

FUNGI

FUNGUS – Achlorophyllous, nucleated, spore bearing, like organism .

Fungus = mushroom

Mycology- study of fungus

Plant pathology- study of fungal disease

GENERAL CHARACTER OF FUNGI

Habit and habitat

Species=5,0000-1,00000

Heterotrophic-food consume from host, decompost material, symbiotic plant.

Parasittic,saprophytic ,symbiotic

PARASITIC

Food consume from host cell and disease causes in host plant.



SAPROPHYTIC

Food consume from decomposed material(death organism).



SYMBIOTIC

Food consume from symbiotic organism



Fungal body

Thalloidal

Filamentous

Coenocytic

Fruiting body

Heterothallic

THALLOIDAL

Fungal body not differentiate in root ,stem ,and leaf.



FILLAMENTOUS

Fungal body thin, long and branched.

HETEROTHALIC

Fungal body contain male and female reproductive organs.

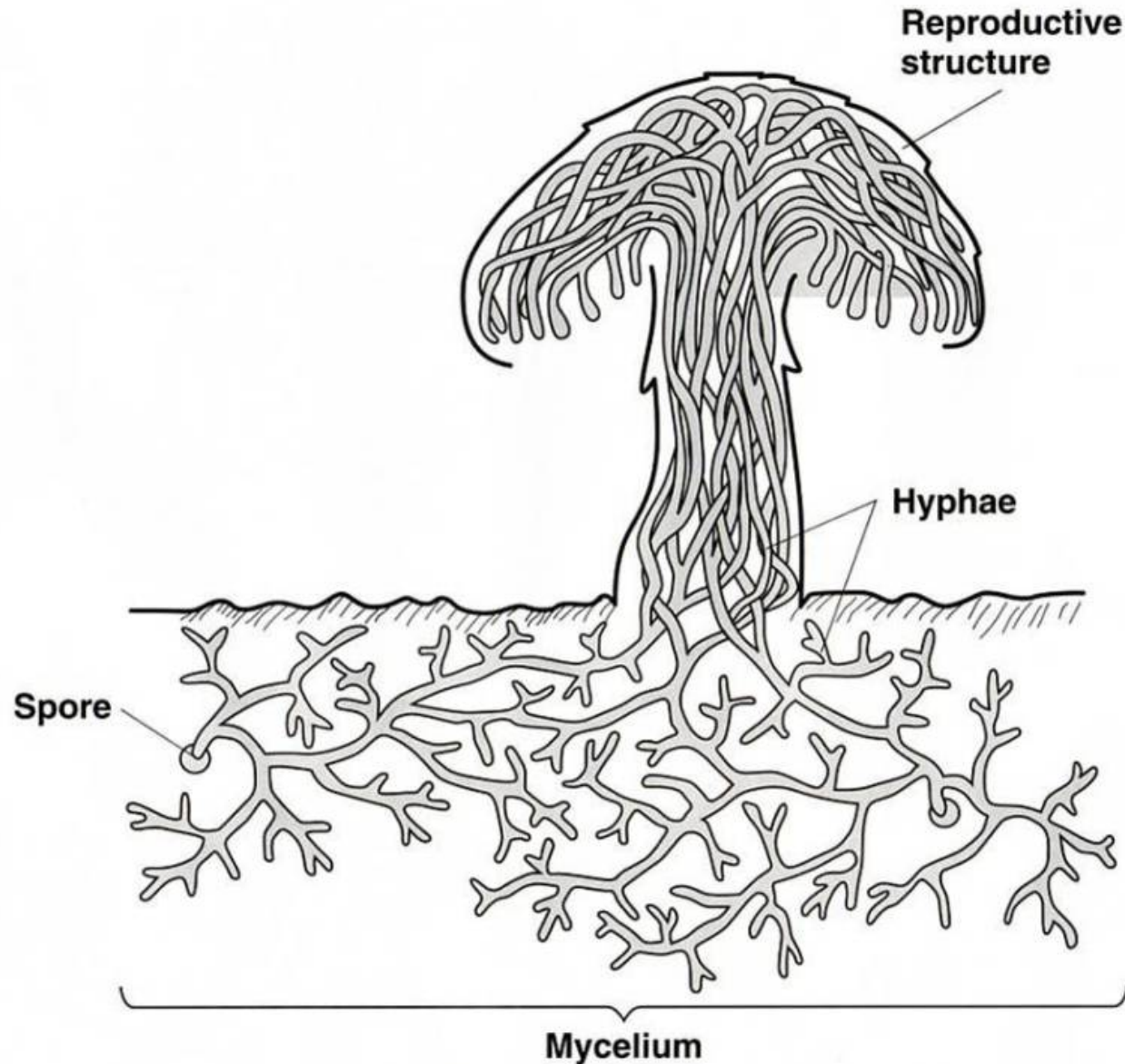
HOMOTHALIC

Fungal body contain only male or female

Reproductive organce

FRUITING BODY

Fungal body show fruit like structure



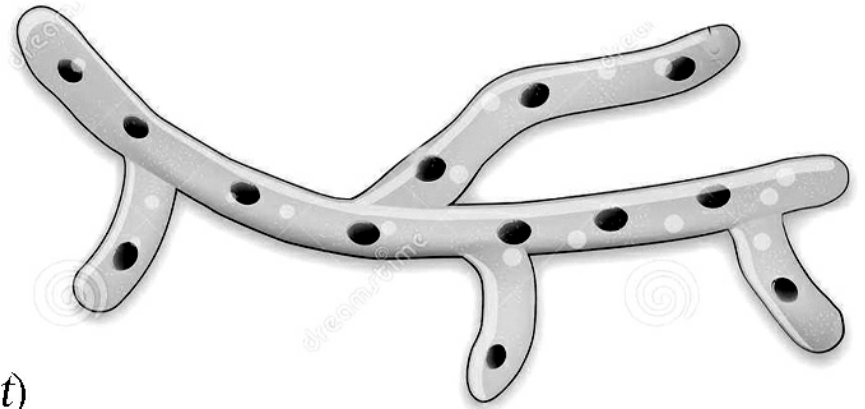
THALLUS ORGANISATION

1. Hyphae
2. Mycelium
3. Plectenchyma
4. Prosenchyma
5. Pseudo parenchyma
6. Rhizomorpha
7. Sclerosia
8. Stroma
9. Appressorium
10. Haustorium

Hyphae Mycelium



Unicellular thallus (*Yeast*)



Filamentous thallus (*Mucor*)

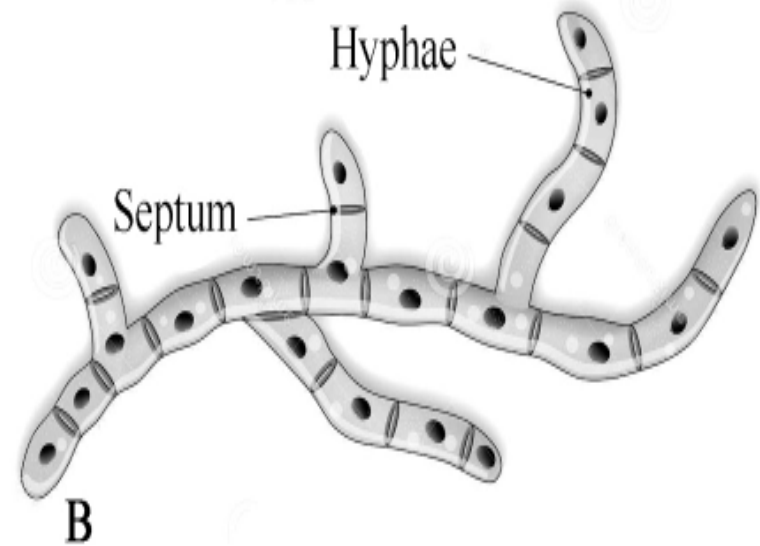
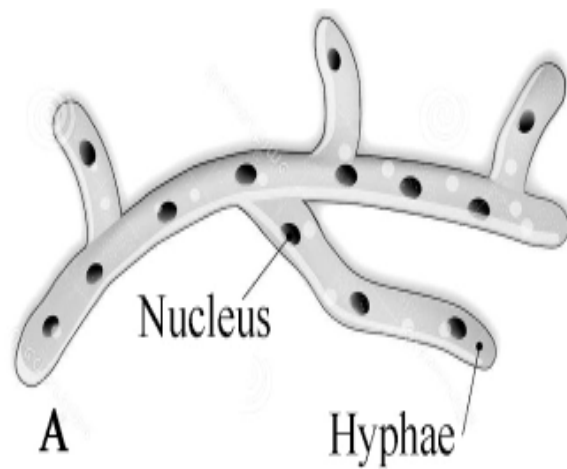
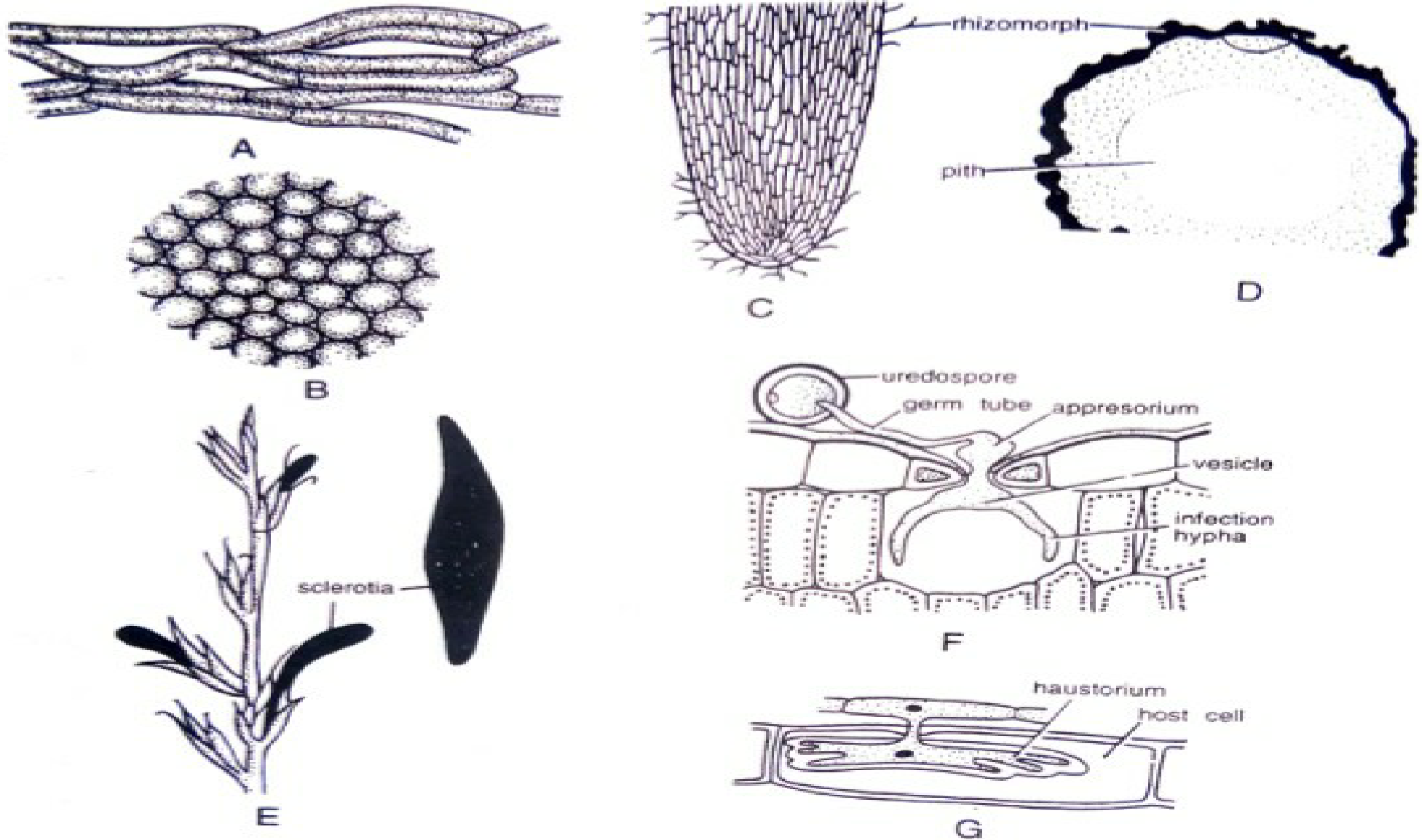


Fig: (A) Aseptate (coenocytic hyphae) and (B) Septate hyphae

Plectenchyma, Prosenchyma, Pseudo parenchyma



चित्र 4 A-G. कवक तंतुओं के रूपान्तरण (Modifications) : A. दीर्घऊलक (prosenchyma), B. आपासी पैरेन्काइमा (pseudoparenchyma), C-D. तंतुजटा (rhizomorph), E. स्क्लेरोशियम (sclerotium), F. आसंगण (appressorium), G. चूषकण (haustorium)।

Rhizomorphs

Sclerosia

Stroma

Appressorium

Houstorim

CELLULAR CHARACTER OF FUNGI

Eukaryotic cell

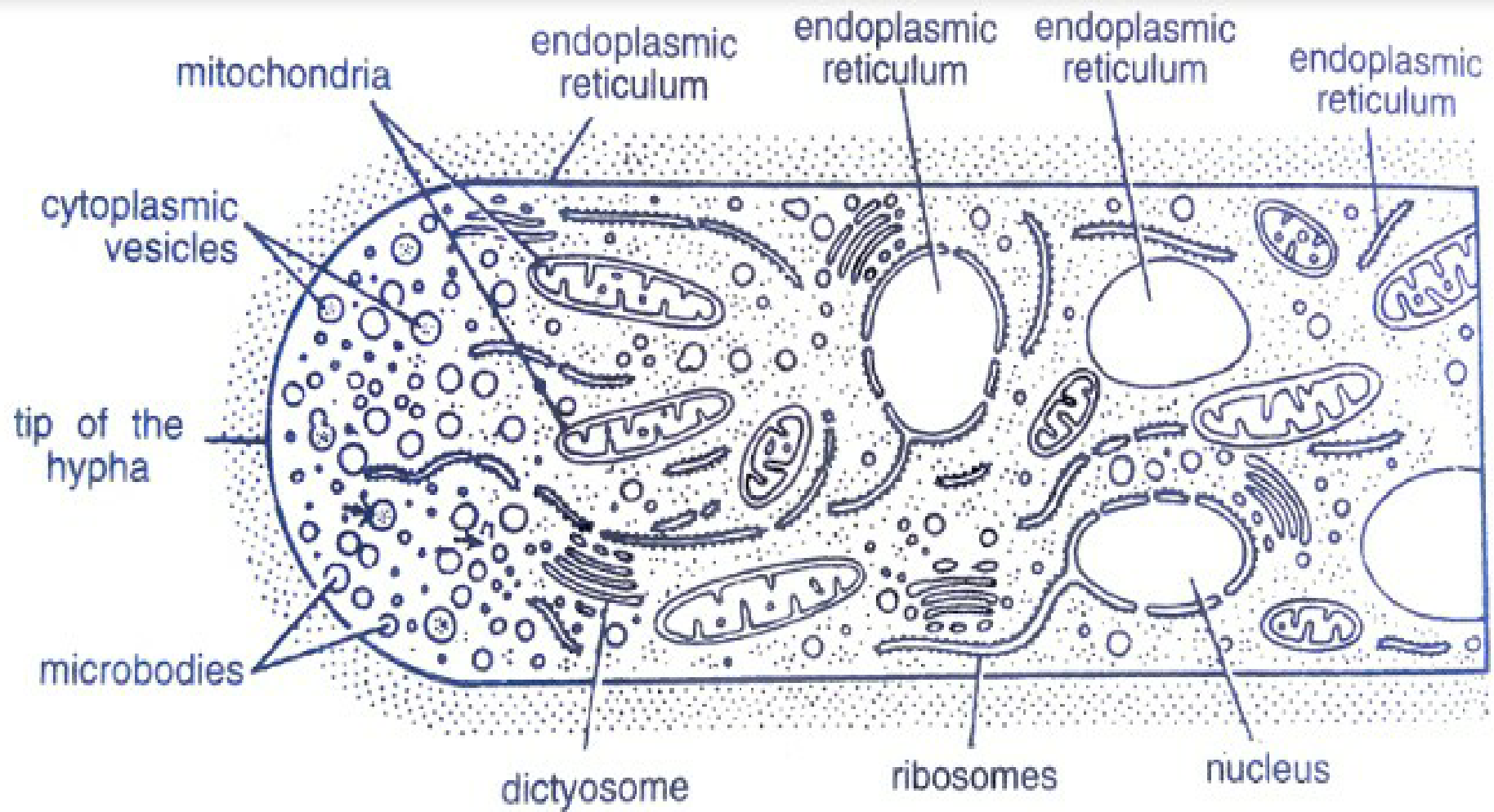
Cell wall- cellulose and chitin(n-acetylglycosamine)

Plasma membrane(loamosome)-

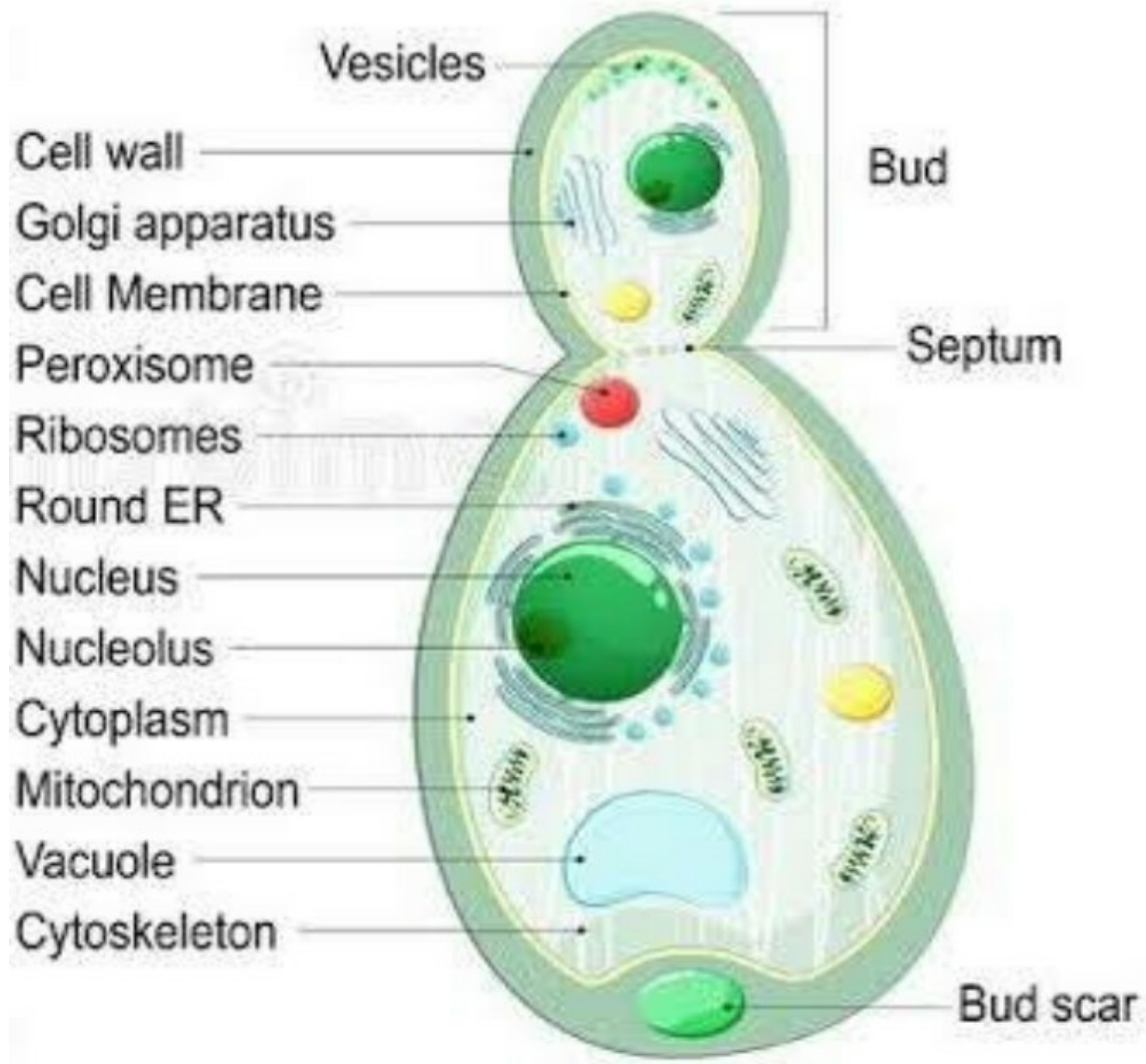
Cytoplasm-nucleus

Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- glycogen, oil droplets.

