1.3. RHIZOPUS

SYNOPSIS

Kingdom	:	Plant kingdom
Sub-kingdom	:	Cryptogamae
Division	:	Thallophyta
Sub-division	:	Fungi
Class	:	Zygomycetes
Order	:	Mucorales
Family	:	Mucoraceae

Distribution and habitat

- *Rhizopus* is a cosmopolitan genus having about 35 species.
- The species of *Rhizopus* are saprophytes and they grow on a variety of food materials.
- Bread mould (Mold), Blackmold and pin mold are the common names given to the species of *Rhizopus.*
- Young mycelium show profuse cottony growth on the substratum, hence the species are called moulds (molds).

Structure of mycelium and hypha

- In mature mycelium the hyphae are distinguished into(a)Rhizoids (b) Stolons (c) sporangiophores.
- Rhizoids are root like structures and their main functions are (1) anchorage (2) absorption.
- Stolons - Grow parallel to the surface and spread in all directions
- Sporangiophores are aerial, apogeotropic unbranched hyphae.
- Each sporangiophore ends up with a solitary sporangium
- The mycelium of *Rhizopus* may become septate (solid septa) when
  (a) the mycelium has become very old
  (b) It is injured.
- The hyphal wall is made up of chitin.
- In older hyphae, the central part is occupied by a large vacuole.
- The food materials are stored in the form glycogen and oil globules.

Reproduction

- *Rhizopus* reproduces by vegatative, asexual and sexual methods
- Vegetative reproduction takes place by means of fragmentation.
- When the conditions are favourable, the asexual reproduction in *Rhizopus* takes place by means of Aplanospores. (Sporangiospores).
- The sporangium is produced at the tip of a sporangiophore.
- The two zones of protoplasm get separated by a large number of vacuoles, which are arranged in the form of a dome.
- The outer dense, multinucleated sporoplasm is divided into many, small, multinucleated portions by means of cleavage.
- Each spore is enclosed by a single layered wall and it contains 2 to 10 haploid nuclei.
- When the spores are mature, the sporangial wall is broken and the spores are liberated by wind.
- The protoplasts get rounded up, and secrete thick walls to become Chlamydospores.

Sexual reproduction

- The sexual reproduction in *Rhizopus* takes place towards the end of growing season.
- The genus *Rhizopus* has Homothallic and Heterothalic species
- In homothallic species the sexual reproduction occurs between the hyphae of same mycelium.
  eg. R. Sexualis
- A.F Blakeslee observed physiological sex differentiation in R. Stolonifer and called it as 'heterothallism'
- In heterothallic species, the sexual reproduction occurs between the hyphae of opposite mating types of complatible strains (+strain and -strain)
  e.g. R. Stolonifer.
- The mycelia of compatiable (+ and -) strains grow together and the sexual reproduction is initiated by sex hormone Trisporic acid.
- Each zygophore gives rise to a copulating branch called progametangium.
- The multinucleated gametangia of *Rhizopus* are called coenogametangia;
- As the two gametangia are completely fused losing their identity, the method is called “Gametangial copulation”
- The zygosporangium contains a single large spore called zygospore.
- The zygospore is in diploid condition it contains outer dark and warty layer called exospore are exine, the inner layer is thin and is called the endospore or intine.

Germination of Zygospore

- The zygospore undergoes a period of rest (dormancy) for about 5-9 months
- It germinates under favourable conditions.

- Before the germination the diploid nuclei divide meiotically to form haploid (n) nuclei and protoplast swells by absorbing water.
- The exine split and contents surrounded by endospore emerge through slit to form small, stout, vertical hypha known as 'germ tube' or 'promycelium'
- The promycelium grows to a limit extent and bears terminal sporangium called 'germ sporangium' which lacks columella.
- The protoplast of germ sporangium undergoes cleavage to produce non motile meiospores known as germ spores.
- The + and - strained nuclei are segregated into separate germ spores
- The germ spores are initially uninucleated but later on become multinucleated by simple mitosis.
- The germ spores are liberated by rupturing of sporangium, and disseminated by wind.
- The germ spores germinate on a suitable substratum to form new mycelium

Life cyle

- The zygospore is the only diploid structure in the life history of *Rhizopus*, its life cycle is haplontic.

