1.2. SPIROGYRA

SYNOPSIS

Kingdom	:	Plant kingdom
Sub-kingdom	:	Cryptogamae
Division	:	Thallophyta
Sub-division	:	Algae
Class	:	Chlorophyceae
Order	:	Conjugales
Family	:	Zygnemataceae
Genus	:	*Spirogyra*

Distribution and habitat

- *Spirogyra* consists of **300 species** and all are **fresh water forms**
- *Spirogyra* is free floating form in ponds and pools. So, they are called **pond scum**
- Some species are attached to rocks
  Ex : ***S.adnata*** and ***S.jogensis***

Thallus structure

- *Spirogyra* filament is **multicellular, uniseriate** and **unbranched**
- In attached forms the basal cell acts as **rhizoidal cell** and it is called **holdfast** or **hapteron**
- In free floating forms **polarity is absent**
- In attached forms **polarity** is seen

Cell structure

- In a *Spirogyra* cell length is more than the width and shape is **cylindrical.**
- Cell wall has **2 layers**, where **outer wall is made of pectin** and inner wall **cellulose**
- Outer pectin wall partially dissolves in water and forms **mucillage**. So, *Spirogyra* is called **pond silk**.
- In a matured cell of *Spirogyra* cell **cytoplasm is peripheral** with a **central vacuole**. This condition is called **Primordial utricle.**
- The name *Spirogyra* is based on the **chloroplast.**
- Each cell of *Spirogyra* filament has 1 to **16 ribbon shaped** chloroplast which are coiled in **anti-clock wise** direction.
- In the **mid – axial line** of each chloroplast **many pyrenoids** are present
- Each pyrenoid is a **protein body** surrounded by **starch grains.**
- In the hold fast **chloroplast is absent**
- In *Spirogyra* cell is **haploid** and **uninucleate**
- Nucleus is suspended at the centre with **cytoplasmic strands**.
- Every cell of *Spirogyra* can undergo **mitosis**.
  (Except hold fast)
- The growth of the filament is **diffused type**

Reproduction

- *Spirogyra* reproduces by vegetative, asexual and sexual methods

Vegetative reproduction

- *Spirogyra* reproduce vegetatively by **fragmentation**
- During favaourable conditions, *Spirogyra* shows **rapid vegetative propagation**. Generally **asexual reproduction is absent**

Asexual reproduction

- Asexual reproduction occurs by **akinetes** and **aplanospores**
- During unfavourable conditions *Spirogyra* reproduce asexually by **thick walled** spores called **akinetes** ex. ***S. farlowii***
- A thin walled spore without flagella are called **aplanospores** ex. ***S. aplanospora***

Sexual reproduction

- In *Spirogyra* sexual reproduction occurs by **conjugation**
- If two gametangia are **connected by conjugation tube** during **conjugation**.
- In *Spirogyra* conjugation occurs by two methods **Scalariform and lateral**
- when two filaments are arranged paralelly, connected by conjugation tube is called **scalariform conjugation**.

Scalariform conjugation

- In *Spirogyra* two filaments are arranged paralelly, connected by conjugation tube is called **scalariform conjugation**.
- The two filaments which involve in scalariform, one acts as **male** and the other **female**. So, this conjugation is called **dioecious conjugation**.
- A lateral outgrowth is formed from each cell and they are papillae which grow in opposite direction.
- Two **papillae** meet and the separating wall dissolves by the enzyme **cytase** and forms conjugation tube.
- The two filaments are connected by many conjugation tubes. As it resembles a **Ladder**, it is called **scalariform**.
- During the formation of conjugation tube, each cell acts as gametangium which are **unicellular**, **naked**
- Protoplast of each cell contracts and changes into a **non-motile** gamete.

- The gametes of *Spirogyra* are **morphologically similar**.
- Female gamete is non-motile and the male gamate shows **amoeboid movement**. So, the fusion is called **physiological anisogamy.**
- In some species of *Spirogyra*, both the gametes show amoeboid movement. The fusion occurs in conjugation tube. So, this fusion is called **Isogamy**.