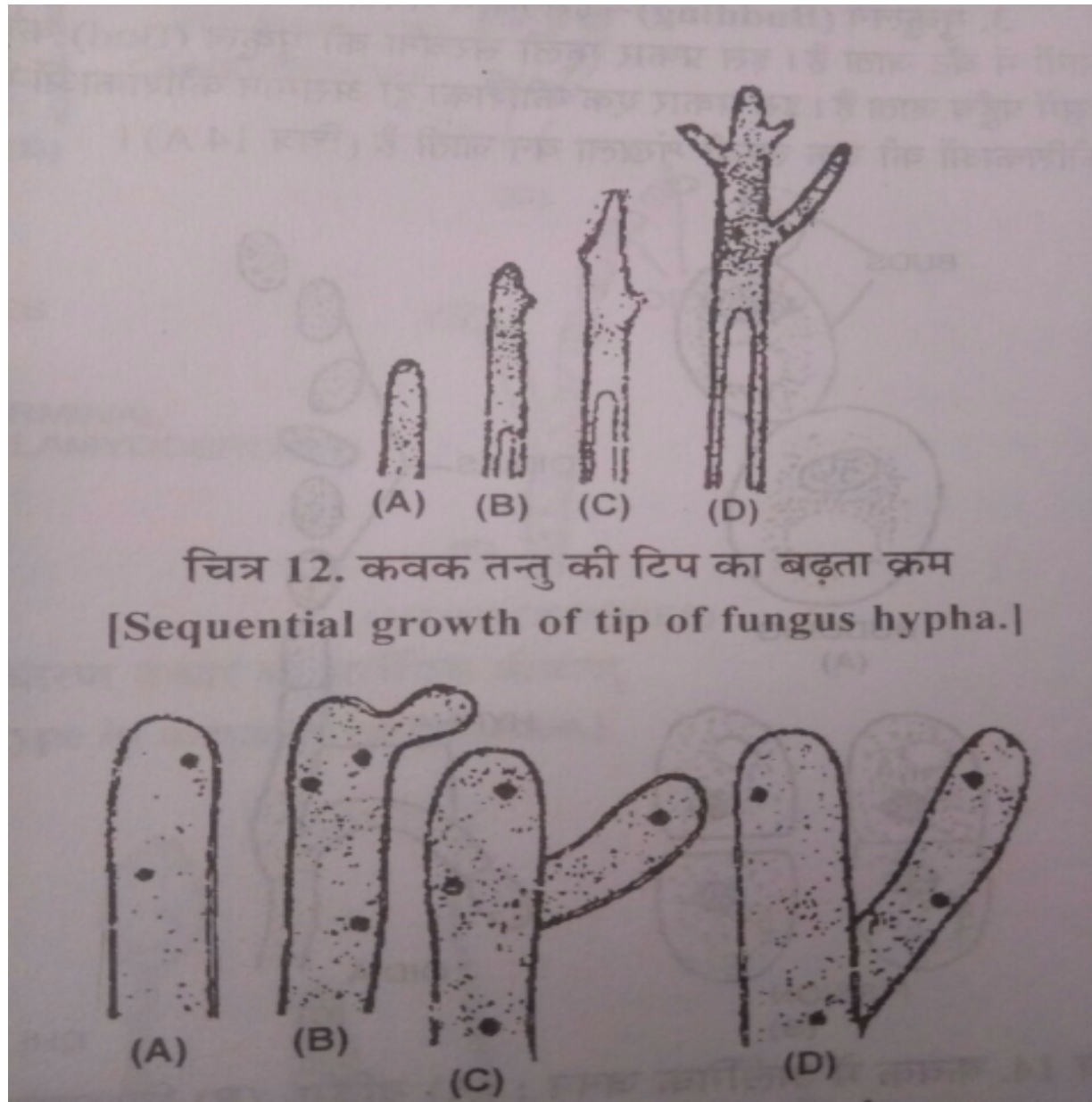


चित्र 2. कवकतन्तु (Hypha) : संरचना का आरेखी निरूपण (diagrammatic representation) ।



GROWTH OF FUNGUS

❖ Sequential growth



REPRODUCTION CHARACTER IN FUNGI

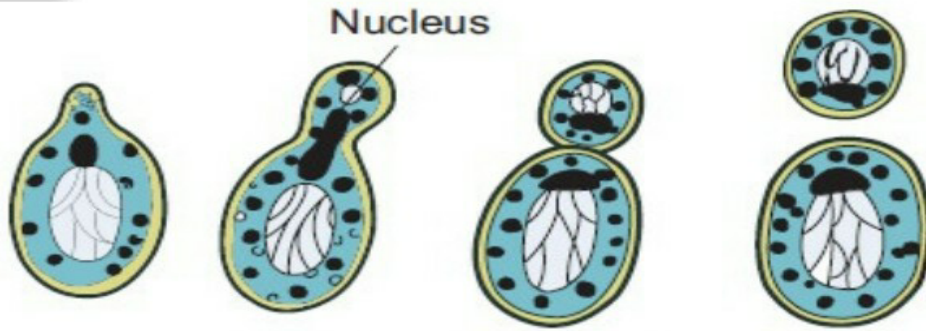
Generally three type reproduction show in fungi

1. Vegetative reproduction
2. Asexual reproduction
3. Sexual reproduction

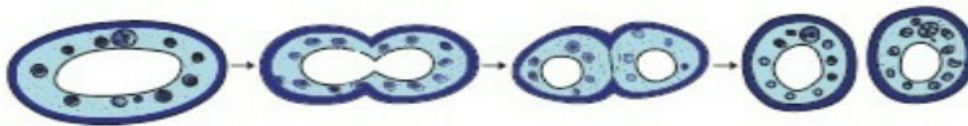
VEGITATIVE REPRODUCTION

1. BY FRAGMENTATION
2. BY FISSION
3. BY BUDDING
4. BY SCLEROTIA

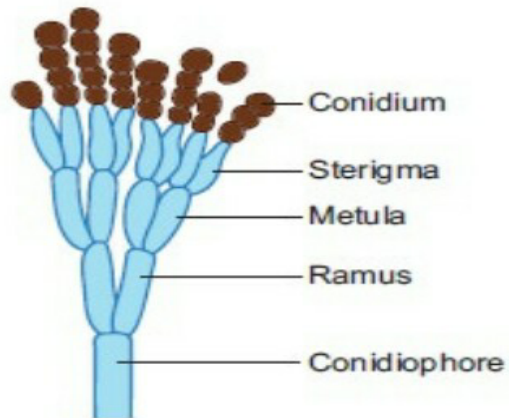
BY FRAGMENTATION



(a) Budding - Yeast

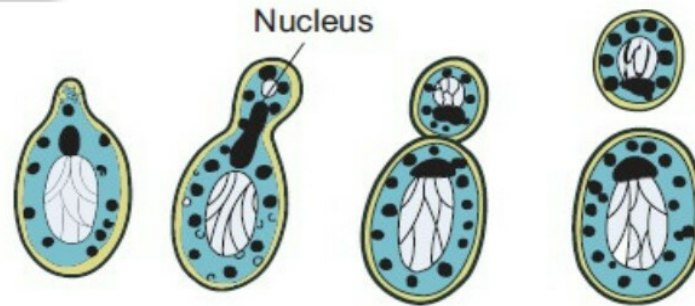


(b) Fission - Yeast

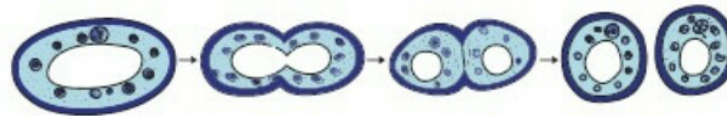


(c) Conidia formation - *Penicillium*

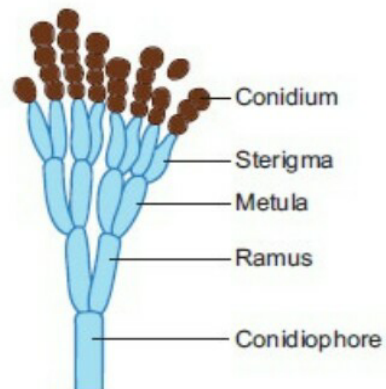
BY FISSION



(a) Budding - Yeast

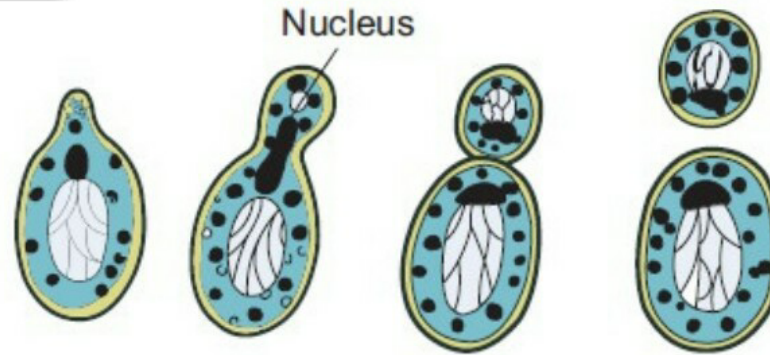


(b) Fission - Yeast

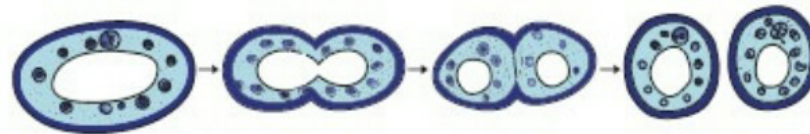


(c) Conidia formation - *Penicillium*

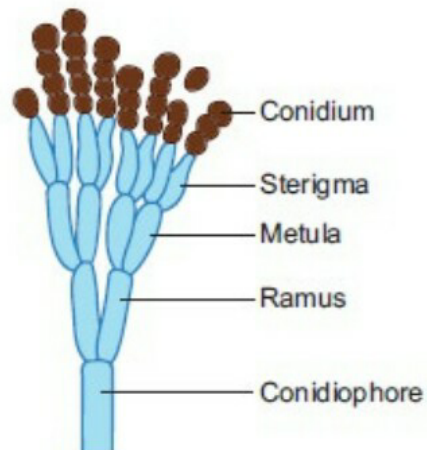
BY BUDDING



(a) Budding - Yeast



(b) Fission - Yeast

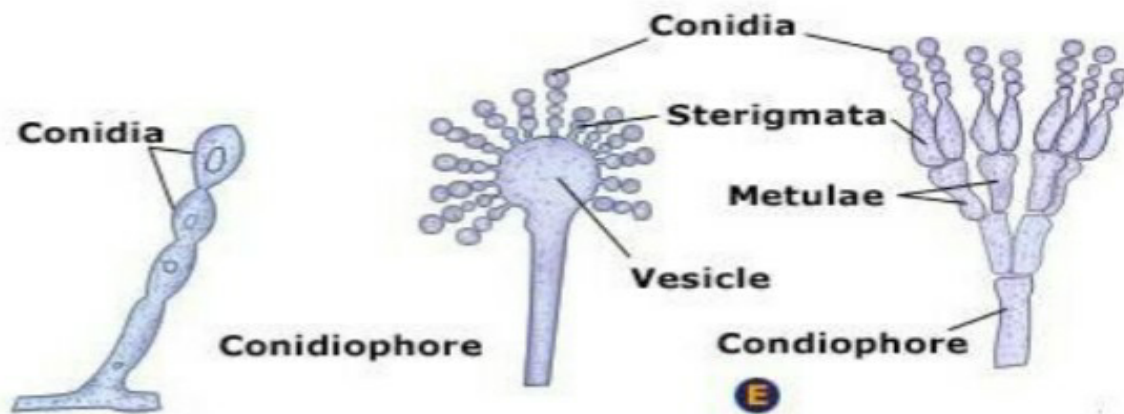
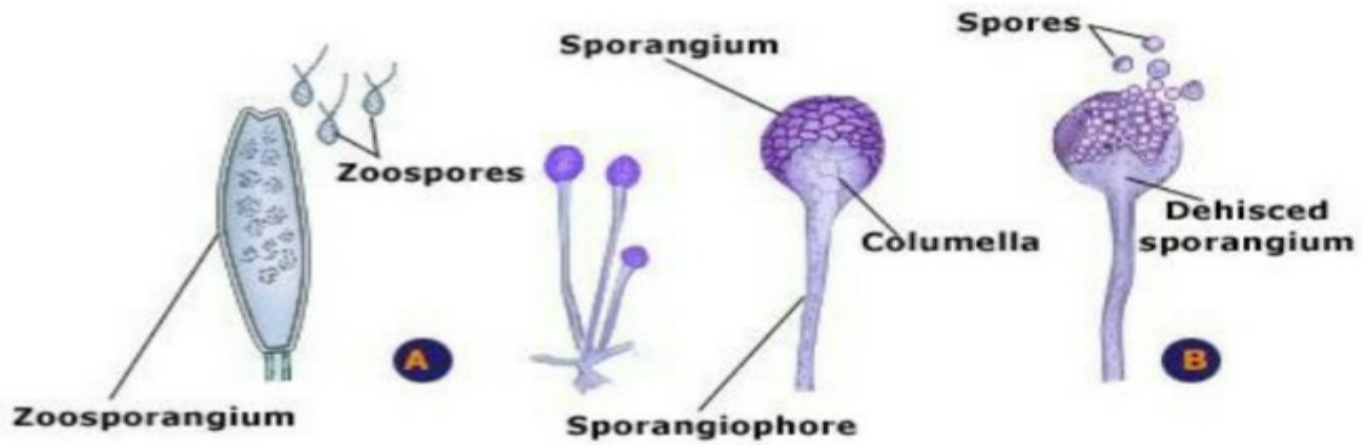


(c) Conidia formation - *Penicillium*

BY SCLEROTIA

ASEXUAL REPRODUCTION

1. By oidia/oidium
2. By chlamydospore
3. By zoospore
4. By aplanospore
5. By conidium
6. By conidiosporangium



By oidia/oidium
 By chlamydospore
 By zoospore

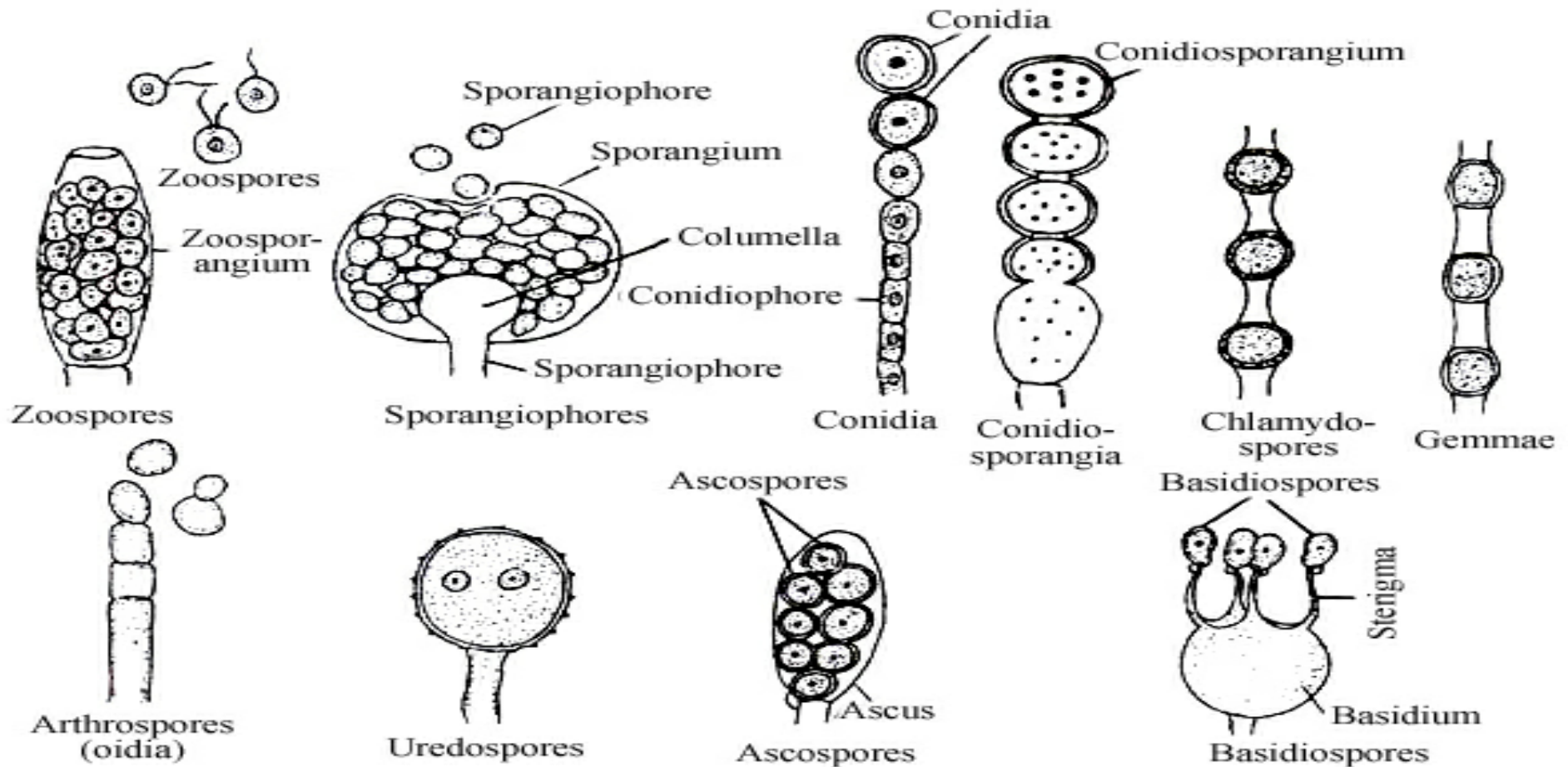


Fig: Various types of fungal spores.