LEVEL-I

168. *Rhizopus* belongs to class
1) Myxomycetes 2) Zygomycetes
3) Basidiomycetes 4) Ascomycetes

169. Fungal body is called
1) Perithecium 2) Mycelium
3) Ascocarp 4) Basidiocarp

170. Bread mould is the common name for
1) *Spirogyra* 2) *Rhizopus*
3) *Agaricus* 4) *Bacillus*

171. The weed of the laboratory is
1) *Rhizopus stolonifer* 2) *Spirogyra*
3) *E.coli* 4) Bacteriophage

172. Mould, a word used in mycology, means
1) A branch of fungal mycelium
2) Cottony growth formed of the mycelium of fungus on the substance
3) The thallus of fungus
4) All the rhizoids of fungus

173. Type of nutrition mostly in *Rhizopus*
1) Chemosynthetic 2) Saprophytic
3) Parasitic 4) Symbiotic

174. Number of types of hyphae in asexually reproducing *Rhizopus* is
1) 1 2) 2 3) 3 4) 4

175. Hypha in *Rhizopus* is
1) Prokaryotic 2) Ribbon shaped
3) Unbranched 4) Coenocytic

176. Stolons of *Rhizopus* grow
1) Vertically upwards 2) Into the substratum
3) Creep over the substratum
4) Positively geotropic

177. Rhizoidal hyphae of *Rhizopus*
1) Produce sporangia
2) Produce chlamydospores
3) Secrete enzymes to dissolve the food
4) Produce gametangia

178. Enzyme secreting hyphae of *Rhizopus* are
1) Haploid, binucleate
2) Diploid, multinucleate
3) Haploid, multinucleate
4) Polyploid, coenocytic

179. Digestive enzymes secreted hyphae in *Rhizopus is*
1) Stolons 2) Spores
3) Sorangiophore 4) Rhizoids

180. Hyphae in *Rhizopus*
1) Dikaryotic 2) Monokaryotic
3) Multinucleate 4) Anucleate

181. Structure useful for absorption of organic substances in *Rhizopus* are
1) Stolons 2) Roots
3) Rhizoids 4) Sporangiophores

182. In *Rhizopus*, horizontally growing hyphae on the substratum are known as
1) Stolons 2) Sporangiophores
3) Rhizoids 4) Roots

183. The vertical hyphae of *Rhizopus* from which sporangia are formed are called
1) Stolons 2) Promycelia
3) Sporangiophores 4) Rhizoids

184. The wall of the hypha of *Rhizopus* primarily made up of
1) Cellulose and pectin 2) Chitin
3) Diamino pimelic acid 4) Suberin

185. The food stored in *Rhizopus* is
1) Glycogen 2) Sugar
3) Starch 4) Acetone

186. Which of the following does not contain chlorophyll?
1) Fungi 2) Algae
3) Bryophyta 4) Pteridophyta

187. Cell organelles absent in fungi are
1) Mitochondria 2) Golgi complex
3) Plastids 4) Ribosomes

188. In *Rhizopus*, each sporangiophore bears how many sporangia?
1) 2-5 2) Many
3) One 4) 2-10

189. The nuclei in sporangiospores of *Rhizopus*
1) Haploid 2) Diploid
3) Triploid 4) Tetraploid

190. Sporangiospores in *Rhizopus* are formed
1) In basipetal manner 2) In acropetal manner
3) By cleavage method 4) By budding

191. Sporangiospores in *Rhizopus* are
1) Uninucleate 2) Without nuclei
3) 11 to 20 nucleii 4) Multinucleate

192. In which of the following plants, columella is present in sporangia?
1) *Funaria* 2) *Spirogyra*
3) *Pteris* 4) *Rhizopus*

193. Find the **correct** statement about *Rhizopus*
1) Stolons are vertical
2) Rhizoids are horizontal
3) Sporangia do not have columella
4) Sporangiophores are vertical

194. In the sporangium of *Rhizopus*, the columella is formed by
1) Fusion of vacuoles
2) Fusion of phragmoplasts
3) Fusion of nuclei
4) Enlargement of dictyosomes.

