it is included in the family ***Oscillatoriaceae*** .

Occurrence

Oscillatoria is commonly found in ***freshwater*** habitats such as ***ponds, pools,*** etc.

Some species are ***marine***. Eg. *Oscillatoria salina* and *Oscillatoria sancta.*

Some species live on ***moist soils*** and fix the atmospheric nitrogen in the soil. Eg *Oscillatoria princeps* and *Oscillatoria formosa.*

Oscillatoria annae is ***epiphytic*** on aquatic plants.

Oscillatoria includes about 100 species.

Some common Indian species of *Oscillatoria* are :

Oscillatoria chlorina
Oscillatoria limosa
Oscillatoria princeps
Oscillatoria tenuis
Oscillatoria formosa
Oscillatoria annae.

Structure

Oscillatoria is a ***blue - green alga.*** It is included in the class ***Cyanophyceae***

The plant is a ***haploid gametophyte***.

It is a ***prokaryote***.

It lives in ***freshwater***.

They are ***free floating*** forms.

Usually, a few *Oscillatoria* filaments aggregate together and occur as a slightly ***gelatinous*** mass, floating on the surface of water.

The plant body of *Oscillatoria* is called ***thallus*** as it has no differentiation into root, stem and leaves. It is a simple, ***unbranched filament.***

The filament of *Oscillatoria* is known as a ***trichome.***

Each trichome is surrounded by a ***mucilaginous sheath.*** It consists of a row of cells arranged one above the other.

The cells are broader than their length.

All the cells of the trichome are alike, except the terminal cell which is ***round*** or ***dome*** shaped.

In some species, the terminal cell has a thickening, at the apex, called ***cap*** or ***calyptra.*** Eg. *Oscillatoria proboscidea.*

In the filament, there are biconcave ***dead cells*** filled with ***mucilage.*** These dead cells are called ***'necridia'*** or ***'separation discs'.***

The small piece of the filament between the adjacent necridia is called a ***hormogone*** or ***hormogonium.***

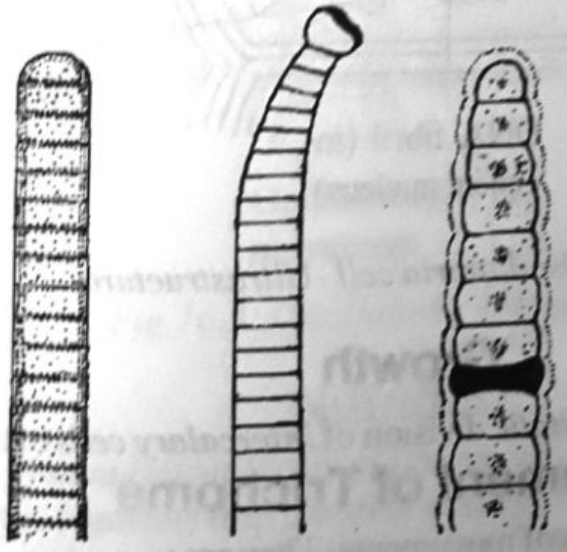
The cells of *Oscillatoria* are ***prokaryotic.***

Each cell consists of an outer ***cell wall,*** a middle ***plasma membrane*** and an inner ***protoplasm.***

The cell wall is firm and is composed of ***hemicellulose*** and ***pectin.***

The cell wall is made up of 2 layers. It bears many pores. There is a ***mucilage*** sheath around the cell wall.

The protoplast is enclosed by a ***plasma membrane.***



Oscillatoria limosa *Oscillatoria proboscidea* *Oscillatoria annae*

Fig. 16.1: Oscillatoria.

The ***protoplasm*** is differentiated into an outer pigmented portion called ***chromoplasm*** and an inner colourless portion called ***centroplasm*** or ***central body.***

Many elongated sacs called ***thylakoids*** are freely dispersed in the chromoplasm.