By aplanospore
 By conidium
 By conidiosporangium

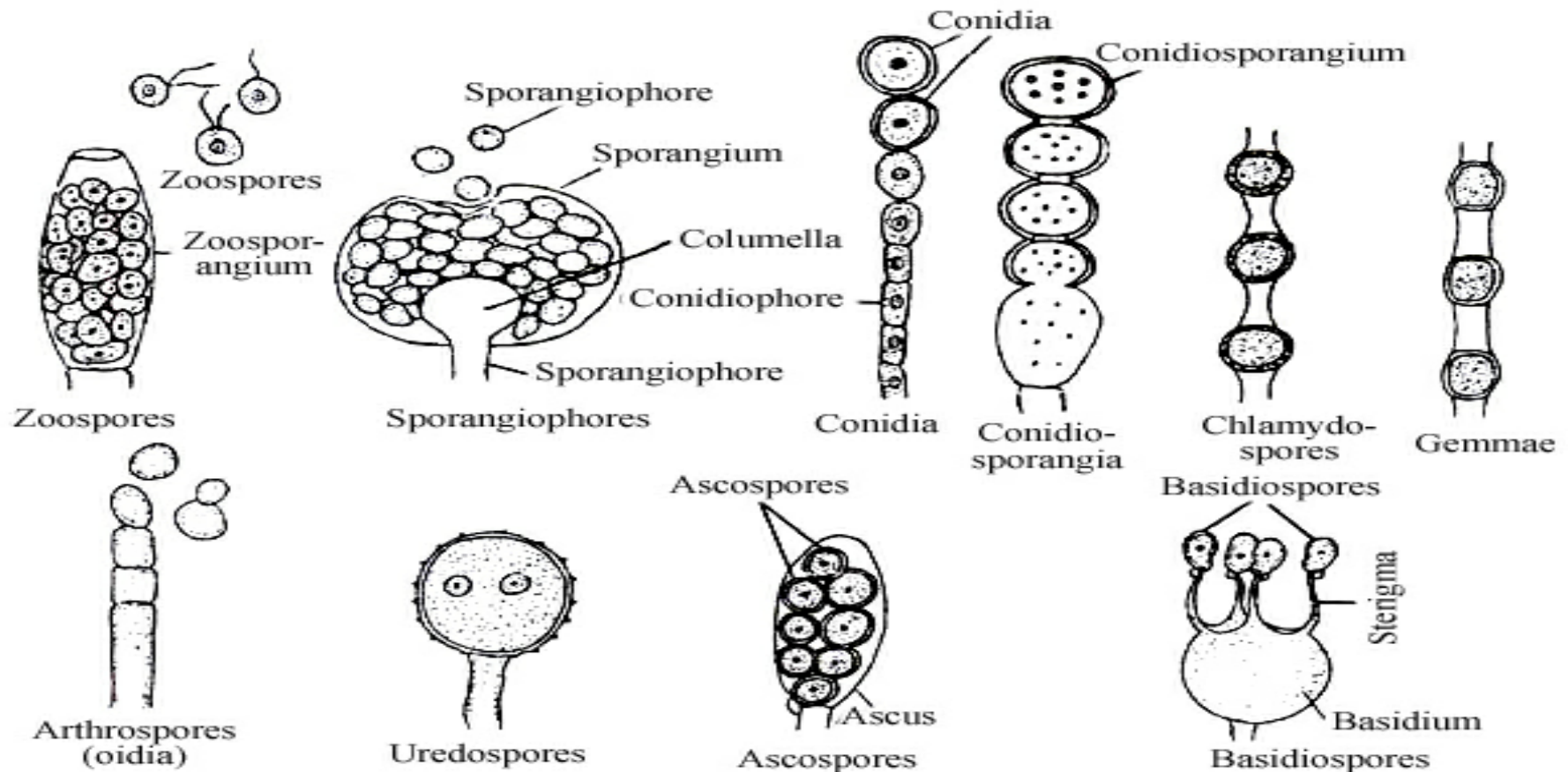


Fig: Various types of fungal spores.

SEXUAL REPRODUCTION

1. Planogametic copulation
2. Gametangial contact
3. Gametengial copulation
4. Spermatization
5. Somatogamy/autogamy

PLANO GAMETIC COPULATION

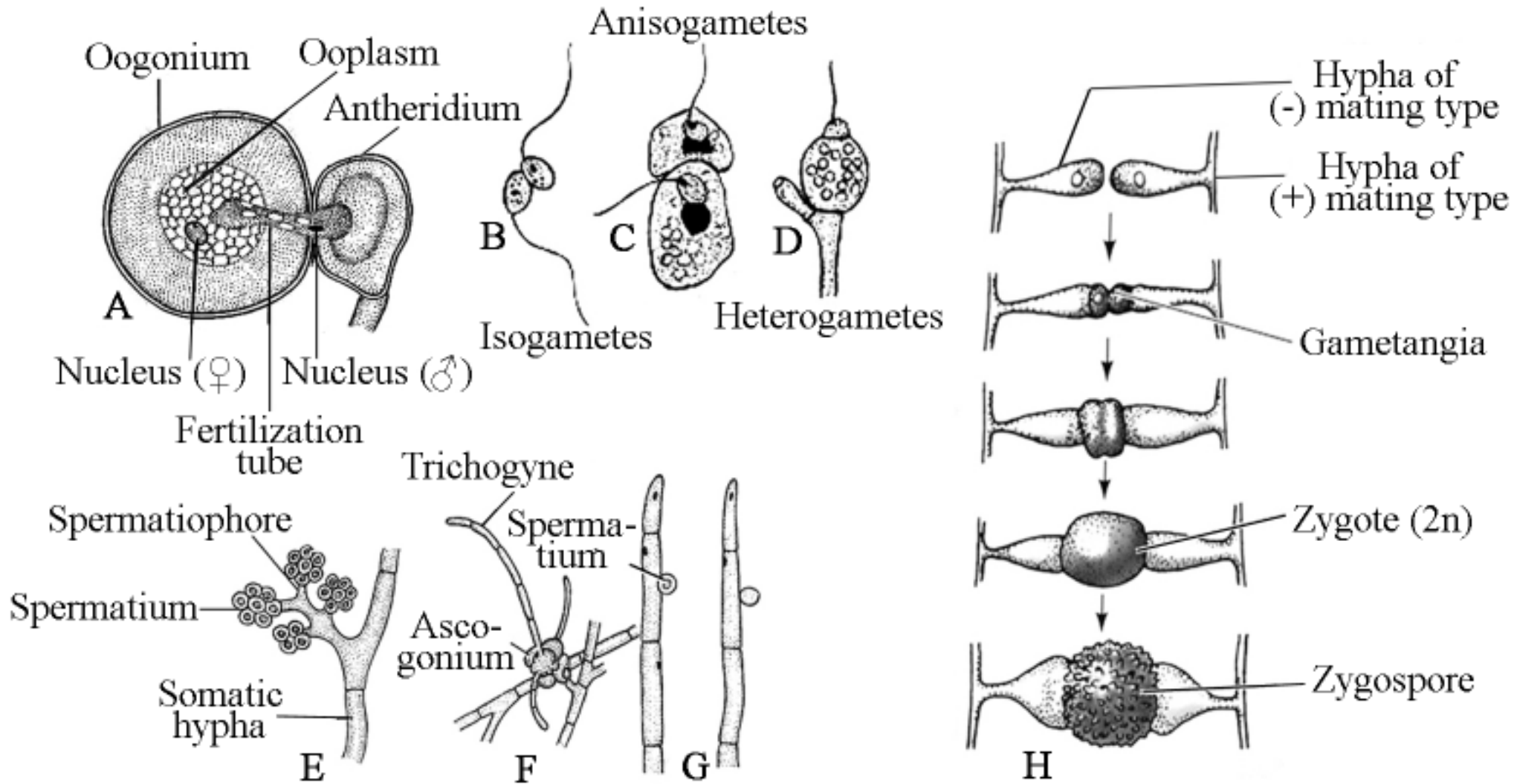
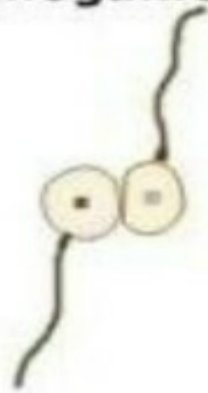


Fig: Sexual Reproduction in Fungi. (A) Gametangial copulation, (B-C-D) Gametic contact, (E-F-G) Spermatization, (H) Gametangial copulation.

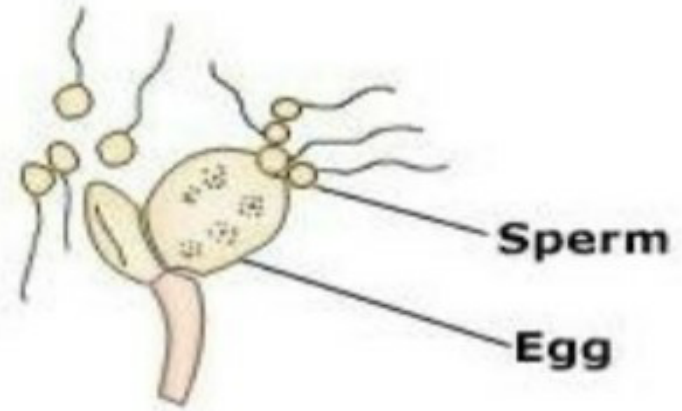
Planogametic copulation



Isogamy

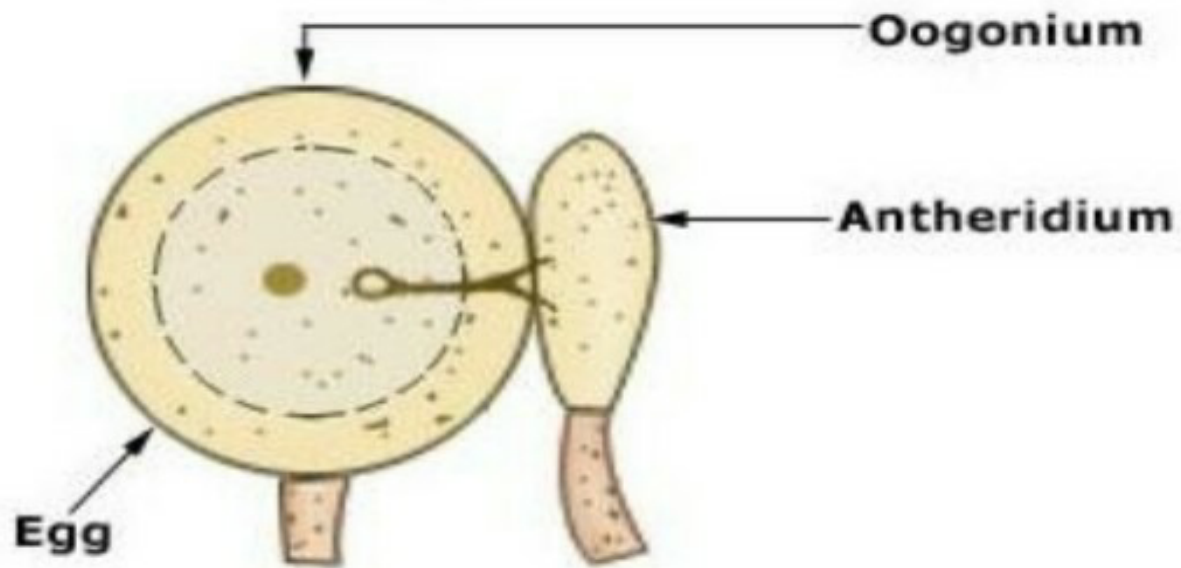


Anisogamy



Oogamy

Gametangial contact



GAMETANGIAL CONTACT

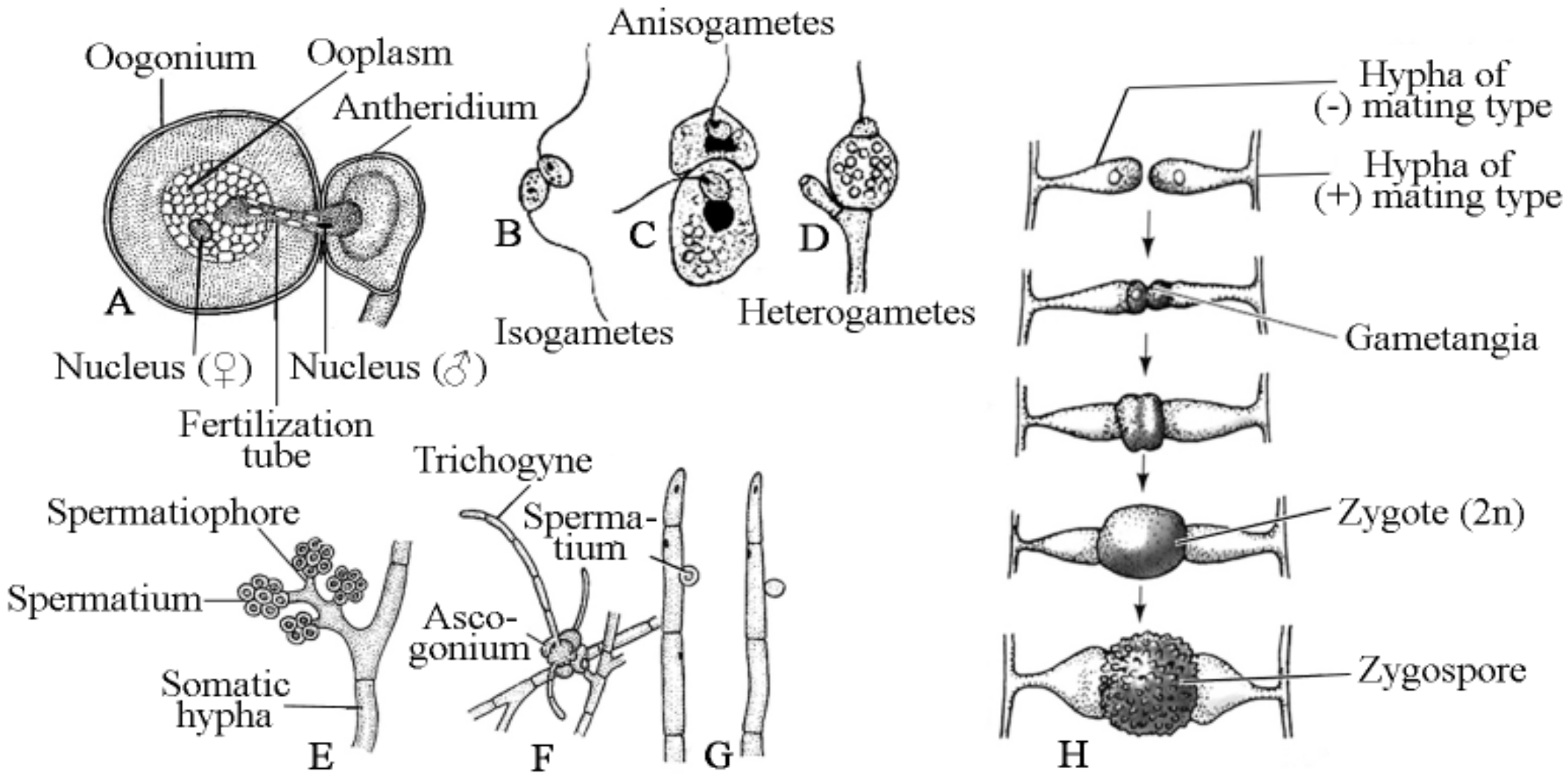


Fig: Sexual Reproduction in Fungi. (A) Gametangial copulation, (B-C-D) Gametic contact, (E-F-G) Spermatization, (H) Gametangial copulation.