195. In *Rhizopus* the sporangiophores are formed
1) as isolated hyphae along the length of stolons
2)as isolated hyphae, only from the points of rhizoids
3) in tufts along the length of stolons
4) in tufts only from the points of rhizoids

196. In *Rhizopus*, asexual reproduction takes place by means of
1) Uninucleated aplanospores
2) Multi nucleated aplanospores
3) Uninucleated zoospores
4) Multinucleated zoospores

197. What is the region in the developing sporangium of *Rhizopus* where few nuclei and more vacuoles are seen ?
1) Sporangiophore 2) Columelloplasm
3) Sporoplasm 4) Progametangium

198. The sterile dome shaped structure in the sporangium of *Rhizopus* is called
1) Apophysis 2) Columella
3) Suspensor 4) Gametangia

199. The sporoplasm and columelloplasm in the sporangium of *Rhizopus* are separated by a
1) Chitinous membrane
2) Suberised membrane
3) Pectinous membrane
4) Cleavage furrow formed by the fusion of flattened vacuoles

200. During unfavourable conditions the older hyphae of *Rhizopus* produces the thick walled spores are called
1) Aplanospores 2) Chlamydospores
3) Zygospores 4) Hypnospores

201. The moulds growing on breads and other food material are
1) Autotrophs 2)Saprophytes
3) Symbionts 4) Parasites

202. The mating hyphae of *Rhizopus* are
1) Zygophores 2) Zygospores
3) Zygosporangiophores
4) Sporangiophores

203. In *Rhizopus*, two strains are morphologically similar and physiologically different. This condition is called
1) Homothallism 2) Heterothallism
3) Monoecious 4) Autoecious

204. Sexual reproduction in *Rhizopus* takes place
1) During unfavourable conditions
2) Towards the end of growing season
3) When injured
4) When mycelium is young

205. In *Rhizopus* the zygospore is gametangia are held in position by
1) Zygophores 2) Progametangia
3) Suspensors 4) Promycelium

206. In *Rhizopus* this hormone stimulates the hyphae to become zygophores
1) Auxin 2) Citric acid
3) Trisporic acid 4) Propionic acid

207. The gametangia taking part in sexual reproduction in *Rhizopus* are
1) Multinucleate 2) Uninucleate
3) Binucleate 4) Without nucleus

208. In *Rhizopus*, sexual fusion takes place between
1) Two gametangia 2) Two gametes
3) Two hyphae 4) Two sporangia

209. A stalk-like portion of the *Rhizopus* gametangium is called
1) Paraphyses 2) Suspensor
3) Haustorium 4) Foot

210. These nuclei in the gametangia of *Rhizopus* degenerate?
1) Small nuclei 2) Very large nuclei
3) Haploid and unpaired nuclei
4) No nuclei degenerate

211. Trisporic acid in *Rhizopus* is
1) a hormone involved in sexual reproduction
2) the cell wall material
3) the reserve food material in cytoplasm
4) the main acid secreted out and is responsible for saprophytic life of *Rhizopus*

212. The product formed after gametangial union is known as
1) Sporangiospore 2) Germspore
3) Sporangiophore 4) Promycelium

213. Heterothallism in *Rhizopus* was discovered by
1) E.J. Butler 2) A.F. Blackslee
3) B.B. Mundkar 4) K.C. Mehta

214. The coupulating branch from which a gametangium in *Rhizopus* is formed is known as
1) Suspensor 2) Zygosporangium
3) Progametangium 4) Rhizoid

215. A gamete having multinucleate condition as found in *Rhizopus* is known
1) Aplanogamete 2) Parthenogamete
3) Coenogamete 4) Planogamete