Lateral conjugation

- In lateral conjugation only one filament is involved with both gametangia. This conjugation is called **Monoecious conjugation.**
- If conjugation tube is formed on either side of the septa, it is called **Indirect lateral conjugation**.
- In **Direct lateral conjugation**, conjugation tube is not formed but the male gamete enters the female cell through **septal pore**.
- In Direct conjugation female cell is larger than the male which are present above holdfast. So, it is called **morphological anisogamy**.
- Direct conjugation was discovered by **M.O.P. Iyyenger in S. Jogensis**.
- Direct lateral conjugation was recorded by **R.S. Rattan in *S. mirabilis***

Zygospore

- The product of fusion is a diploid **Zygospore** which is **unicellular sporophyte**.
- Zygospore is covered by **3 layers**
- The reserve food in Zygospore is in the form of **Oil globules**

Germination of Zygospore

- Zygospore tides over unfavourable conditions and **germinates during favourable conditions.**
- During germination the diploid nucleus undergoes **meiosis** forming **4 haploid nuclei**.
- Only **one nucleus is functional** and the other three **degenerate.**
- The endospore of Zygospore comes out as **germ tube** and it produces **apical** and **basal cell**
- Base cell acts as **holdfast**
- Apical cell produces the filament.
- In free floating forms, basal cell gets detached from the **filament**
- In *Spirogyra* life cycle, only Zygospore is diploid. So, the life cycle is **haplontic**

EXERCISE

LEVEL-I

83. *Spirogyra* is a
    1) Submerged and marine alga
    2) Free-floating and marine alga
    3) Motile fresh water alga
    4) Free floating, fresh water alga
84. *Spirogyra* occurs in
    1) Running salt water 2) Running fresh water
    3) Stagnant salt water 4) Stagnant fresh water
85. *Spirogyra* belongs to the order
    1) *Spirogyra*les 2) Conjugales
    3) Agaricales 4) Mucorales
86. *Spirogyra* does not grow in
    1) River 2) Stagnant fresh water
    3) Tank 4) Ocean
87. *Spirogyra* is known as Pond Scum because
    1)It lives in fresh water ponds
    2) It has filaments which are slippery to touch
    3) It forms large floating masses
    4) Chloroplast
88. A cell in *Spirogyra* which can not divide.
    1) Apical cell 2) Sub apical cell
    3) Middle cell 4) Hold fast
89. The common name "pond scum" is not applicable to the following *Spirogyra* species
    1) S *affinis &* S. *farlowii*
    2) S. *adnata &* S. *gratiana*
    3) S. *jogensis &* S. *gartiana*
    4) S. *adnata &* S. *jogensis*
90. The basal achlorophyllous cell in *Spirogyra* is known as
    1) Gametangium 2) Hold fast
    3) Intercalary cell 4) Reproductive cell
91. *Spirogyra* is often called "Pond silk" - State the reason
    1) The filaments are made up of silk
    2) The filament secrete mucilage
    3)The cellulose layer of cell wall becomes mucilagenous
    4)The pectic layer of cell wall becomes mucilagenous
92. The pyrenoids of *Spirogyra* are
    1) Protein bodies with lipid coat
    2) Starch bodies with lipid coat
    3) Protein bodies with starch coat
    4) Starch bodies with protein coat
93. Pyrenoid is found in this part of *Spirogyra*
    1) Nucleus 2) Chloroplast
    3) Cytoplasm 4) Cell wall

94. The food storing structures present in each cell of S. *venkataramanii* filament with 20 cells are
1) 1 2) 20
3) 10 4) Many

95. The ratio between nucleus, chloroplast and pyrenoids is 1:1:many in vegetative cell of
1) *Spirogyra affinis*
2) *Spirogyra venkataramanii*
3) *Spirogyra aplanospora*
4) *Spirogyra jogensis*

96. Pyrenoids are centres for the storage of
1) Starch 2) Raphides
3) Cystoliths 4) Oil drops

97. The outer layer of *Spirogyra* cell wall consists
1) Cellulose 2) Chitin 3) Lignin 4) Pectin

98. *Spirogyra* species where only one chloroplast in each cell was recorded in
1) *S. venkataramanii* 2) *S. condensata*
3) *S. farlowi* 4) *S. jogensis*

99. A Cell of *Spirogyra* filament can undergo
1) Only mitosis but not meiosis
2) Only meiosis but not mitosis
3) Both mitosis and meiosis
4) Neither mitosis nor meiosis

100. The name of *Spirogyra* is after
1) The shape of pyrenoid
2) The shape of plasma membrane
3) The arrangement of chloroplast
4) The shape of mitochondria

101. The shape of the chloroplast in *Spirogyra* is
1) Girdle shaped 2) Cup shaped
3) Ribbon shaped 4) Star like

102. The place of pyrenoid in *Spirogyra* is in
1) Cell wall 2) Cytoplasm
3) Nucleoplasm 4) Chloroplast

103. The cell in *Spirogyra* is
1) Longer than broad 2) Broader than long
3) Squarish 4) Spherical or oblong

104. Number of pyrenoids present in each chloroplast of *Spirogyra* is
1) One 2) Two 3) Many
4) Pyrenoids are equal to number of chloroplast.