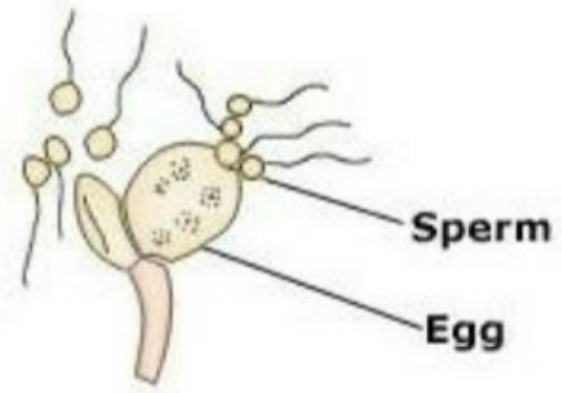
Planogametic copulation



Isogamy

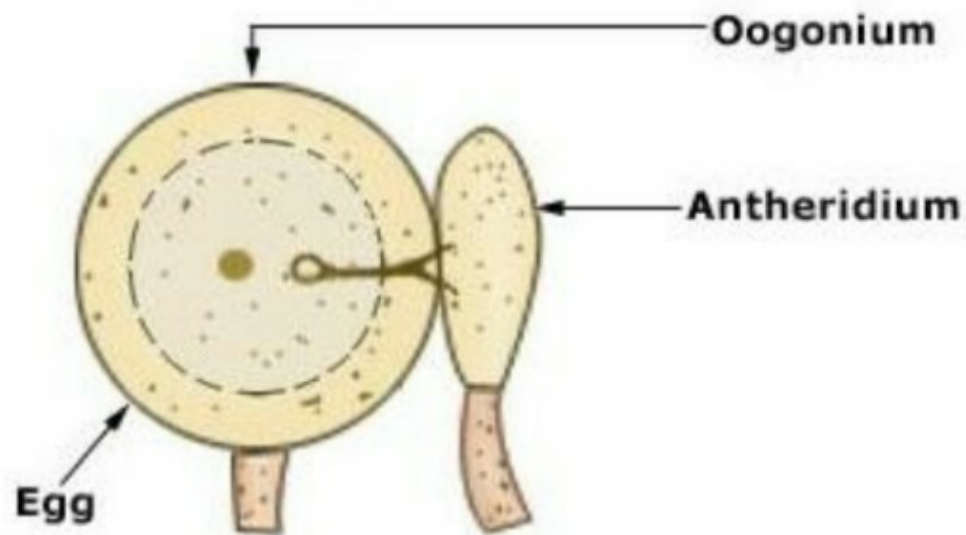


Anisogamy



Oogamy

Gametangial contact



GAMETANGIAL COPULATION

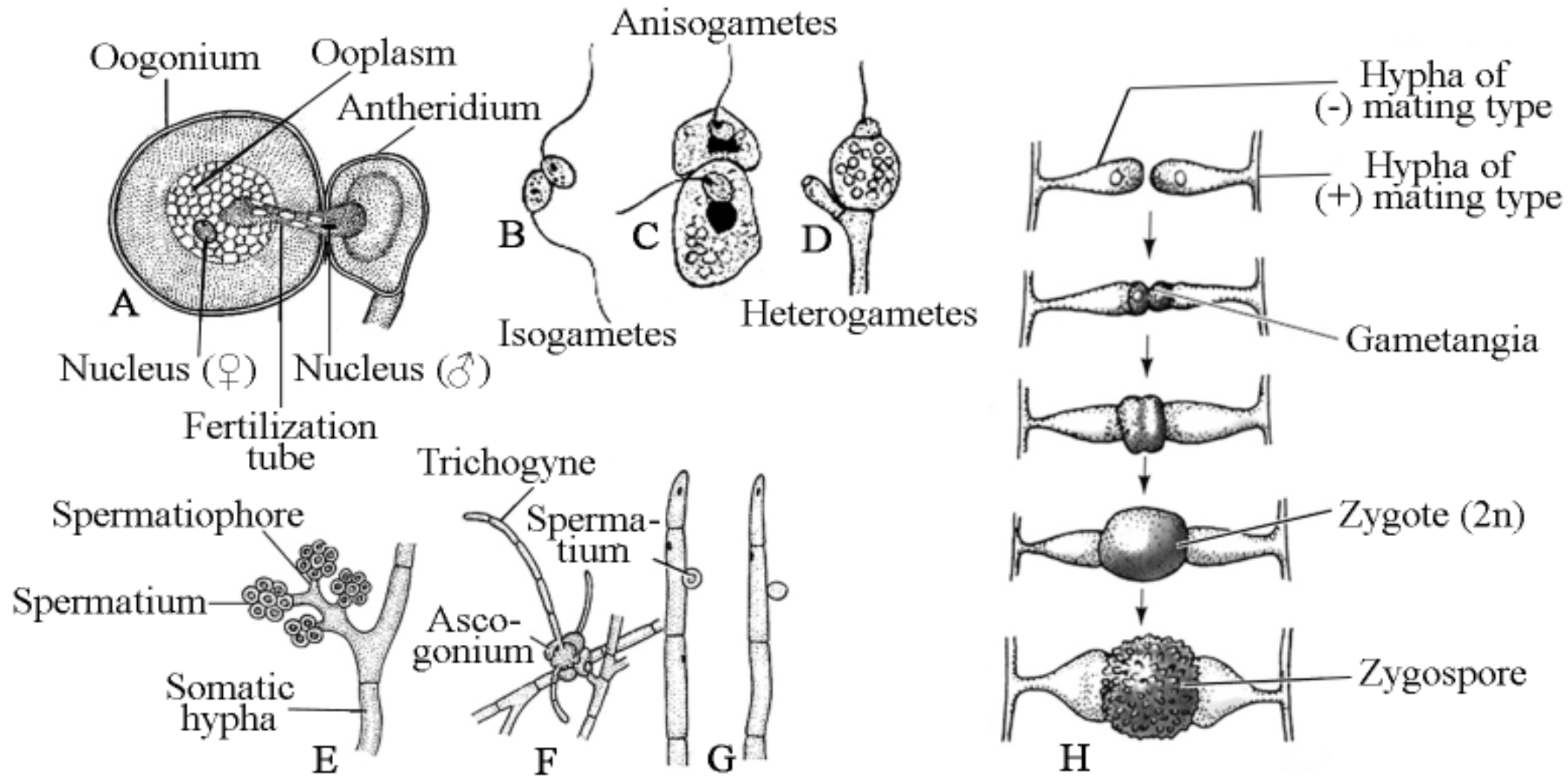
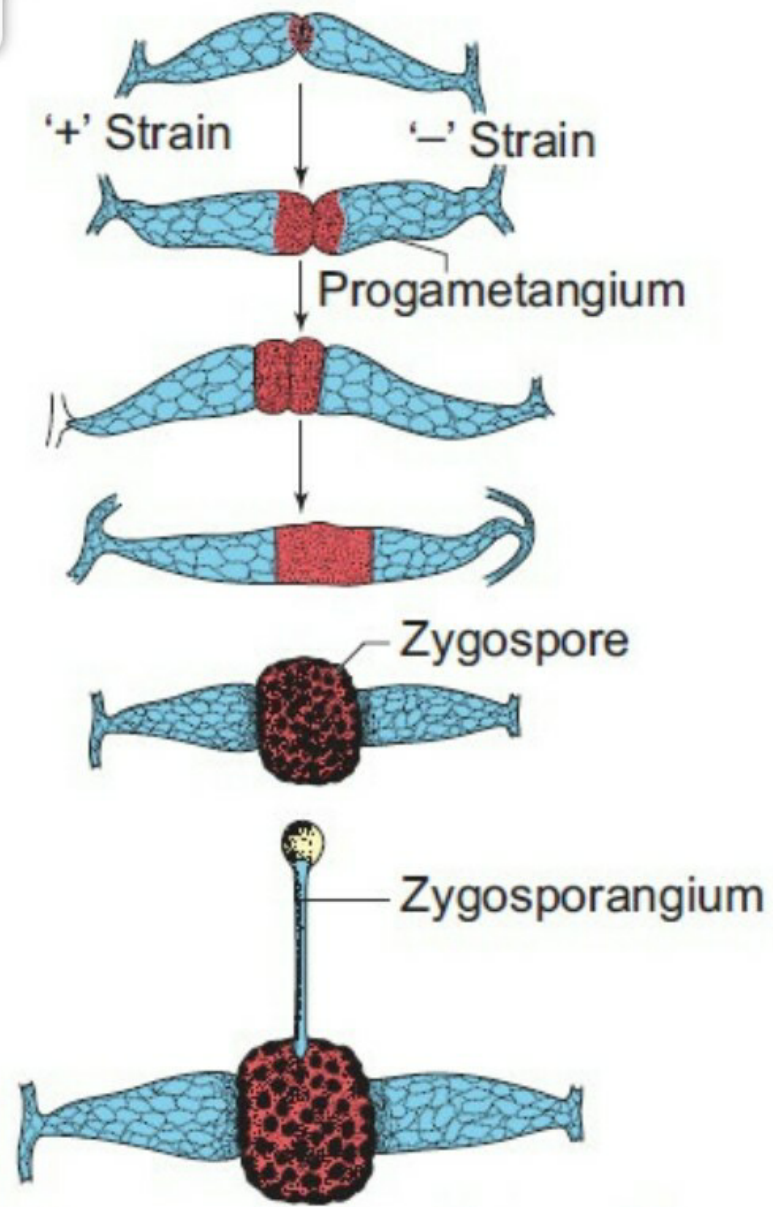
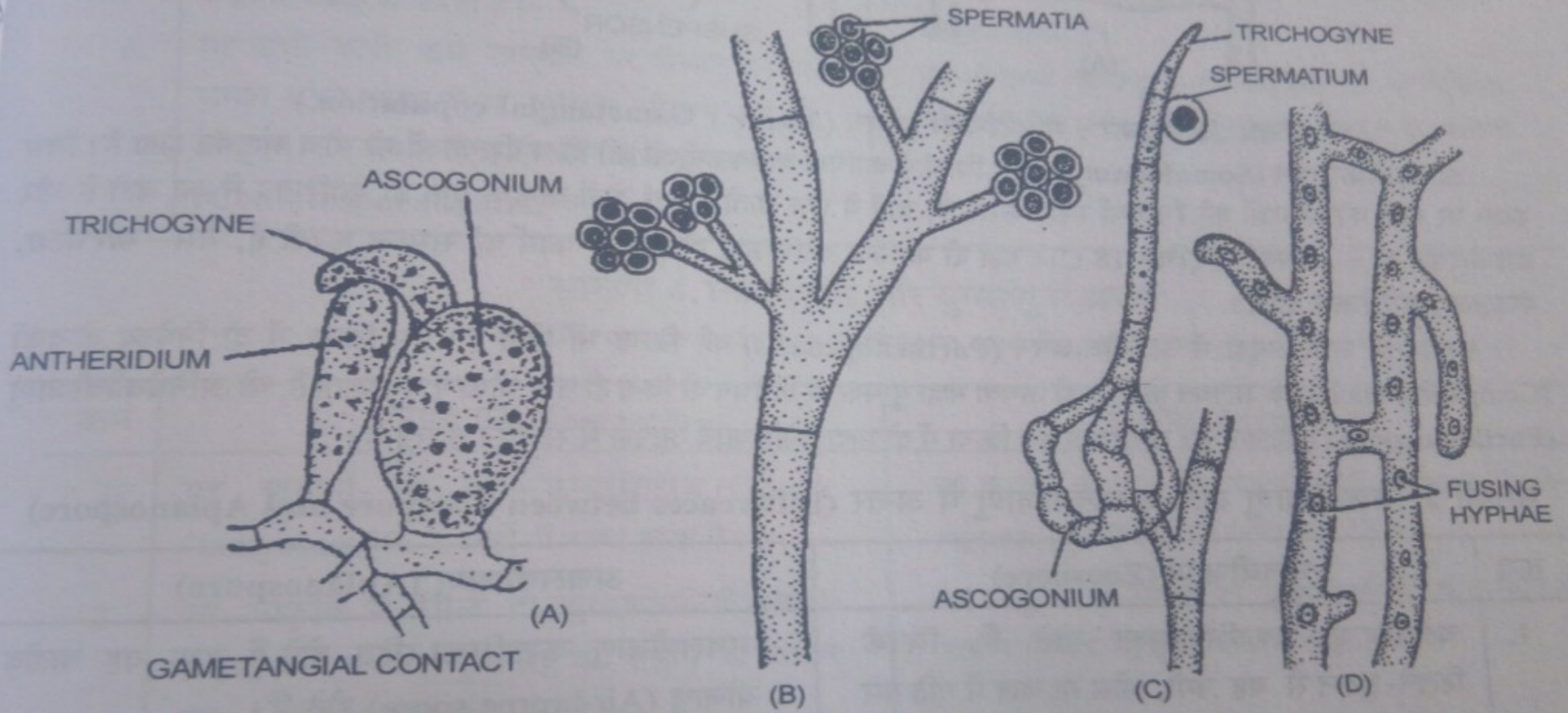


Fig: Sexual Reproduction in Fungi. (A) Gametangial copulation, (B-C-D) Gametic contact, (E-F-G) Spermatization, (H) Gametangial copulation.



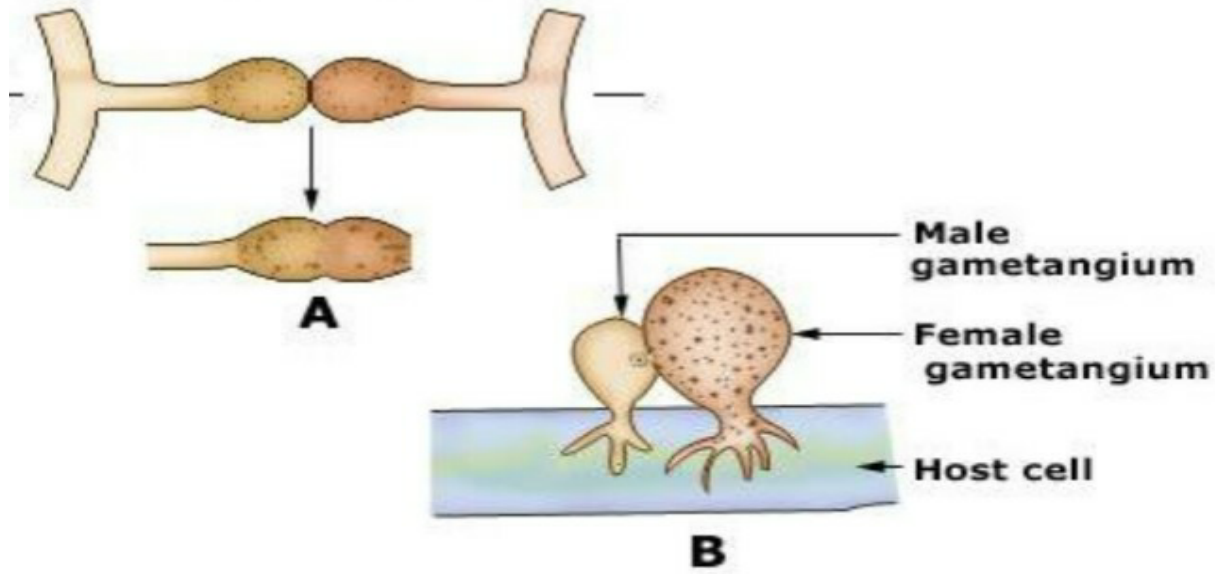
(g) Gametangial copulation - *Rhizopus*

SPERMATIZATION

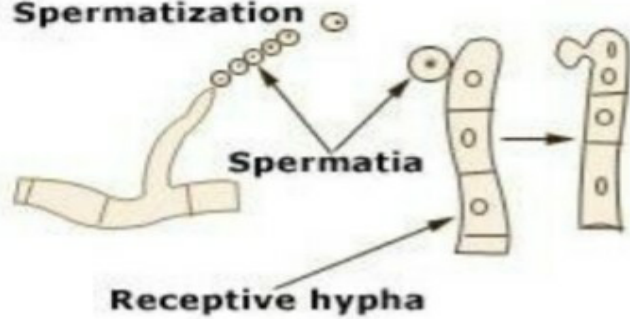


चित्र 18. उच्च कवक में लैंगिक जनन : (A) युग्मकधानीय संयुग्मन, (B-C) अचल पुमुण युग्मन, (D) कायिक युग्मन
 [Sexual reproduction in Higher Fungi : (A) Gametangial contact,
 (B-C) Spermatization, (D) Somatogamy.]