216. Homothallic species of *Rhizopus* is mostly
1) Chemosynthetic 2) Saprophytic
3) Parasitic 4) Symbiotic

217. In the life cycle of *Rhizopus*, the unicellular structure with diploid nuclei is
1) Sporangiospore 2) Sporangium
3) Zygospore 4) Gametangium

218. In *Rhizopus* diploid chromosome number is found in
1) Hyphae 2) Sporangium
3) Spore 4) Zygospore

219. In which of the following stages of *Rhizopus*, haploid number of chromosomes is not found ?
1) Zygospore 2) Hypha
3) Sporangium 4) Spore

220. In a microbiology lab, a nutrient medium is contaminated by a spore of heterothallic species. The resulting mycelium fails to reproduce through
1) Sporangiospores 2) Chalamydosproes
3) Germ spores 4) Fragmentation

221. The dormancy period of *Rhizopus* zygospore is
1) 2-10 months 2) 5-10 months
3) 5-9 months 4) 2-9 months

222. The growth of promycelium of *Rhizopus* is
1) Transverse 2) Horizontal
3) Vertical 4) Oblique

223. How many types of mitospores and meiospores are produced by *R. stolonifer* during asexual and sexual reproduction respectively
1) Only one type 2) Two and two
3) Always two types 4) Two and one

224. The spore produced in the germ sporangium of *Rhizopus stolonifer* on germnation gives rise to
1) Mycelium, which is multinucleate but all the nuclei of the same strain
2) Mycelium, which has uninucleate cells and all cells of the same strain
3) Mycelium which is multinucleate, and the nuclei of two different strains
4) Mycelium in which alternate cells are having the nuclei of two different strains

225. In the cultures of *Rhizopus stolonifer* in a laboratory zygospores are not formed due to the
1) oxygen deficiency 2) abscence of light
3) deficiency of hormones
4) abscence of mycelia of different strains

LEVEL-II

226. The hyphae of *Rhizopus* are
1) Unbranched, aseptate and uninucleate
2) Branched, septate and uninucleate
3) Branched, aseptate and multinucleate
4) Unbranched, septate and coenocytic

227. Stolon is a term used in *Rhizopus* as
1) a hypha that grows into the substratum
2)a hypha that grows horizontally on the substratum
3) a hypha that grows vertically and aerially
4) all the above are called stolons

228. Which one of the following statements is **correct**?
1) The reserve food in the vegetative cells of *Spirogyra* is starch
2) The reserve food in the Zygospore of *Spirogyra* is glycogen
3) The reserve food in the zygospore of *Rhizopus* is starch
4) The reserve food in *Rhizopus* is stored in elaioplasts

229. In *Rhizopus*, dome shaped sterile portions are found on erect structures that arise from stolons. These structures are referred to as (EAMCET 2004)
1) Gametangia 2) Progametangia
3) Zygosporangia 4) Sporangiophores

230. When *Rhizopus* is cultured in the laboratory, the formation of zygospore is absent, Identify the reason
1) There is a deficiency of light
2) Absence of (+) and (-) strains in the mycelium
3) There is deficiency of CO_2
4) Presence of (+) and (-) strains in the mycelium

231. Find the **correct** statement
I. *Rhizopus* is aseptate
II. *Rhizopus* produces septa when injured or during reproduction.
III.*Rhizopus* has only zygospore as diplophase
IV. *Rhizopus* is obligate parasite.
1) I, II, III 2) II, III,IV
3) III, IV 4) II, IV

232. Find the **incorrect** statement.
I. *Rhizopus* shows 2 kinds of heterotrophic nutrition.
II. *Rhizopus* has homothallic and heterothallic species
III.*Rhizopus stolonifer* produces 2 strains of germspores in the germsporangium
IV.*Rhizopus* produces 1 germspore from one diploid nucleus in the zygospore
1) I, II 2) II, III
3) III, IV 4) IV only