The pigments such as ***chlorophyll-a, carotenes, xanthophylls, phycocyanin-c*** and ***phycoerythrin-c*** are found in the chromoplasm.

Small gas vacuoles called ***pseudovacuoles*** are also found in the chromoplasm.

Reserve food is in the form of ***cyanophycean starch*** and ***β-granules*** present in the protoplasm.

Membrane bound cell organelles such as ***nucleus, endoplasmic reticulum, plastids, mitochondria, dictyosomes*** and ***vacuoles*** are absent. However, small ***ribosomes*** are found in the protoplasm.

The nuclear material is found at the centre of the protoplasm.

The nuclear material consists of irregularly arranged ***DNA fibrils***. The nuclear membrane is absent. This type of nuclear material without nuclear membrane is called ***nucleoid*** or ***incipient nucleus.*** There is ***no nucleolus.***

Some ***polyhedral bodies*** are found associated with the DNA fibrils.

The structure of cells resemble ***bacteria*** in many aspects. So, *Oscillatoria* is also known as a *Cyanobacterium*.

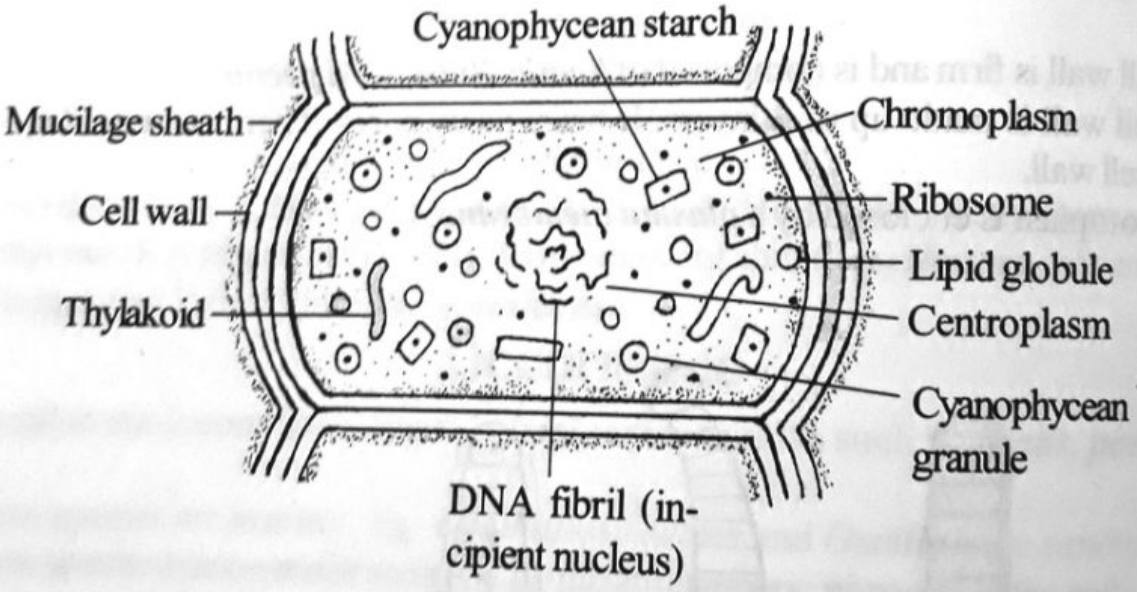


Fig.16.2: Oscillatoria cell -Ultrastructure.

Growth

The growth takes place by ***amitotic*** division of ***intercalary cells*** of the filament.

Movement of Trichome

Oscillatoria shows ***three*** types of movements. They are :

1. *Gliding movement* or *axial movement*
2. *Oscillatory movement*
3. *Bending movement* or *tip revolving movement.*

1. Gliding Movement

This type of movement is exhibited by the entire filament. Here, the trichome moves *back-*

wards and ***forwards*** rhythmically in the direction of the long axis of the trichome. So it is often known as ***axial movement***.