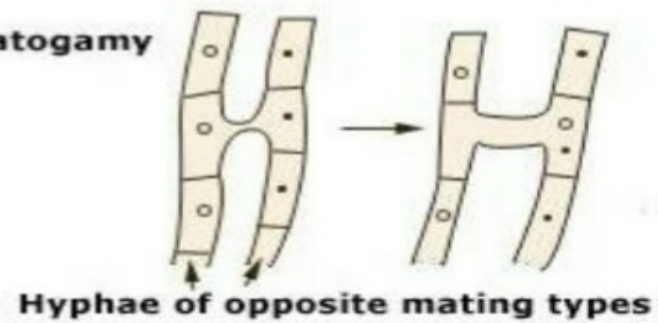
Gemetangial Copulation



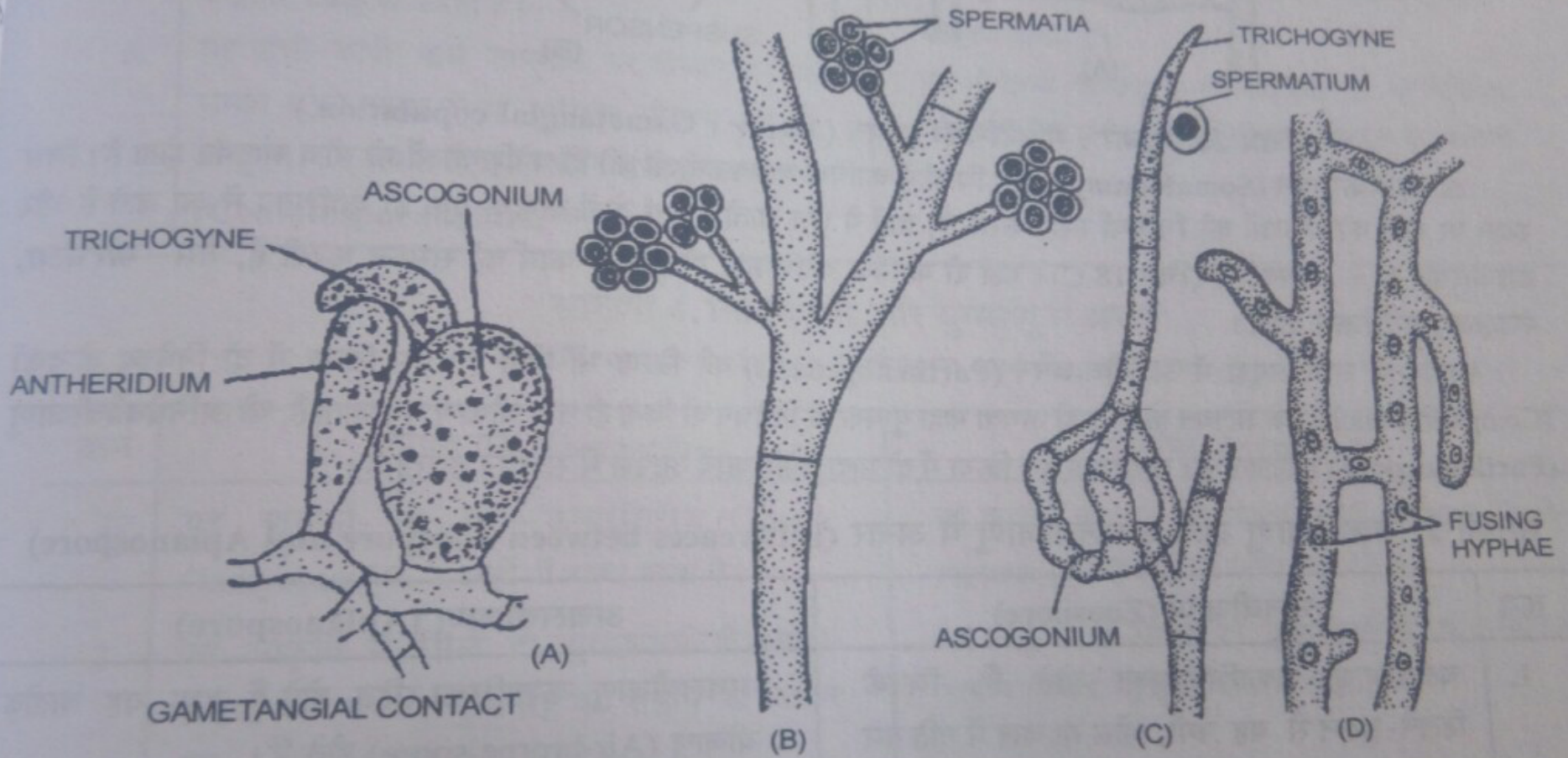
Spermatization



Somatogamy

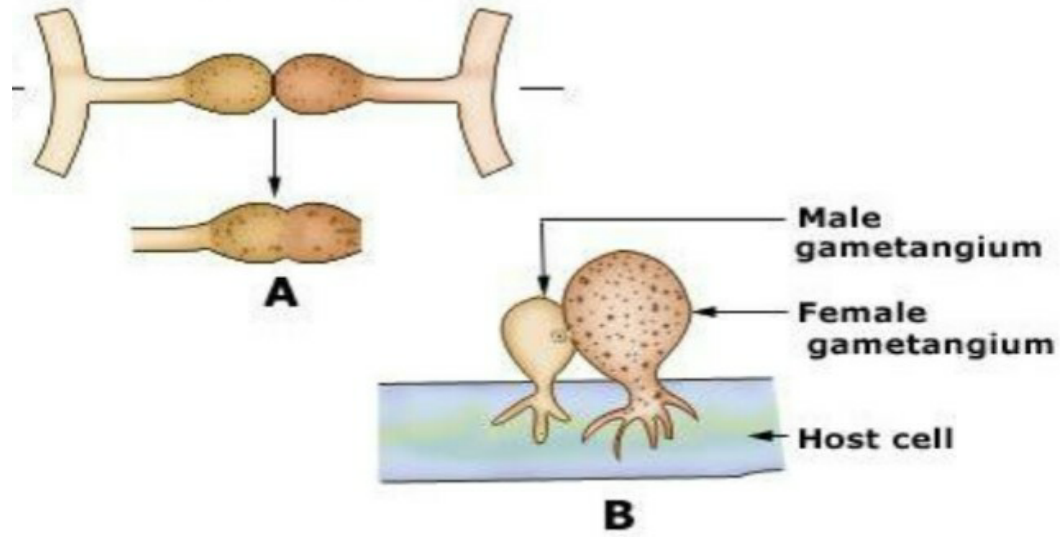


SOMATOGAMY/AUTOGAMY

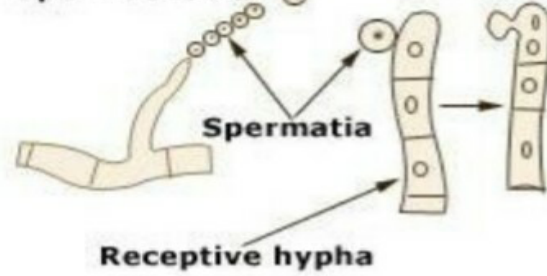


चित्र 18. उच्च कवक में लैंगिक जनन : (A) युग्मकधानीय संयुग्मन, (B-C) अचल पुमुण युग्मन, (D) कायिक युग्मन
 [Sexual reproduction in Higher Fungi : (A) Gametangial contact,
 (B-C) Spermatization, (D) Somatogamy.]

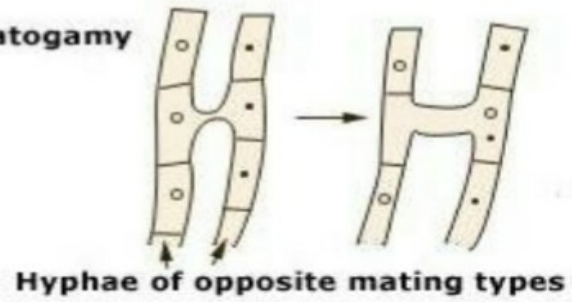
Gemetangial Copulation

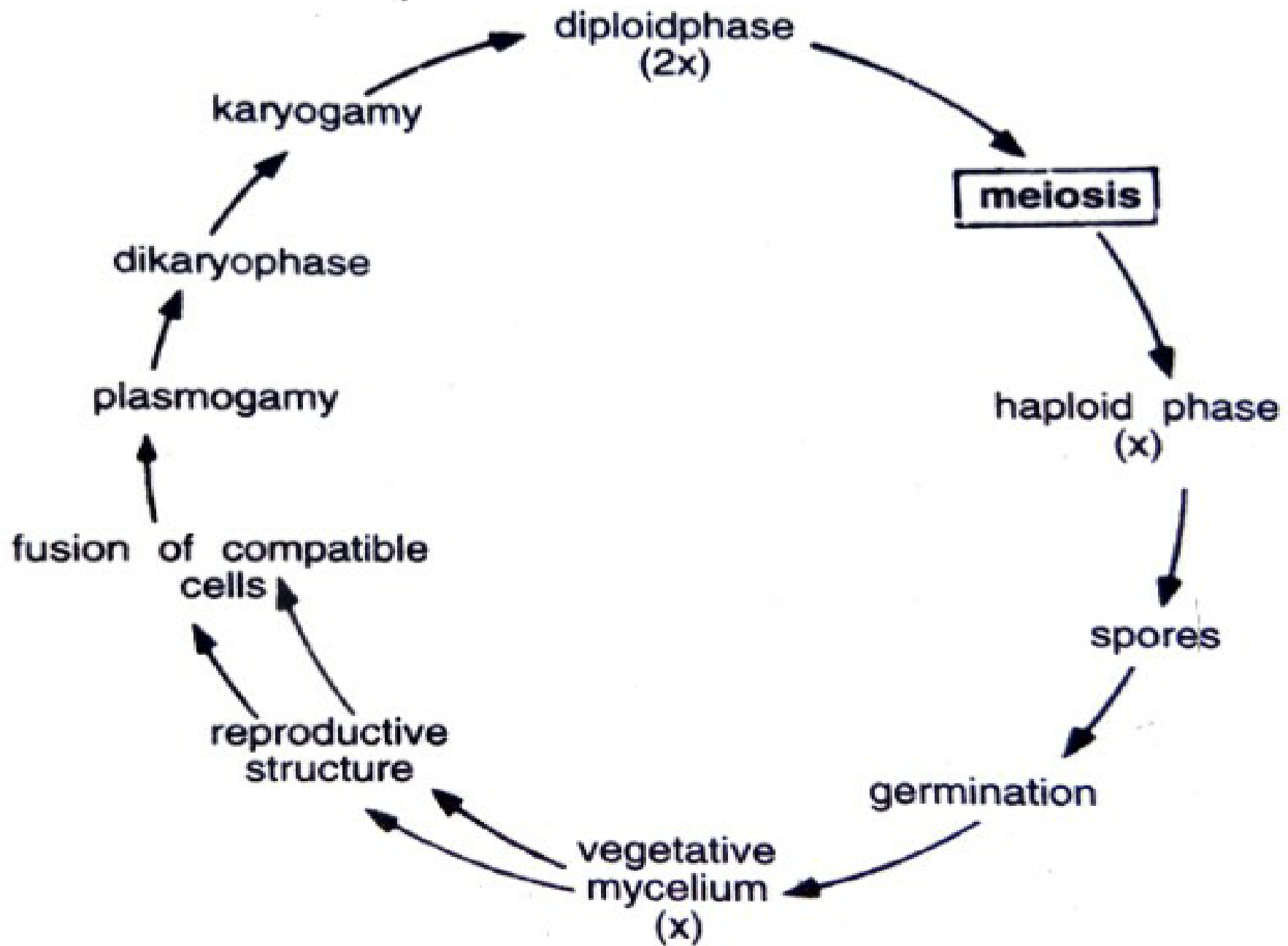


Spermatization



Somatogamy





चित्र 11. कवकों का सामान्य जीवन-चक्र ।

CLASSIFICATION OF FUNGI

(AMODERN CLASSIFICATION)

ACORDING TO AINSWORTH -1973

DIVISION-02- MYXOMYCOTA
EUMYCOTA

SUB-DIVISION- - 05

CLASS - 04 17

DIVISION-01- MYXOMYCOTA

CHARACTER- WITHOUT CELL WALL,
IMPERFECTI STAGE (SEXUAL
REPRODUCTION ABSENT),SLIME MOLD

CLASS – 04

- 1) ACRASIOMYCETES
- 2) HYDROMYXOMYCETES
- 3) MYXOMYCETES
- 4) PLASMIDIOPHOROMYCETES

DIVISION-02- EUMYCOTA

CHARACTER- Cell wall, perfecti stage (sexual reproduction).

SUB-DIVISION- 05

Sub-division 01. Mastigomycotina

Sub-division 02. Zygomycotina

Sub-division 03. Ascomycotina

Sub-division 04. Basidiomycotina

Sub-division 05. Deuteromycetes

Sub-division 01. Mastigomycotina

Character- motile spore.Oospore formation

Class- 03

Class-01. Chytridiomycetes

Class-02.Hyphochytridiomycetes

Class-03.Oomycetes

Sub-division 02. Zygomycotina

Character- non motile spore,zygospore formation.

Class-02

Class-01.Zygomycetes

Class-02.Tricomycetes

Sub-division 03. Ascomycotina

Character- non-motile spore, Ascospore, ascocarp.

Class-06

Class-01. Hemiascomycetes

Class-02. Loculomycetes

Class-03. Plectomycetes

Class-04. Le Boulbeniomycetes

Class-05. Pyrenomycetes

Class-06. Discomycetes

Sub-division 04. Basidiomycotina

Character-motile basidiospore formation

Class- 03

Class-01.Teliomycetes

Class-02. Hymenomycetes

Class-03. Gastromycetes

Sub-division 05. Deuteromycetes

Character- imperfecti fungi ,sexual reproduction absent.

Class-03

1. Blastomycetes
2. Hyphomycetes
3. Coelomycetes

saprolegnia

Aquatic mold, cotton mold

Classification –

Division– eumycota

Class- oomycetes

Order -saprolegnials

Family- saprolegniaceae

Genus-saprolegina

A)Vegetative character

Habit and habitat

Saprophytic, water mold,

Parasitic(fish,insect)

Disease –salimon disease

Species:-

1. s.dioca,
2. salimon monoica,
3. s.mixa

Fungal body

Thaloidal, hyphae mycelium Filamentous,
branched (rhizoidal, erect)

Gametophyte achlorophytic, coenocytic,
white / brown colored .

Cellular character

Eukaryotic cell

Cell wall-chitin(n-acetylene glucosamine)

Plasma membrane(loamosome)-

Cytoplasm-

Nucleus, Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- glycogen.

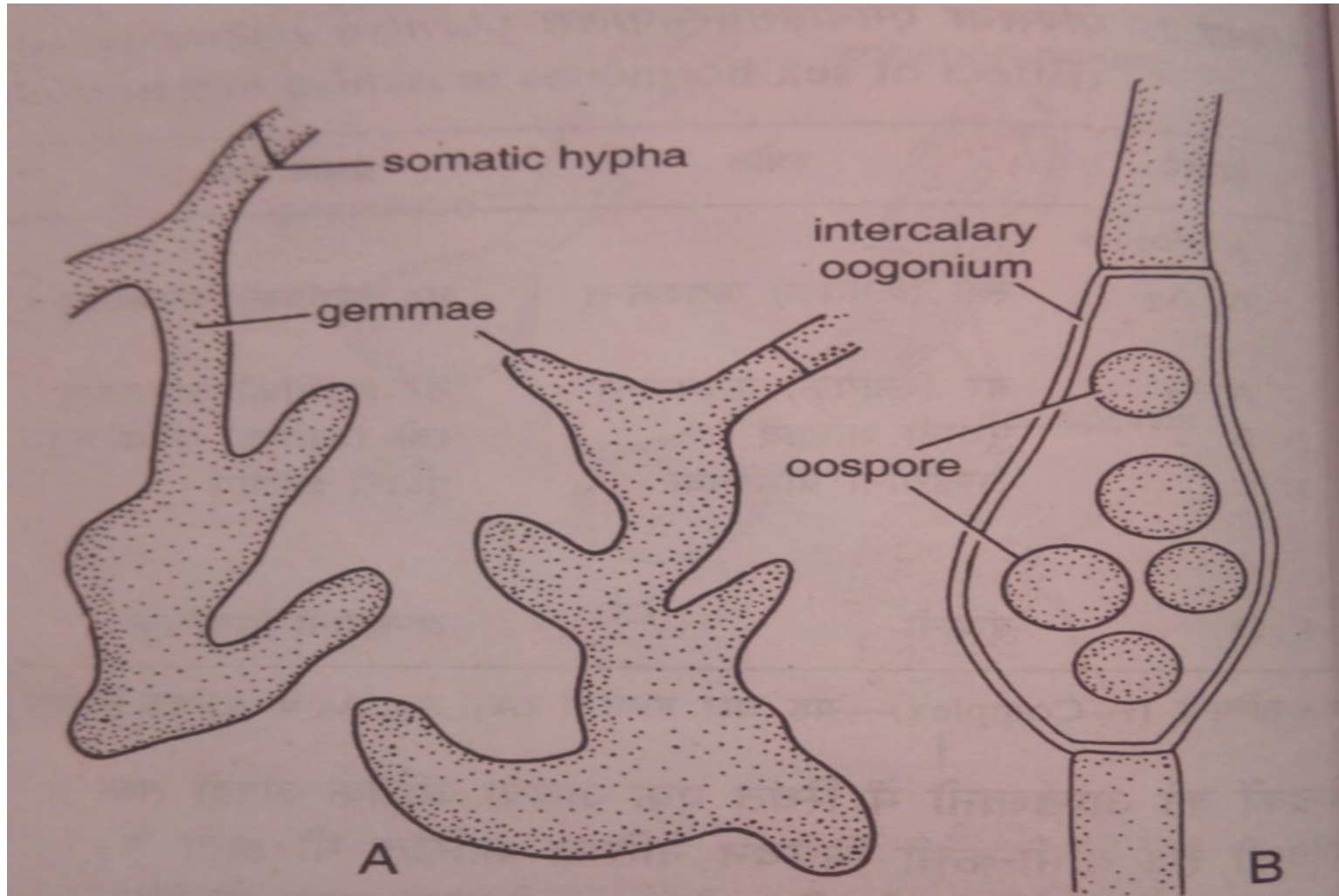
REPRODUCTION CHARACTER IN FUNGI

Generally three type reproduction show in fungi

1. Vegetative reproduction
2. Asexual reproduction
3. Sexual reproduction

VEGITATIVE REPRODUCTION

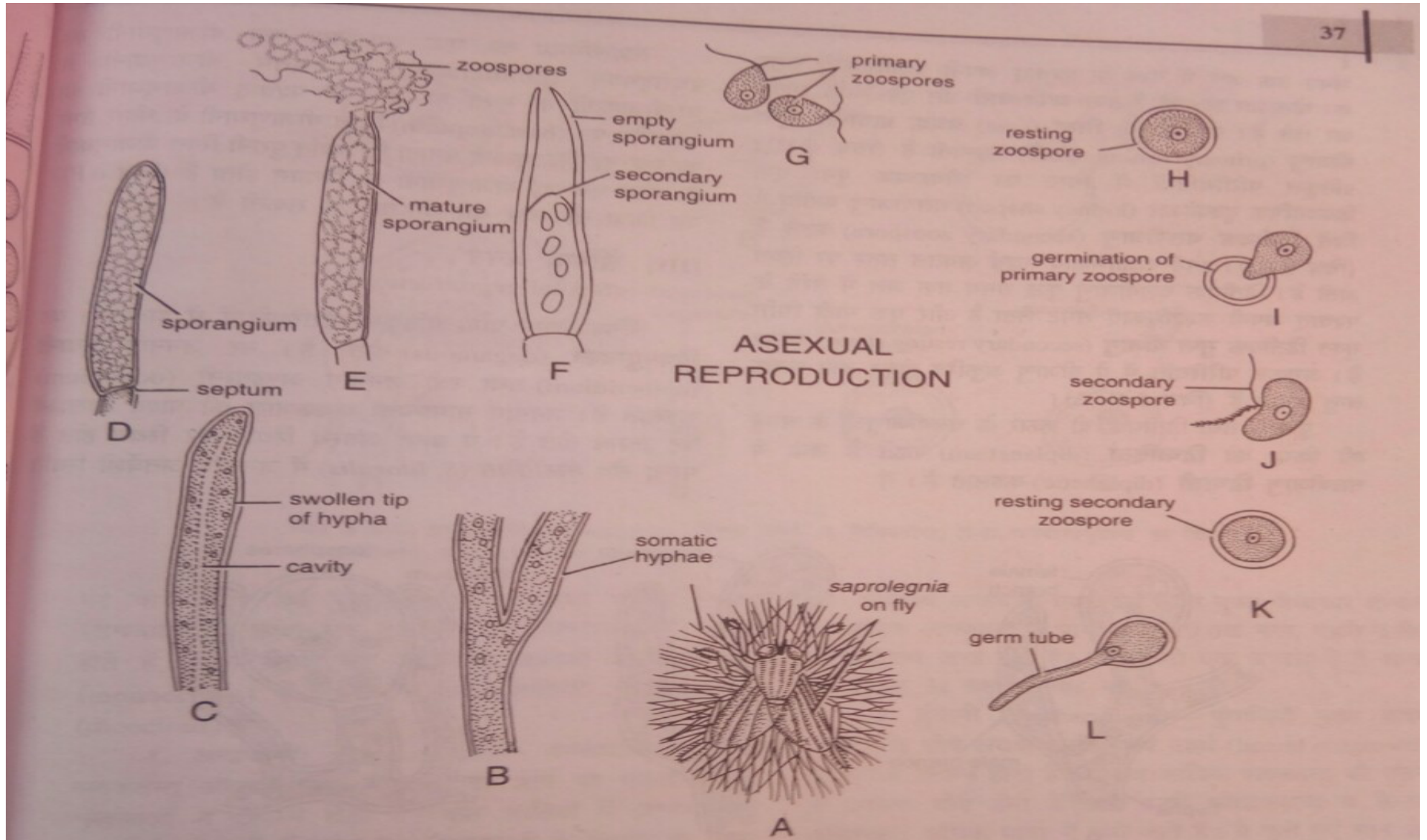
1. BY FRAGMENTATION



चित्र 5A-B. सैप्रोलेग्निया (*Saprolegnia*) : A. जेमी (gemmae); B. अन्तर्वेशी अण्डधानी (oogonium) ।