233. Promycelium in *Rhizopus* develops from
I. Chlamydospore II. Zygospore
III. Sporangiospore
1) I and II are correct 2) II and III are correct
3) II alone is correct 4) I and III are correct

234. What are the successive structure formed in course of sexual reproduction of *Rhizopus*?
(EAMCET - 2005)
1) Zygospore, progametangium, gametangium, Zygophore
2) Progametangium, Zygophore, Gametangium, Zygospore
3) Progametangium, Gametangium, Zygospore, Zygophore
4) Zygophore, Progametangium, Gametangium, Zygospore

235. Find the **correct** statement about *Rhizopus*
1) Reduction division occurs in the sporangium
2) Life cycle is diplontic
3) Reduction division does not occur in zygospores
4) Reduction division occurs in zygospores

236. In the life cycle of *Rhizopus*, large time interval exists between
1) Karyokinesis and meiosis
2) Plasmogamy and karyogamy
3) Karyogamy and meiosis
4) Meiosis and meiospore formation

237. Common character found in *Spirogyra* and *Rhizopus* is
1) Presence of uninucleate haploid cells
2) Presence of spirally coiled chloroplasts
3)Presence of glycogen as the reserve food material
4) Presence of unicellular gametangia

238. *Spirogyra* differs from *Rhizopus* in having
1) Anisogametes
2) Sexual reproduction
3) Multicellular gametes
4) Uninucleate gametangia

239. *Rhizopus* differs from *Spirogyra* in
1) Presence of Plastids
2) Simple thallus
3) Coenocytic
4) Presence of Cytoplasm

240. Germ sporangium in *Rhizopus* is
1) Sporangium formed at the tip of the germtube produced after germination of a zygosporangium
2) Sporangium formed at the tip of sporangiophore
3) Sporangium which is germinating
4) Chlamydospore

241. Hetrothallism refers to
1) Fusion is not accompanied by zygote formation
2) Fusion between morphologically similar strains
3) Fusion between strains which are structurally similar and physiologically different
4) Fusion between same strains

242. Assertion (A): Hypha is a structural unit of mycelium
Reason (R): Mycelium constitutes the fungal thallus in *Rhizopus*

243. Assertion (A) Cytokinesis will not occur in *Rhizopus* mycelium
Reason (R) Free nuclear divisions take place in Zygospore of Rhizopus

244. Which of the following is applicable to Fungi
I) Prokaryotes II) Lack of plastids
III) Chitinous cell wall IV) Extra cellular digestion
1) I, III and IV only 2) I, II, III and IV
3) I and II only 4) II, III and IV only

245. Find out the **correct** sequence leading to asexual reproduction in bread mould
1) Sporangiophore → stolons → sporangium → Aplanospores
2) Stolons → Sporangium → Sporangiophore Cleavage → Aplanospores
3) Sporangium → Stolons → Aplanospores Cleavage → Sporangiophore
4) Stolons → Sporangiophore →Sporangium Cleavage → Aplanospores

246. Choose the **correct** statement:
1) Scalariform conjugation results in the formation of zygospore directly
2) The germtubes produced in *Rhizopus* and *Spirogyra* are haploid and diploid respectively
3) Mitospores in bread mould initially uninucleate and becomes coenocytic latter
4) Mitospores in black mould are initially coenocytic and rarely uninucleate

247. Assertions (A) : The hyphae of *Rhizopus* are coenocytic
Reason (R): Cytokinesis will not take place in *Rhizopus*.

248. Assertion (A) :Sporangiospores in *Rhizopus* are also called aplanospores.
Reason (R): Columella is formed in the sporangiophore .

249. Assertion (A): Only one strain of spores are formed by *R. stolonifer* in germ sporangium.
Reason (R): *R. stolonifer* is a heterothallic species

250. Assertion (A): *Rhizopus stolonifer* is heterothallic fungus
Reason (R): Gametangial copulation occurs between 2 hyphae of same mycelium. in *R.stolonifer*

251. Assertion (A) Columella is useful for dispersal of spores in *Rhizopus*
Reason: (R) In germsporangium of *Rhizopus* columella is absent

252. Assertion (A) : The number of nuclei in the spores of *Rhizopus* is not constant.
Reason (R) Initially one nucleus in germspore and many in chlamydospores .