2. Oscillatory Movement

The genus *Oscillatoria* has been named on account of this type of movement. In this movement, the tip of the trichome shows ***pendulum-like*** oscillation.

3. Bending Movement

This is similar to the oscillatory movement, but the apical cell bends rapidly at the end of each oscillation. So, this movement is called ***bending movement.***

The movement of trichomes may be due to -

- The presence of invisible cilia at the tip of the trichome.
- The secretion of mucilage through the pores of cell wall.
- The rhythmic contraction and expansion of the protoplasm.
- The wave-like movement of mucilage layer along the length of the trichome.

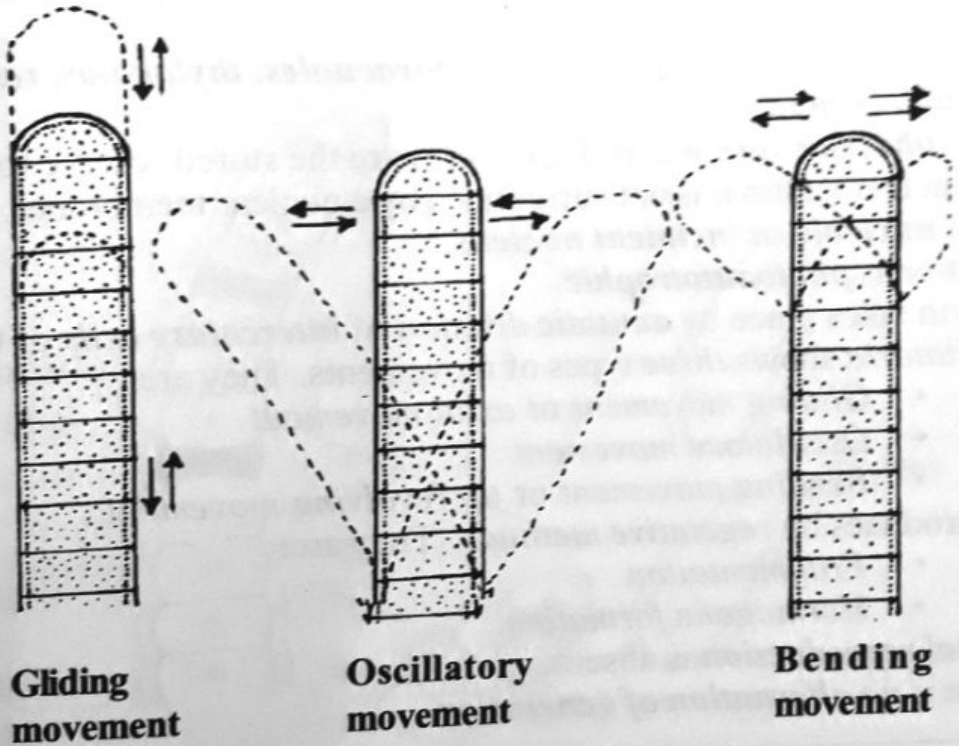


Fig.16.3: Oscillatoria - Movements.

Nutrition

- Nutrition is ***photoautotrophic*** by ***photosynthesis***.
- Photosynthetic pigments trap the solar energy and synthesize ***starch*** and ***glycogen***, which are later converted into ***cyanophycean starch*** and ***glycoprotein***.

Highlights

Oscillatoria

- *Oscillatoria* is a ***freshwater, blue-green alga.***
- It is included in the class ***Cyanophyceae.***