ASEXUAL REPRODUCTION

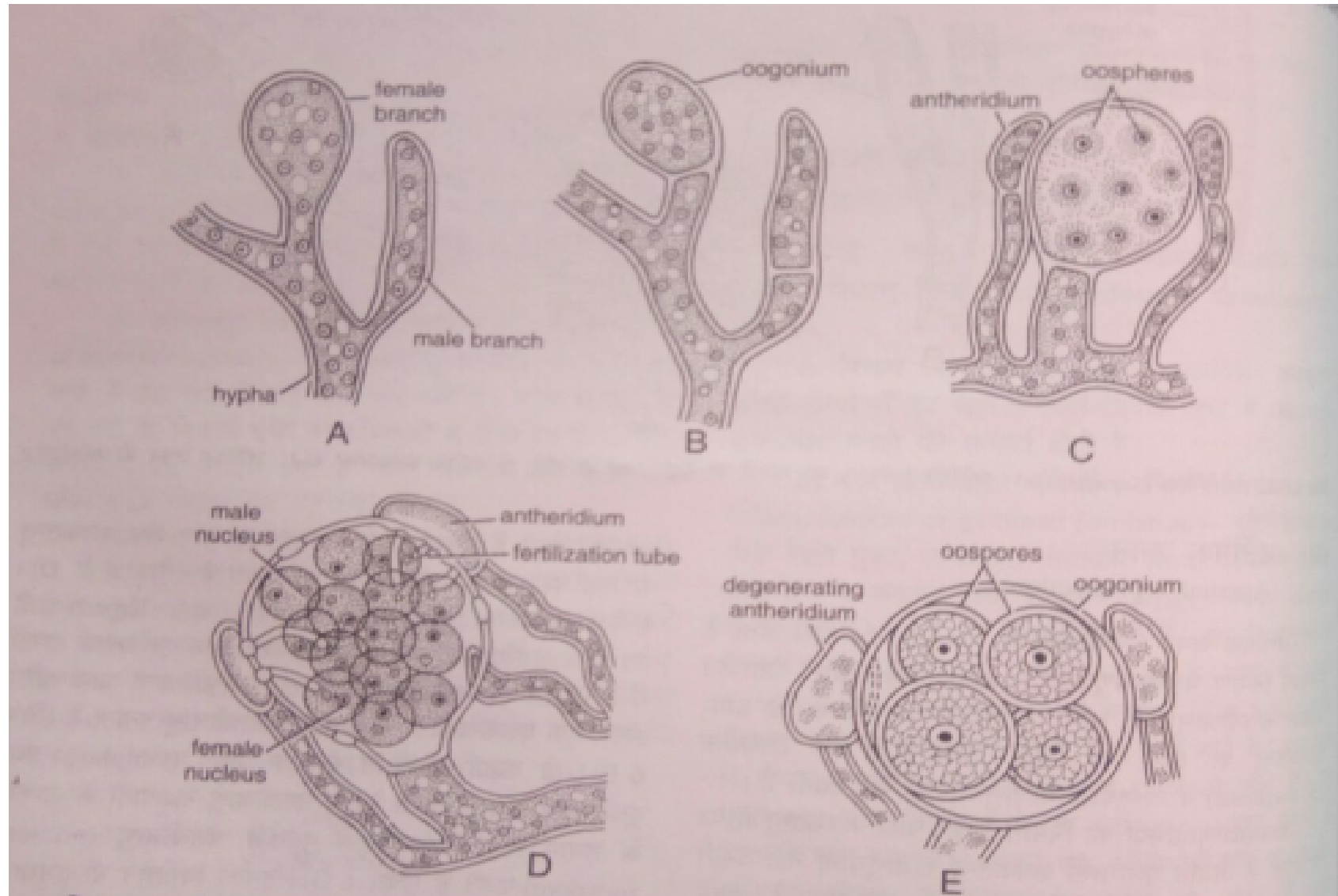
1. By zoospore



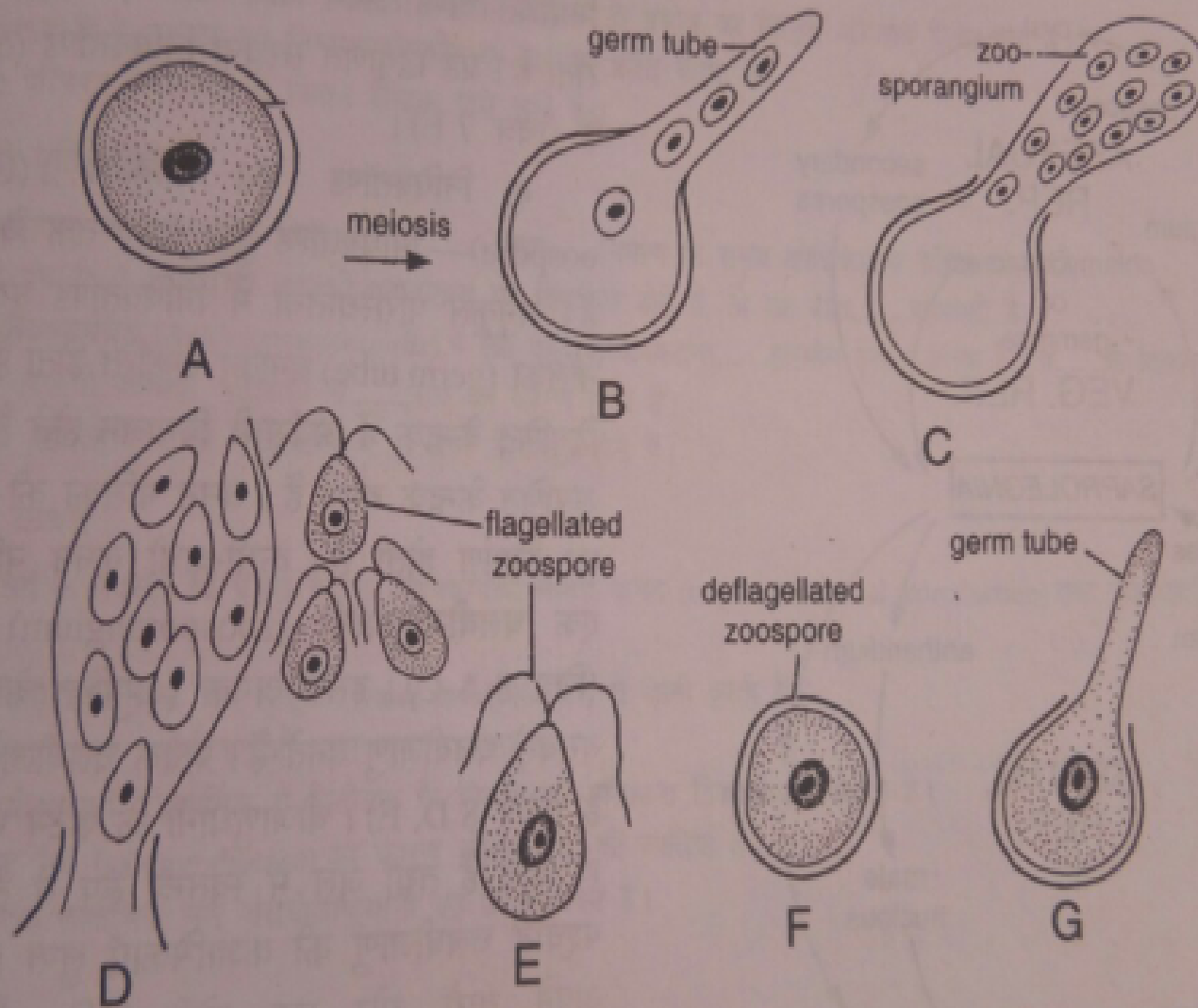
चित्र 6A-L. सैप्रोलेग्निया (*Saprolegnia*) : अलैंगिक जनन: A. मृत मक्खड़ी पर सैप्रोलेग्निया की वृद्धि, B. कायिक कवकतन्तु, C-L. अलैंगिक जनन की प्रावस्थाएँ।

SEXUAL REPRODUCTION

1. Gametangial contact



चित्र 7 A-E. *सेप्रोलेग्निया* (*Saprolegnia*) : लैंगिक जनन की प्रारंभिक अवस्थाएँ, A-C. पुंघांती एवं अण्डघांती का विकास, D. निषेचन, E. निषिक्लीक।



चित्र 8 A-G. *सेप्रोलेग्निया* (*Saprolegnia*) : लैंगिक जनन; A. निषिकर्तोण्ड, B-D. चलबीजाणुधानी का विकास, E. चलबीजाणु, F-G. चलबीजाणु का अंकुरण।

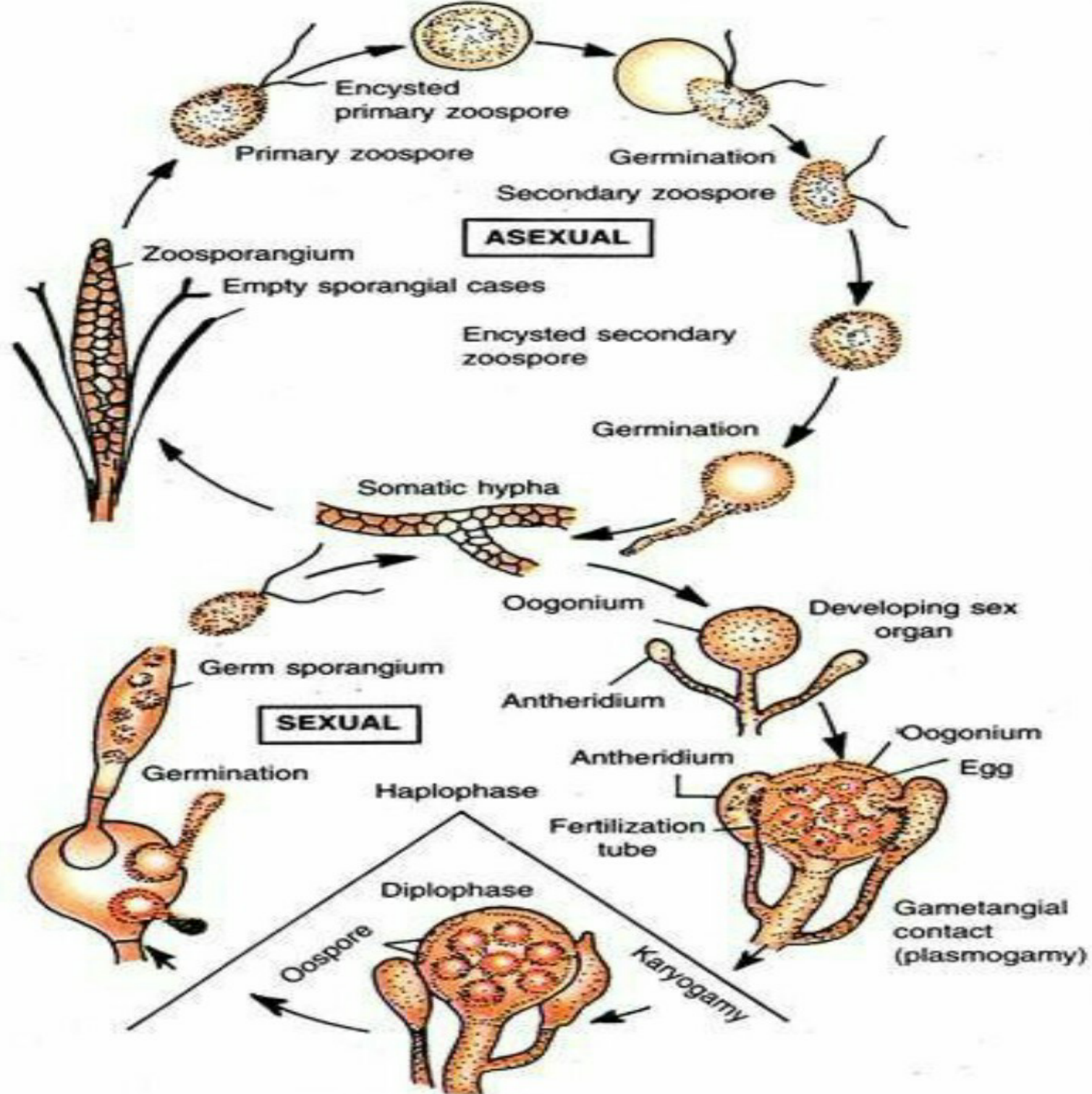
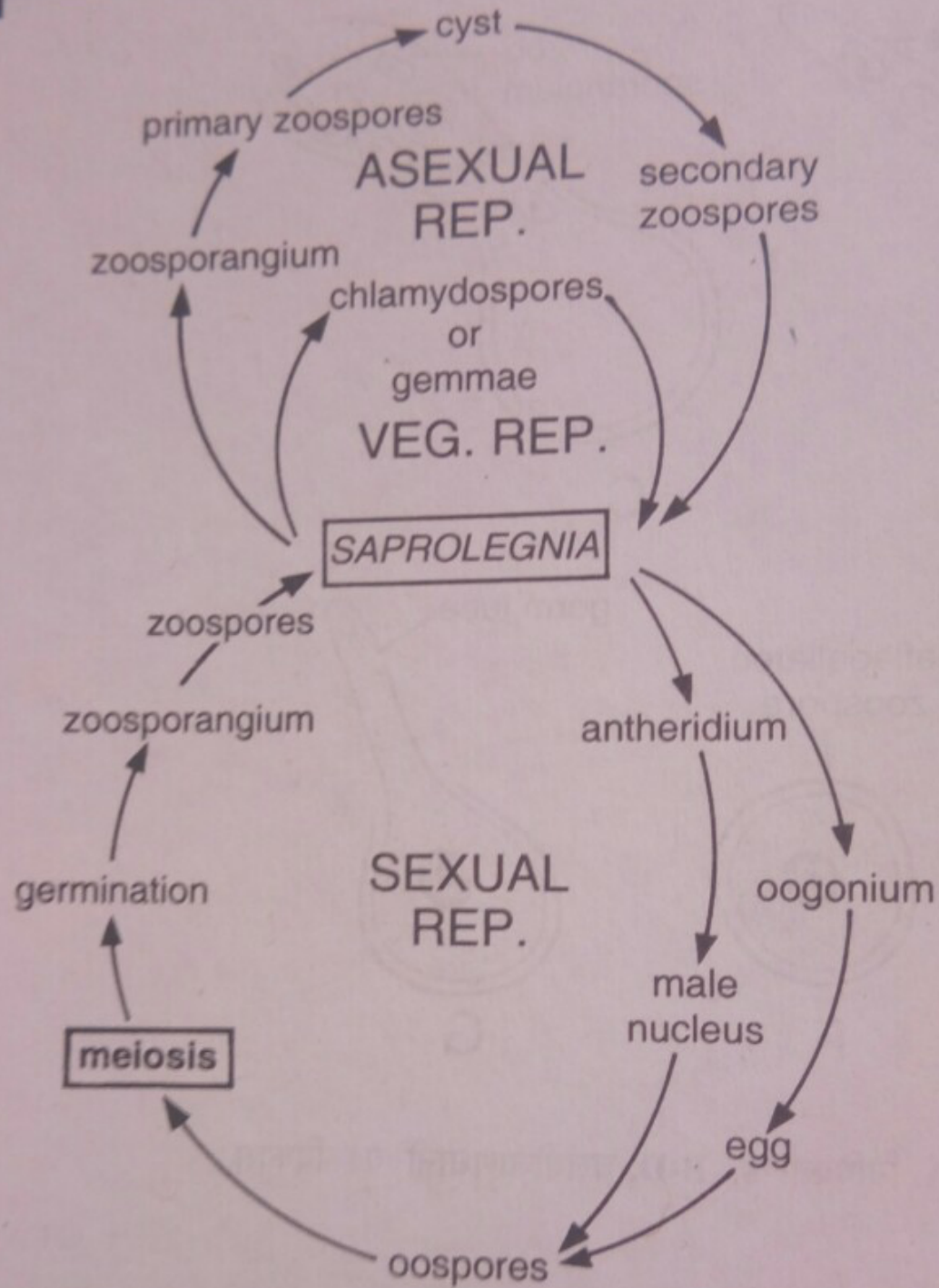


Fig. 6.9 Pictorial life cycle of *Saprolegnia*.