105. The reserve food material in the vegetative cell of *Spirogyra* is
1) Oil 2) Volutin
3) Glycogen 4) Starch

106. When the centre of the cell is occupied by a large vacuole and the cytoplasm is at the periphery as a thin layer it is called
1) Primordial utricle 2) Vacuole
3) Centroplasm 4) Nucleoplasm

107. The cell wall of *Spirogyra* is made up of
1) Cutin and Chitin 2) Cellulose and Pectin
3) Suberin and Cutin 4) Lignin and Pectin

108. The direction of coiling of chloroplast in *Spirogyra* is
1) Anticlockwise 2) Clockwise
3) It doesnot coil
4) It is flat ribbon like organelle

109. Under unfavourable conditions, *Spirogyra* survives by
1) Zygospore 2) Zoospore
3) Aplanospore 4) Chlamydospore

110. The type of asexual reproduction that takes place in *Spirogyra farlowii* under unfavourable conditions is by formation of
1) Akinetes 2) Zoospores
3) Aplanospores 4) Parthenospores

111. Most advanced type of conjugation in *Spirogyra* is
1) Scalariform 2) Direct lateral
3) Indirect lateral 4) Monoecious

112. The interveining wall in the papillae during conjugation in *Spirogyra* is dissolved by
1) Pectinase 2) Cytase
3) Amylase 4) Protease

113. Find the **correct** statement
1) Scalariform conjugation is primitive
2) Lateral conjugation is advanced
3) Scalariform conjugation is advanced
4) Oogamy is present in *Spirogyra* during scalariform conjugation

114. Some times the two filaments of *Spirogyra* exhibit a ladder like structure. It is characteristic of
1) Asexual reproduction 2) Conjugation
3) Scalariform conjugation
4) Lateral conjugation

115. Gametes of *Spirogyra* are
1) Uniflagellate 2) Biflagellate
3) A flagellate 4) Multiflagellate

116. In *Spirogyra* after participating in scalariform conjugation
1) Both the filaments die
2) Only male filament dies
3) Only female filaments dies
4) Both the filaments survive

117. Which one of the following formed in *Spirogyra* is different based on the ploidy of nucleus?
1) Zygospore 2) Azygospore
3) Aplanospore 4) Akinete

118. The enzyme secreted during scalariform conjugation is (EAMCET - 2008)
1) Amylase 2) Pepsin
3) Cytase 4) Lipase

119. When two gametes which are morphologically alike and physiologically different unite, the union is called
1) Anisogamy 2) Oogamy
3) Physiological anisogamy 4) Apogamy

120. How many nuclei are present in each gametangium of *Spirogyra* just before conjugation
1) One 2) Two 3) Many
4) Nuclei disappear before fertilization

121. Which is not a characteristic feature of the life cycle of *Spirogyra* ?
1) Isogamous conjugation 2) Fragmentation
3) Zoospore formation 4) Scalariform conjugation

122. The species in *Spirogyra* where Indirect lateral conjugation is reported
1) *Spirogyra jogensis* 2) *Spirogyra affinis*
3) *Spirogyra adnata* 4) *Spirogyra mirabilis*

123. Species of *Spirogyra* showing both scalariform and lateral conjugation is
1) *S.gratiana* 2) *S.adnata*
3) *S-farlowii* 4) *S.jogensis*

124. In monoecious conjugation of *Spirogyra* number of cells participating in conjugation is
1) One 2) Two 3) Four
4) Cells do not participate in conjugation

125. A species of *Spirogyra* in which conjugation tube is not formed during sexual reproduction is
1) *S. adnata* 2) *S. jogensis*
3) *S. affinis* 4) *S.indica*

126. A single filament of *Spirogyra* of this species reproduces sexually and forms single zygospore
1) *S. affinis* 2) *S. gratiana*
3) *S. jogensis* 4) *S. farlowii*