- It is ***prokaryotic.***
- The vegetative thallus is a ***haploid gametophyte.***
- In this alga, the tip of the trichome shows ***pendulum- like oscillating*** movement. So this alga is named as ***Oscillatoria.***
- The thallus is an ***unbranched trichome.***
- The filaments are ***uniseriate.***
- It is surrounded by a ***mucilaginous sheath.***
- The trichome consists of a row of closely arranged uniform cells.
- The terminal cell has a thickening at the apex called ***cap*** or ***calyptra.***
- The filament contains ***necridia*** and ***hormogone.***
- Each cell consists of an outer ***cell wall,*** a middle ***plasma membrane*** and an inner ***protoplasm.***
- The cell wall is made up of ***pectin*** and ***cellulose.***
- The ***plasma membrane*** lies below the cell wall.
- The ***protoplasm*** is differentiated into an outer ***chromoplasm*** and an ***inner centroplasm.***
- Protoplasm contains ***pigments, pseudovacuoles, thylakoids, reserve food*** and ***nuclear material.***
- ***Cyanophycean starch*** and ***β -granules*** are the stored reserve food.
- The nuclear material is not surrounded by a nuclear membrane. Hence it is called ***nucleoid*** or ***incipient nucleus.***
- Nutrition is ***photoautotrophic.***
- Growth takes place by ***amitotic division*** of ***intercalary cells*** of the filament.
- *Oscillatoria* shows ***three*** types of movements. They are:
    - *Gliding movement* or *axial movement*
    - *Oscillatory movement*
    - *Bending movement* or *tip revolving movement.*
- It reproduces by ***vegetative methods.*** They are:
    - *Fragmentation*
    - *Hormogone formation.*
- ***Sexual reproduction*** is absent.
- There is ***no alternation of generation.***

Reproduction

Oscillatoria reproduces by ***vegetative methods.*** Sexual reproduction is ***absent.*** The vegetative methods of reproduction are:

1. *Fragmentation*
2. *Hormogone formation.*

1. Fragmentation

The filament breaks into many small pieces called ***fragments*** by mechanical forces or due to the formation of hormogones in the filament. Each fragment later on grows into a new filament. This method is known as ***fragmentation.***

2. Hormogone Formation

Hormogones or hormogonia are produced in mature filaments during the ***favourable season***.

Some intercalary cells of the filament lose their protoplast and die. These dead cells become biconcave and filled with ***mucilage***.

The mucilage filled dead cells are called ***necridia*** or ***separation discs***.

The small piece of the filament between the two adjacent necridia is called a ***hormogone*** or ***hormogonium***.

When the filament breaks at necridia, the hormogones are released free in water. They grow into new filaments.

Conclusion

The life cycle of *Oscillatoria* is very ***simple*** and purely ***vegetative***. Sexual reproduction is completely ***absent***. The vegetative thallus is a ***haploid gametophyte*** (N) and it is ***prokaryotic***. It reproduces vegetatively by ***fragments*** and ***hormogones***. They grow into new vegetative thalli (N). There is ***no alternation of generation*** in the life cycle of *Oscillatoria*.