चित्र 9. सैप्रोलेग्निया (*Saprolegnia*) : जीवन-चक्र ।

Albugo(cystopus)

Classification

Division-eumycota

class -phycomycetes

Order-perenosporales

family-albuginacea

genus-albugo/cystopus

Vegetative character

Habit and habitat

Parasitic -cruciferea ,compositea,capparidaceae,
convolv-ulaceae,amarenthacea

Disease –white rust disease(white colour spot)

Identify spp.-25

Indian spp.10

1. a.bliti
2. a.candida
3. a.evoluuli
4. a.ipomaea panduraneae
5. a.tragopogonsis
6. a.platensis
7. a.molluginis
8. a.protulaceae
9. a. mysorensis



Fig. 6.48. Diseased plant of *Capsella* bearing white pustules of *Albugo candida*. The stem is distorted as a result of infection.



Fig. 6.49. Infected Radish leaf showing pustules of white rust (*Albugo candida*).

Fungal body

Thaloidal, hyphae mycelium Filamentous,
branched

Gametophyte achlorophytic, coenocytic,
haustoria.

Intercellular.

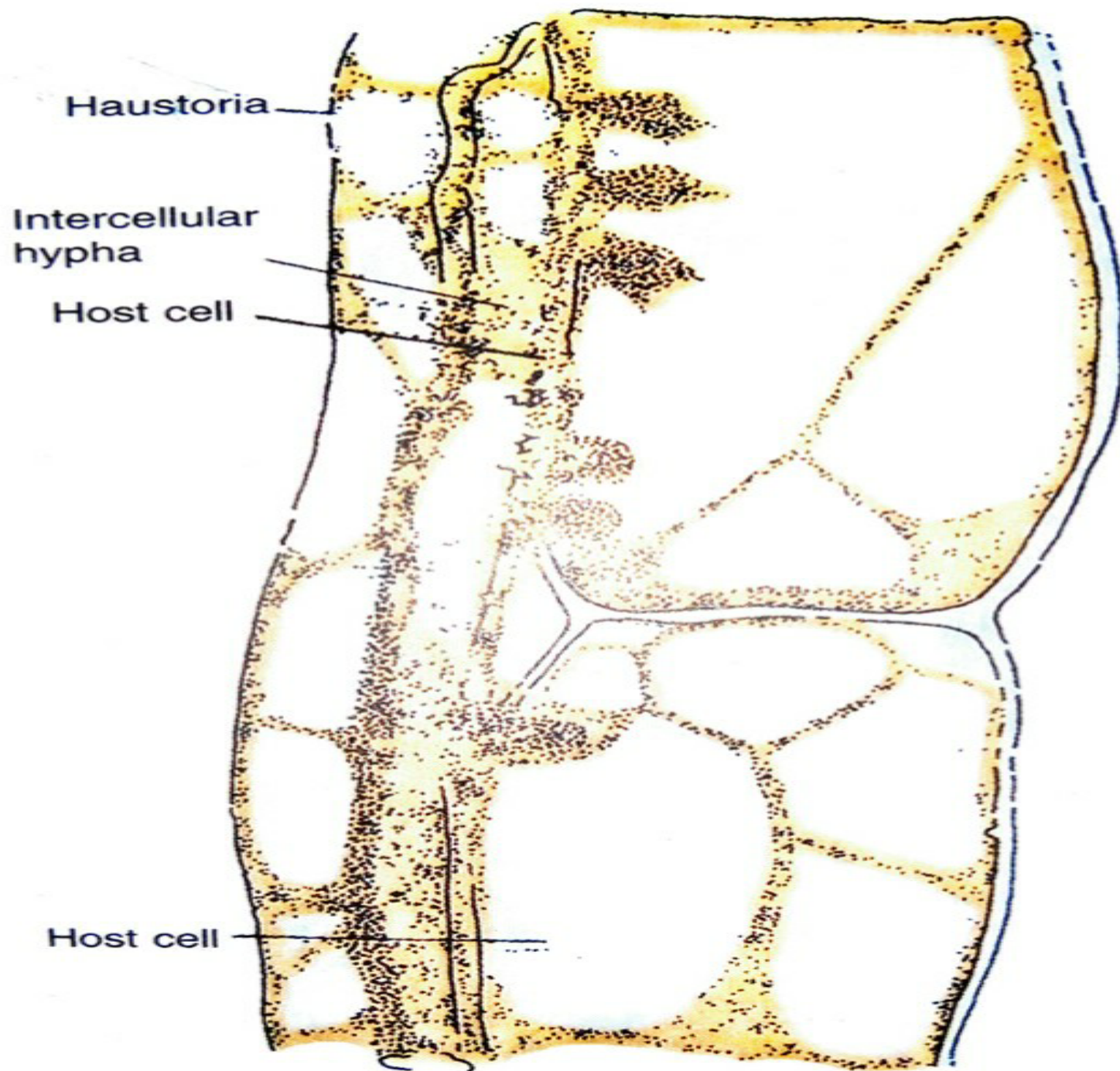


Fig. 6.50. *Albugo candida*. Section through the host stem showing a portion of the mycelium bearing haustoria. (Diagrammatic).

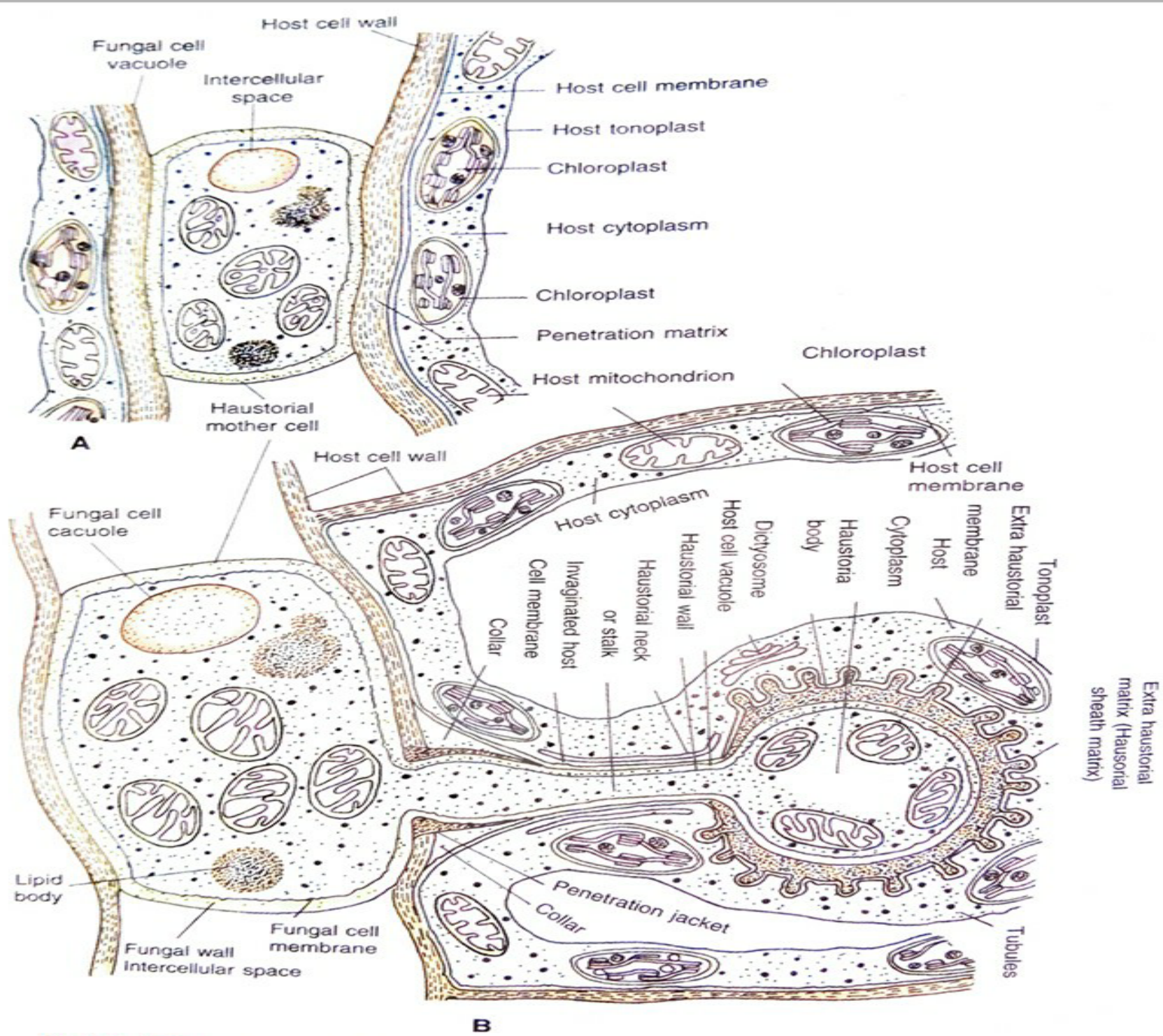


Fig. 6.51. (A-B). *Albugo candida*. Diagrammatic representation of ultrastructure of the haustorial apparatus in section passing through the host mesophyll cell (Based on Coffey)

Cellular character

Eukaryotic cell

Cell wall-chitin(n-acetylene glucosamine)

Plasma membrane(loamosome)-

Cytoplasm-

Nucleus, Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- glycogen oil droplets.

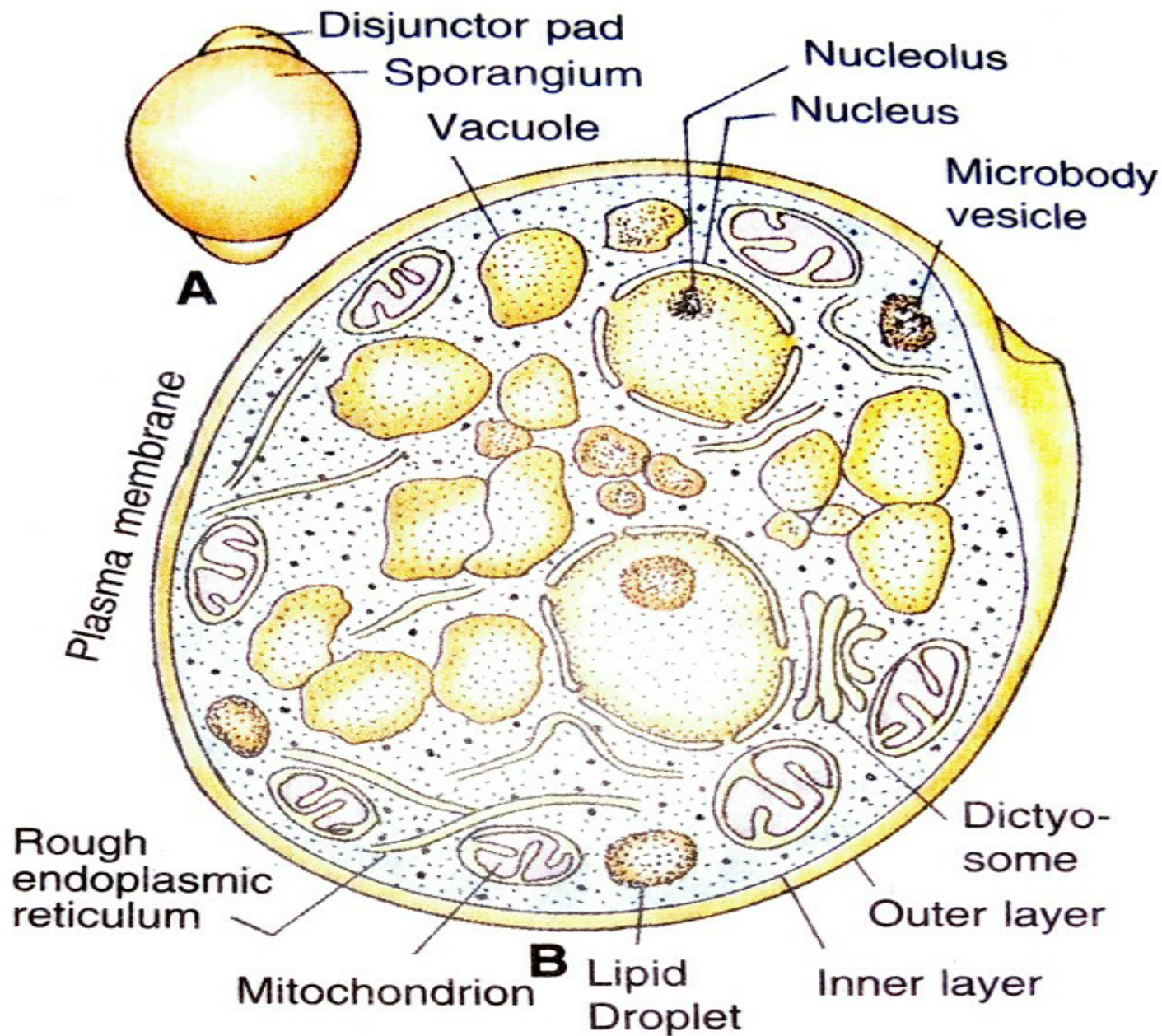


Fig. 6.55 (A, B). *Albugo candida*. A, Sporangium with remains of the disjunctors at both ends; B, ultrastructure of sporangium (Based on Khan).

Reproductive character

Asexual reproduction

Zoospore, conidia, conidiosporangium

Sexual reproduction

Oogamous type

Asexual reproduction

By conidia

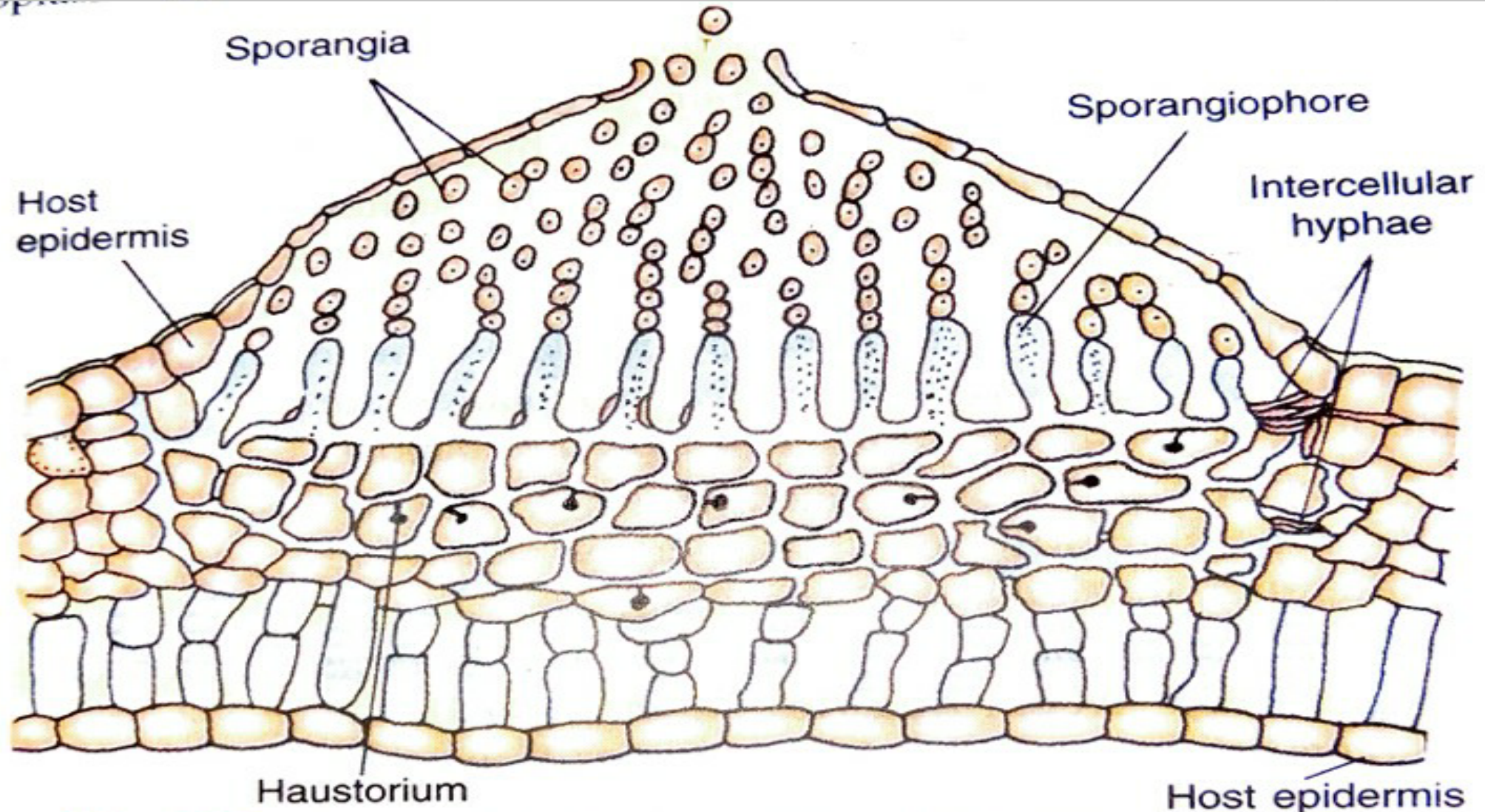


Fig. 6.52. *Albugo candida*. A section of host leaf passing through the sporangial sorus.