253. Find the **correct** statements with regard to *Rhizopus*
I) Meiosis takes place in the zygospore
II) Free nuclear divisions take place in vegetative hyphae and germspores
III) Morphological isogamous type of sexual reproduction takes place in *R. stolonifer*
IV) Seggregation of strains occur in the zygospore of *R.sexualis*
1) I, II 2) II, III , IV
3) I, II. III 4) II, IV

254. Identify the **correct** statement(s) from the following with respect to *Rhizopus*
I. Cell wall is made up cellulose and pectin
II. The reserve food material is in the form of glycogen and oil globules
III. Trisporic acid is a type of sex hormone.
IV. Germ spores are initially multinucleate
The correct answer is
1) I & II 2) III & IV
3) I & IV 4) II & III

255. A heterothallic species of pinmould produced 200 spores in germsporangium and 400 spores in a sporangiosporangium. When all the spores are viable what will be the combination of +st and - st mycelia produced after germination of these spores?

I) 500+st and 100-st II) 300+st and 300-st

III) 100+st and 500-st IV) 400+st and 200-st

1) I only correct 2) III only correct

3) II and IV correct 4) I and III correct

256. A heterothallic sps of *Rhizopus* produced 800 meiospores through sexual reproduction and 300 sporangiospores through asexual reproduction. What would be the combination among the following

1) 950+stain and 150-strain

2) 400+strain and 700-strain

3) 700+strain and 450-strain

4) 550+strain and 500-strain

257. In *Rhizopus* stolonifer, the fertile zysopore is formed, if the copulation takes place between the

1) (+) x (-) strains 2) (+) x (+) strains

3) (-) x (-) strains 4) 2 or 3

258. If 40 diploid nucleii are present how many + strains germspores are formed in *Rhizopus*

1) 40 2) 20 3) 160 4) 80

259. Ratio between the number of fusing nuclei of both mating types and total number of germ spores produced during sexual reproduction in *Rhizopus stolonifer* respectively

1) 1 : 2 2) 2 : 3 3) 1 : 4 4) 1 : 6

260. In *Rhizopus stolonifer* one gametangium contains 35 nuclei another gametangium contains 45 nuclei. How many germspores are produced after the fusion of these gametangia?

1) 140 2) 280 3) 160 4) 320

261. If one of the conjugating gametagia of *Rhizopus* has 120 nuclei and the other has 100 nuclei, the number of nuclei that would be present in the germinating zygospore is

1) 220 2) 100 3) 200 4) 400

262. Assertion(A): Haplophase is dominant in *Rhizopus*

Reason (R) The zygospore undergoes meiosis in *Rhizopus*

263. Arrange the following events in descending order in sexual reproduction in *Rhizopus*

I) Promycelium II) Zygospore

III) Zygophore IV) Gametangium

1) II, III,IV,I 2) I, III, II,IV

3) III,IV,I,II 4) I,II,IV,III

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

List - I	**List -II**
A) Asexual	I) Chlamydospores
B) Sexual	II) Zygospore
C) Vegetative	III) Fragmentation
D) Algae	IV) Akinite
	V) Germ spore

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

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

List - I	List -II
A) Rhizoids	I) Asexual
B) Sporangiospores	II) Absorption
C) Stolon	III) Suspensor
D) Germ sporangium	IV) Sexual
	V) Vegetative

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

266. Study the following table. Which components of the table given below, show **correct** combination in *Rhizopus*

I) Chlamydospore Promycelium Germspore

II) Gametangium Copulation Zygospore

III) Germspore Germination Mycelium

IV) Zygospore Promycelium Aplanosporangium

1) I and II 2) III and IV

3) I and III 4) II and III