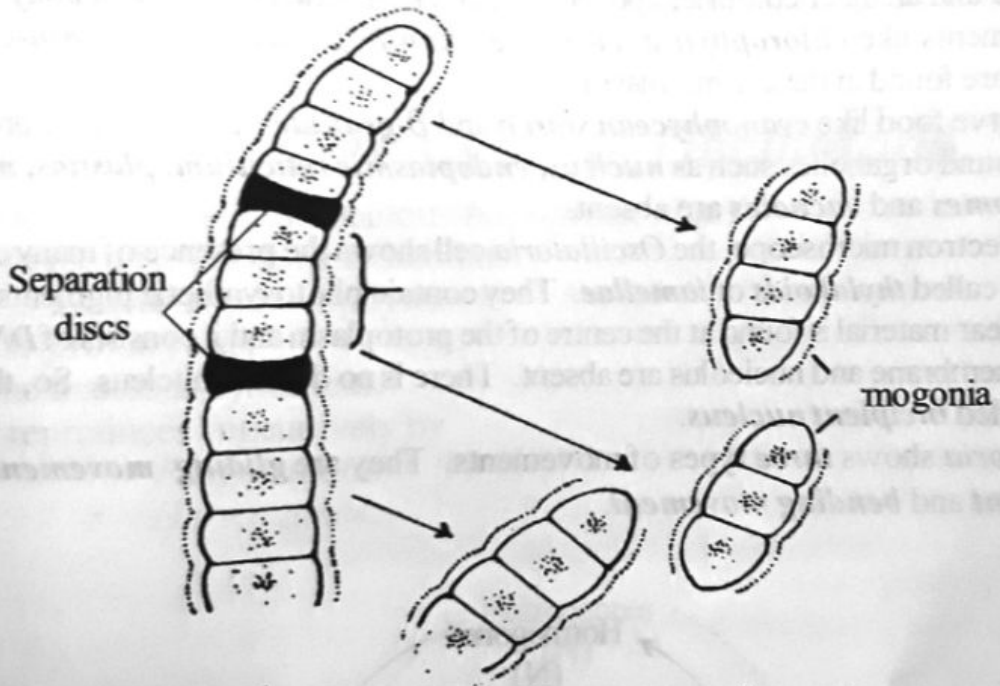


Fig.16.4: Oscillatoria - Hormogone formation.

Economic Importance

1. *Oscillatoria* is consumed as ***food*** by ***fishes***.
2. It increases the ***soil fertility*** by fixing the atmospheric nitrogen in the soil and by adding organic matter to the soil.
3. Together with some other blue-greens, it causes depletion of oxygen in water. The depletion of oxygen causes the death of fishes and aquatic animals.
4. It causes bronchial asthma, blocking of nasal passage, etc. in human beings.
5. *Oscillatoria limosa* serves as an ***indicator*** of organic wastes in water.

Life Cycle of *Oscillatoria*

Oscillatoria is a simple, ***unbranched, filamentous blue-green alga.*** It comes under the class ***Cyanophyceae*** or ***Myxophyceae***. The plant is a ***haploid gametophyte.*** Most species occur in ***freshwaters*** and a few are ***marine***.

The filament of *Oscillatoria* is called a ***trichome***.

The trichome is surrounded by a ***mucilaginous sheath***.

It is freely floating on the surface of water.

Each trichome consists of a row of cells arranged one above the other.

The cells of the trichomes are broader than the length.

All cells of the trichome are alike, except the terminal cell which is rounded or dome-shaped. In some species, the terminal cell has a thickening called ***cap*** or ***calyptra*** at the apex.

The cells of *Oscillatoria* are ***prokaryotic***. Each cell consists of an outer ***cell wall*** and an inner ***protoplasm***.

The cell wall is composed of ***hemicellulose*** and ***pectin.*** The protoplasm is enclosed by a ***plasma membrane.*** The protoplasm is differentiated into an outer pigmented portion called ***chromoplasm*** and an inner colourless portion called ***centroplasm*** or ***central body***.

The pigments like ***chlorophyll-a, carotenes, xanthophylls, phycocyanin-c*** and ***phycoerythrin-c*** are found in the chromoplasm.

The reserve food like ***cyanophycean starch*** and ***β-granules*** are seen in the protoplasm. Membrane bound organelles such as ***nucleus, endoplasmic reticulum, plastids, mitochondria, dictyosomes*** and ***vacuoles*** are absent.

Under electron microscope, the *Oscillatoria* cell shows the presence of many elongated, flattened sacs called ***thylakoids*** or ***lamellae***. They contain photosynthetic pigments.

The nuclear material is found at the centre of the protoplasm and it consists of ***DNA fibrils***. The nuclear membrane and nucleolus are absent. There is no definite nucleus. So, the nuclear material is called ***incipient nucleus***.

Oscillatoria shows ***three*** types of movements. They are ***gliding movement, oscillatory movement*** and ***bending movement***.