127. Direct lateral conjugation in *Spirogyra* was first reported by
1) Fritsch 2) M.O.P. Iyengar
3) Haeckel 4) Nitsch

128. Diploid cell in the life cycle of *Spirogyra* is
1) Akinete 2) Zygospore
3) Azygospore 4) Parthenospore

129. The reserve food material in the zygospore of *Spirogyra* is
1) Volutin 2) Oil globules
3) Starch 4) Glycogen

130. A thickwalled diploid cell formed after fertilization in *Spirogyra* is
1) Zygospore 2) Oospore
3) Parthenospore 4) Aplanospore

131. The reduction division in *Spirogyra* takes place
1) In every cell 2) In the zygospore
3) In the hold fast
4) Just before gamete formation

132. In *Spirogyra*, fusion product, and thick walled structure is known as
1) Oospore 2) Zygospore
3) Zoospore 4) Oosphere

133. Even though *Spirogyra* disappear during unfavourable periods, it can persist in the form of
1) Aplanspore 2) Parthenospore
3) Zygospore 4) Hypnospore

134. Zygospore of *Spirogyra* produces 4 haploid nuclei among them.
1) Two are functional 2) Three are functional
3) One is functional 4) All are functional

135. Both gametangia and gametes are morphologically different in
1) *S.jogensis* 2) *S. affinis*
3) *S.farlowii* 4) *S. gratiana*

136. The number of cells present in the Spiorgyra filament when the germinating zygospore undergoes first two successive mitotic division
1) 4 2) 3 3) 2 4) 1

137. Number of functional nucleii present in the zygospore of *Spirogyra* during germination are
1) 1 2) 4
3) 8 4) Numerous

138. On germination each zygospore of *Spirogyra* gives rise to
1) One plant 2) Two plants
3) Three plants 4) Four plants

LEVEL-II

139. Choose the **incorrect** statement with regard to *Spirogyra*.
1) Growth is confined to Apical cell of the filament.
2) In free-floating forms, the filament does not show polarity
3) Growth of the filament takes place by diffused method
4) *Spirogyra* is less abundant in tropical regions.

140. Which of the following is **not correct** with regard to *Spirogyra*
1) *Spirogyra jogensis* do not form pond scum
2) *Spirogyra venkataramanii* has one chloroplast with many pyrenoids in each cell of its filament
3) In *Spirogyra farlowii*, the protoplast of a cell contracts and rounds up to form an akinete.
4) In *Spirogyra gratiana*, both monoecious and dioecious conjugations occur.

141. The gametangium in *Spirogyra*
1) Unicellular producing flagellated gamete
2) Multicellular producing many amoeboid gametes
3) Unicellular producing one amoeboid gamete
4) Multicellular producing flagellated gametes

142. Find out the **incorrect** statement with regard to *Spirogyra*
1) Vegetative reproduction is very common method.
2) Asexual reproduction is very common method.
3) Sexual reproduction by conjugation method
4) Gametes are haploid.

143. In *Spirogyra* the male gametes are
1) Nonflagellated and nonmotile
2) Nonflagellated but exhibit amoeboid movements
3) Flagellated and show chemotactic movements
4) Flagellated and show phototactic movements

144. The two fusing gametes of *Spirogyra* in indirect lateral conjugation are described as
1) Morphologically dissimilar
2) Morphologically similar
3) Morphologically similar but physiologically dissimilar
4) Morphologically and physiologically dissimilar

145. Which of the following characters are related to *Spirogyra jogensis*? (EAMCET - 2004)
I. Dioecious conjugation
II. Attached species
III. Morphological anisogamy
The correct combination is
1) I, II and III are correct
2) Only I and II are correct
3) Only I and III are correct
4) Only II and III are correct

146. What is the importance of *Spirogyra gratiana* ?
1) Only zoospores are formed
2) Lateral conjugation only takes place
3) Direct lateral conjugation is seen
4) Both lateral and scalariform conjugation are observed

147. Find out the **wrong statement** with regard to *Spirogyra conjugation*.
1) In *S. jogensis* we find direct lateral conjugation
2) Scalalriform conjugation can show physiological anisogamy
3) Direct lateral conjugation was reported in *S. farlowii*
4) Gametes are haploid in condition.