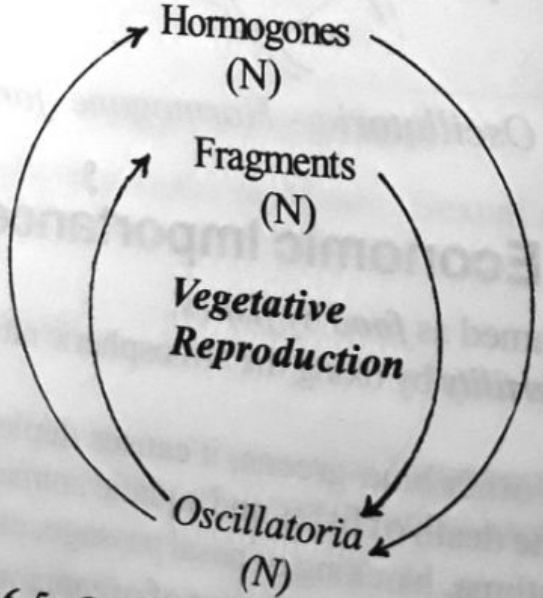


Fig.16.5: Oscillatoria - Gra

Oscillatoria reproduces only by ***vegetative*** methods. Sexual reproduction is ***absent***. The vegetative methods of reproduction are:

Fragmentation
Hormogone formation.

The filament breaks into many ***small pieces*** or ***fragments*** by mechanical forces. Each fragment later on grows into a new filament. This method is known as ***fragmentation***.

Hormogones or ***hormogonia*** are produced in mature filaments. Some of the intercalary cells lose their protoplast and die. These dead cells become ***biconcave*** and filled with ***mucilage***. The mucilage filled dead cells are called ***necridia*** or ***separation discs***.

The small piece of the filament between the two adjacent necridia are known as ***hormogone*** or ***hormogonium***. These hormogone gets separated from the trichome and grows into a new filament.

Conclusion

The life cycle of *Oscillatoria* is ***very simple*** and ***purely vegetative***. Sexual reproduction is completely ***absent***. The vegetative thallus is a ***haploid gametophyte*** (N) and it is ***prokaryotic***. It reproduces vegetatively by ***fragments*** and ***hormogones***. They grow into new vegetative thalli (N). There is no ***alternation of generations*** in the life cycle of *Oscillatoria*.

Highlights

Life Cycle of *Oscillatoria*

- *Oscillatoria* is a filamentous ***blue-green alga***.
- It is found in ***freshwater*** habitats.
- It is a ***haploid gametophyte.***
- It is ***prokaryotic.***
- The thallus is a ***filament.***
- It reproduces vegetatively by
  - *Fragmentation*
  - *Hormogones.*

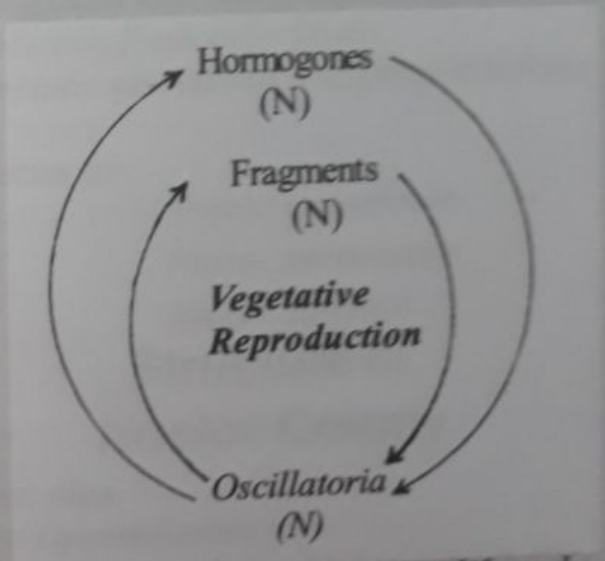


Fig.16.6: Oscillatoria - Graphic life cycle.

- In ***fragmentation***, the filament breaks into many ***fragments.*** Then the fragments grow into new filaments.
- Hormogones are small pieces of living thallus. They are formed due to mechanical breaking of thallus or formation of dead cells within the thallus.
- The ***hormogone*** gets separated from the trichome and grows in to a new filament.
- ***Sexual reproduction*** is completely absent.
- There is ***no alternation of generations***.