148. The number of zygospores formed in the direct lateral conjugation in *Spirogyra* filament of 21 cells is
1) 1 2) 2 3) 10 4) 11

149. Six *Spirogyra jogensis* filaments with 101 cells each participate in monoecious conjugation. Number of young filaments produced from the zygospores are
1) 300 2) 600 3) 6 4) 60

150. Assertion (A): In *Spirogyra* some cells in one of the two filaments become empty after conjugation.
Reason (R): The aplanogametes from the cells of one filament pass through the conjugation tubes into the cells of the other filament. (EAMCET 2005)

151. Assertion (A): Free floating *Spirogyra* filament does not show polarity.
Reason (R): In free floating filament hapteron cell is abscent.

152. Assertion (A): *Spirogyra* filaments are slimy to touch.
Reason (R): In *Spirogyra* the outer pectin layer dissolves in water to become mucilagenous.

153. Assertion (A): In *Spirogyra*, the chloroplast is spirally arranged.
Reason(R) : The chloroplasts are ribbon shaped in *Spirogyra* .

154. Assertion (A): In *Spirogyra*, cytoplasm is present in the form of a thin layer around the tonoplast.
Reason (R) : The cell of *Spirogyra* consists of a large central vacuole.

155. Assertion (A): *Spirogyra* is called pond scum.
Reason (R): *Spirogyra* is found as free floating slimy masses on the surface of stagnant water in ponds.

156. Assertion (A): *Spirogyra* belongs to the order conjugales.
Reason (R) : Reproduction in *Spirogyra* takes place by the process of conjugation.

157. Consider the following statements with regards to *Spirogyra*
I. Each cell has 1-16 chloroplasts in periphery
II. During vegetative reproduction, each fragment grows into a full filament by apical growth
III. Akinete is a resting spore formed due to the contraction of protoplast.
IV. In monoecious conjugation, conjugation tube may be formed or may not be formed
1) I & II are correct 2) II & III are correct
3) I & IV are correct 4) II & IV are correct

158. Assertion (A): Lateral conjugation occurs in **monoecious** forms of *Spirogyra*:
Reason (R): Male and female gametangia are placed altternately in the same filament in all *Spirogyra* species

159. In a *Spirogyra* free floating filament with 20 cells, 50% of the cells experienced monoecious indirect conjugation. After the process the ratio between vegetative cells, empty cells and zygospore containing cells will be
1) 3 : 1 : 1 2) 1 : 1 : 1 3) 1 : 2 : 1 4) 2 : 1 : 1

160. Assertion (A): In *Spirogyra*, zygospore undergoes meiosis.
Reason (R) : In *Spirogyra*, zygospore further gives rise to four filaments.

161. Pick the **correct** statements in *Spirogyra*
I. Tetranucleate stage is seen in zygospore after resting time
II. Cytase help in the formation of conjugation canal
III. Both the types of gametangia and gametes present on holdfast cell are morphologically different in *S.Jogensis*
1) I and II 2) II and III
3) I and III 4) I, II and III

162. Assertion (A): *Spirogyra* is a thallophyte
Reason (R): Zygotic meiosis occur in *Spirogyra*

163. Arrange the different stages of *Spirogyra* in ascending order with reference to its life cycle
I) Zygospore II) Gamete
III) Vegetative cell IV) Conjugation
1) I, II, III, IV 2) II, III,I, IV
3) III, II, IV, I 4) II, IV,I,III

164. Arrange the following events in sequence during the formation of in the zygospore of *Spirogyra*
I) Formation of germ tube
II) Meiosis in zygospore
III) *Spirogyra* young filament
IV) Degeneration of nuclei
1) II, III,IV,I 2) II, III, I, IV
3) I, II, III, IV 4) II, IV, I, III

165. Arrange the different events in order during the formation of zygospore of *Spirogyra*
I) Meiosis II) Diploid nucleus
III) Germ tube IV) Haploid nuclei
1) I,II,III,IV 2) II, I, IV, III
3) III, II,IV,I 4) III, I, II,IV

166. Arrange the following events in order during conjugation in *Spirogyra*
I) Movement of male gamete
II) Paipilla formation III) Conjugation tube
IV) Zygospore
1) I, II,IV,III 2) II, III, I, IV
3) I, II,III,IV 4) II,III,IV, I

167. Match the following and choose the **correct** option

List - I	List - II
A) Primordial utricle	I) Direct lateral
B) Chloroplast	II) Indirect lateral
C) *S.affinis*	III) Anticlock wise
D) *S.jogensis*	IV)Direct & indirect lateral
	V) Cytoplasm

	A	B	C	D
1)	V	III	I	II
2)	V	II	I	III
3)	V	I	II	III
4)	V	III	II	I