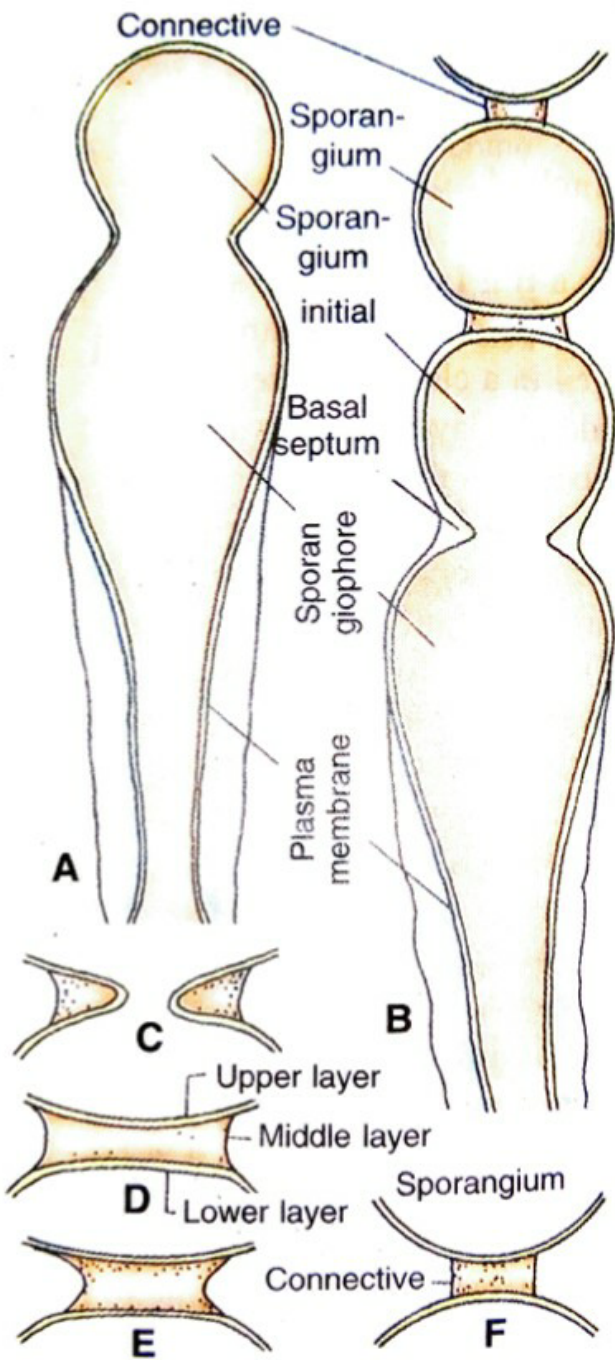


Fig. 6.54 (A-F). *Albugo candida* showing blastic mode of development of sporangia (After Khan)

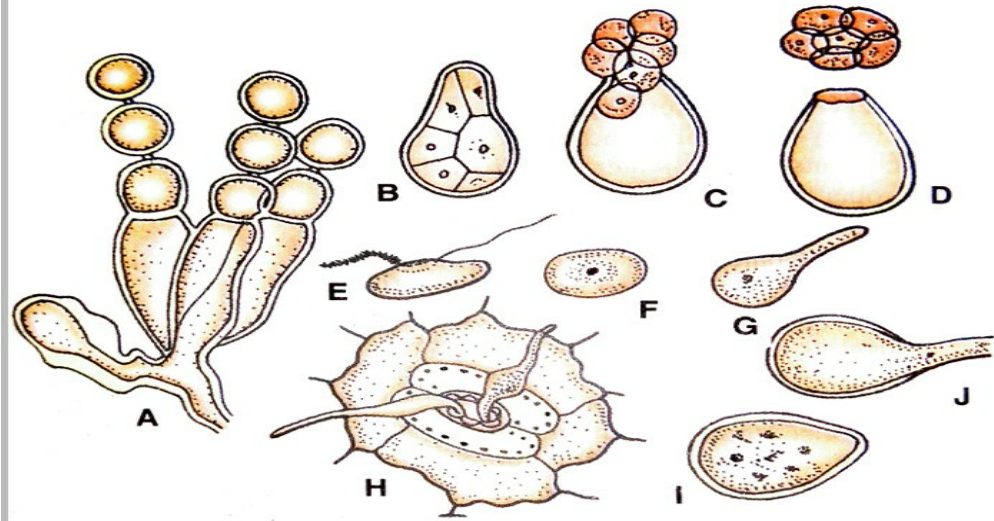


Fig. 6.56 (A-J). *Albugo candida*. A, cluster of sporangiophores bearing sporangia in chains; B-D, differentiation and liberation of zoospores; E, liberated zoospore; F, encysted zoospore; G, germination of cyst to form a germ tube; H, infection through a stoma; I-J, direct germination of sporangium. (After De Bary)

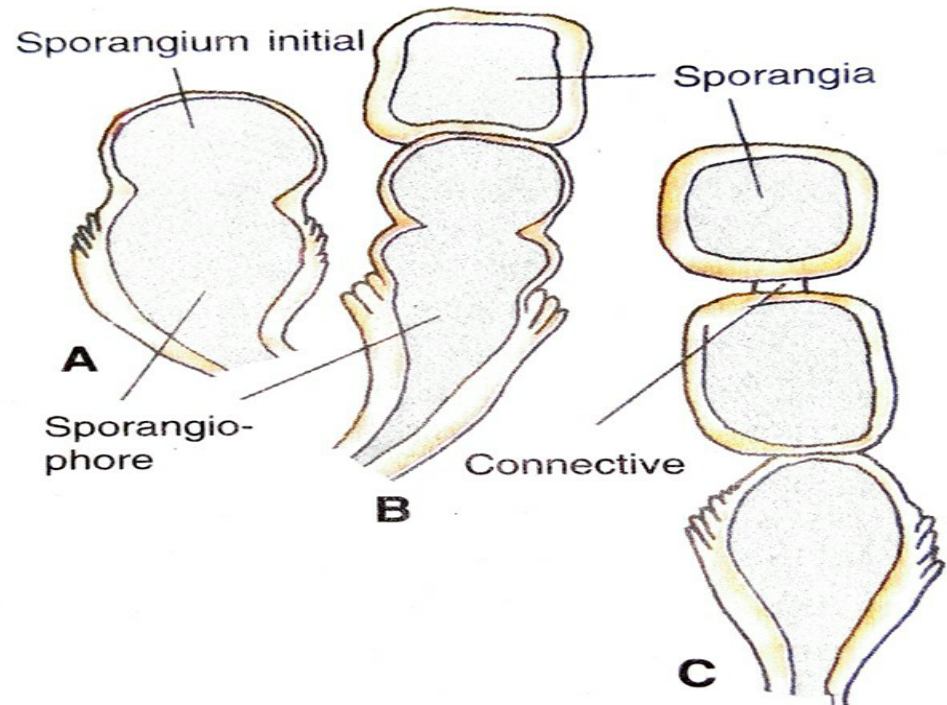


Fig. 6.53 (A-C). *Albugo ipomeae-pandurantae* showing stages in percurrent proliferation of sporangia (After Hughes)

Sexual reproduction

Oogamous type

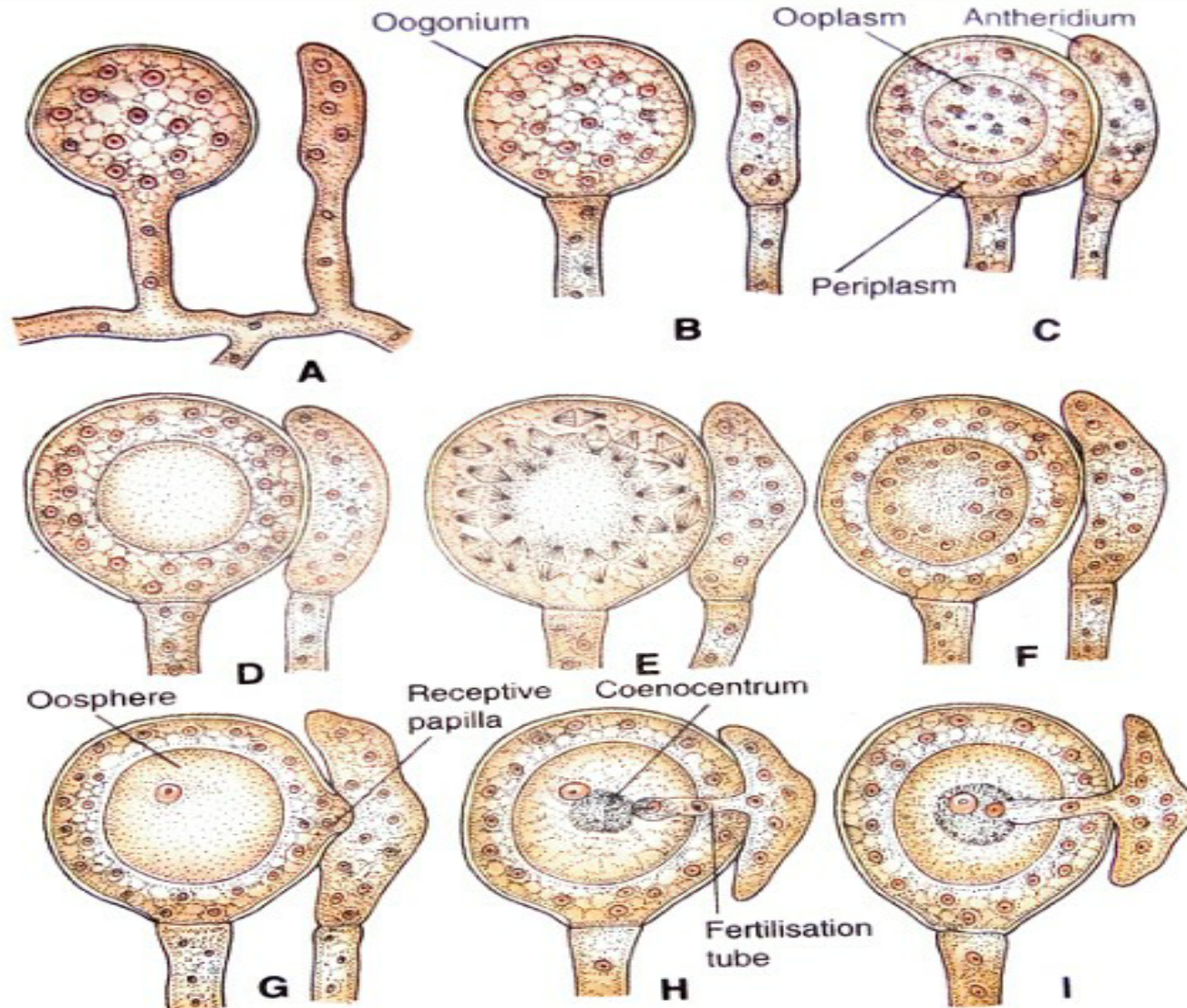


Fig. 6.57 (A-I). *Albugo candida*. Stages in the development of sex organs and fertilisation. Explanation in the text.

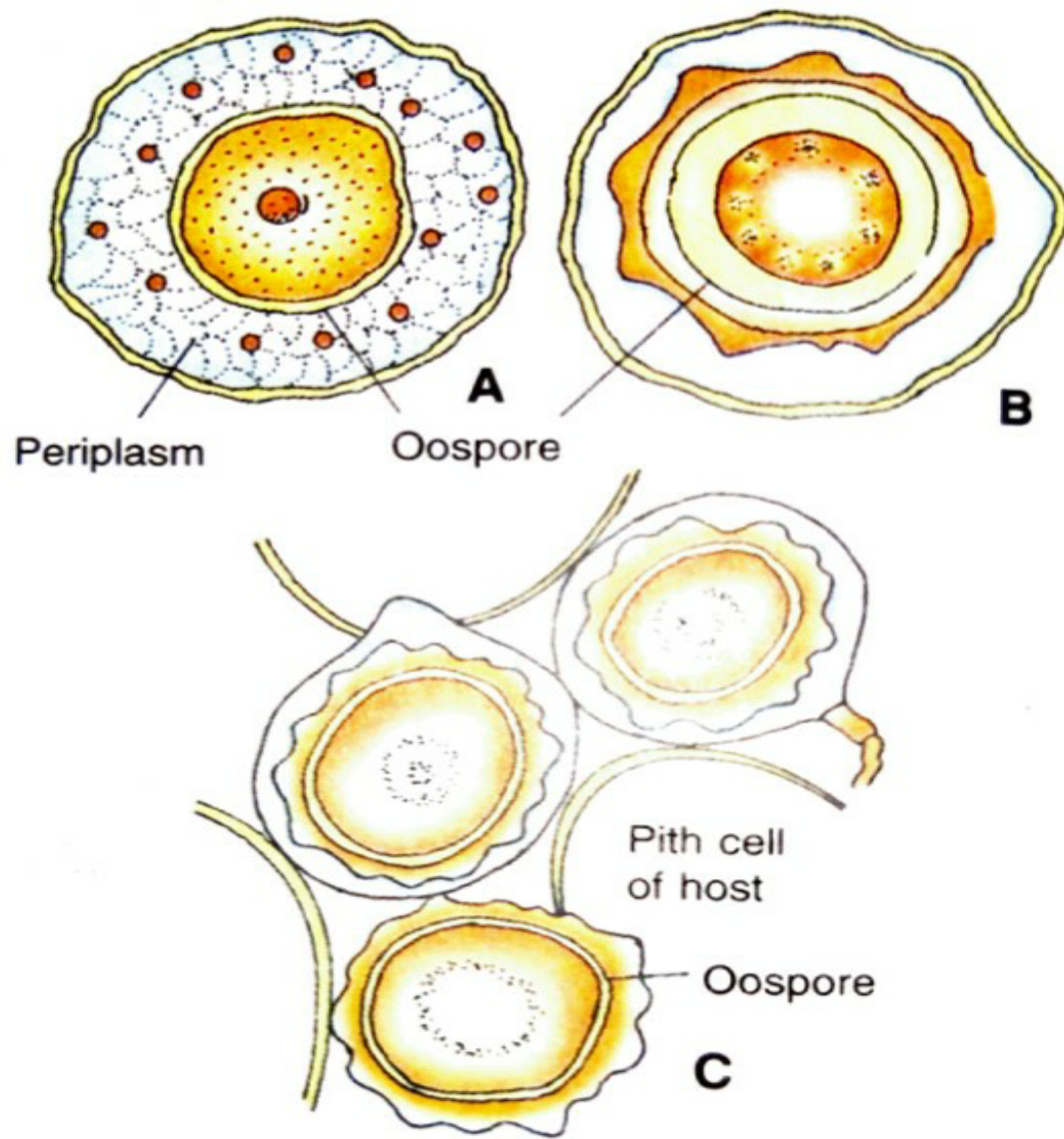


Fig. 6.58 (A-C). *Albugo candida*. Showing structure of oospore as seen under light microscope.

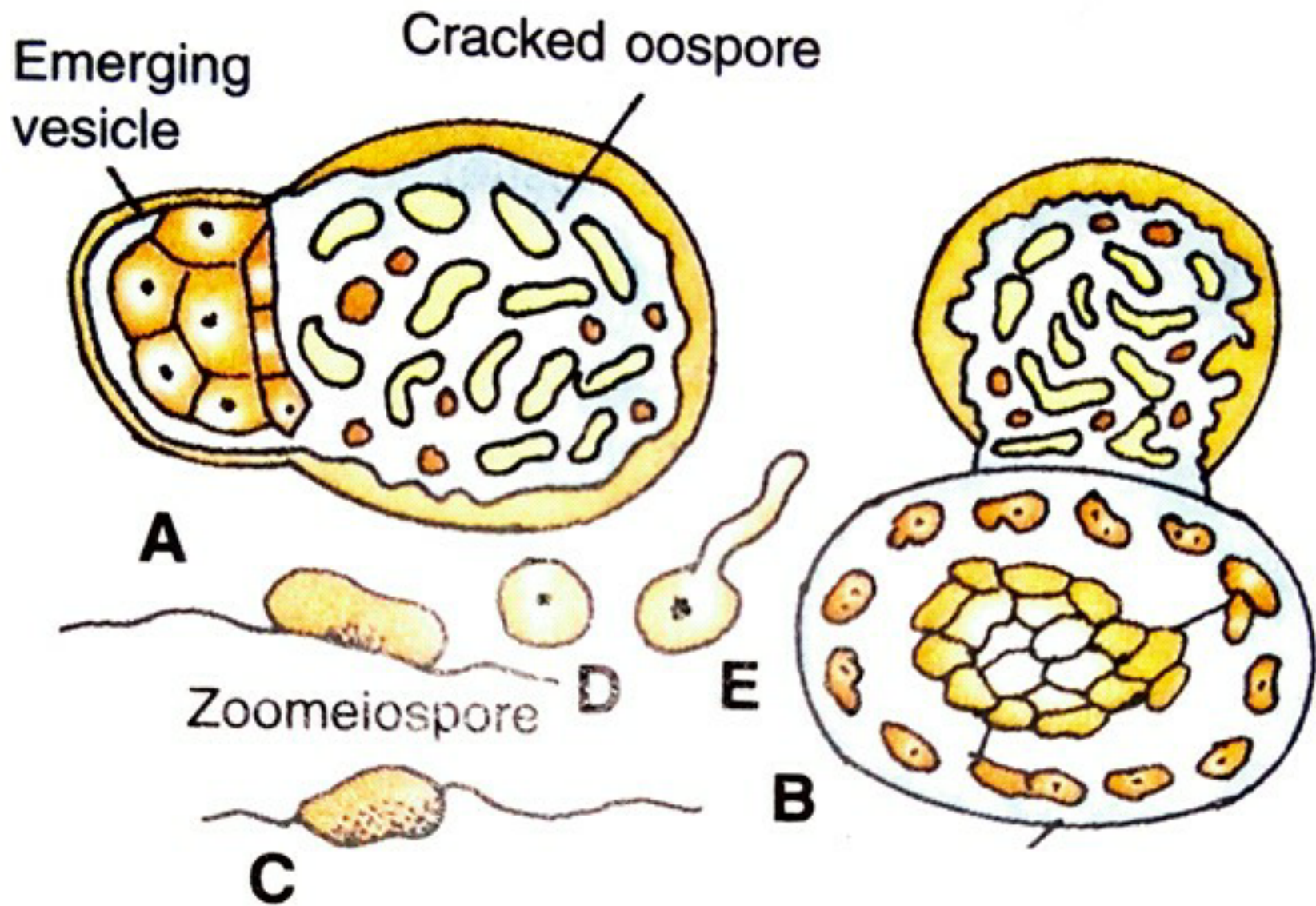


Fig. 6.59 (A-E). *Albugo candida*. A-B, Germination of Oospore; C, liberated zoospore; D-E, germination of zoospore. (After De Bary)

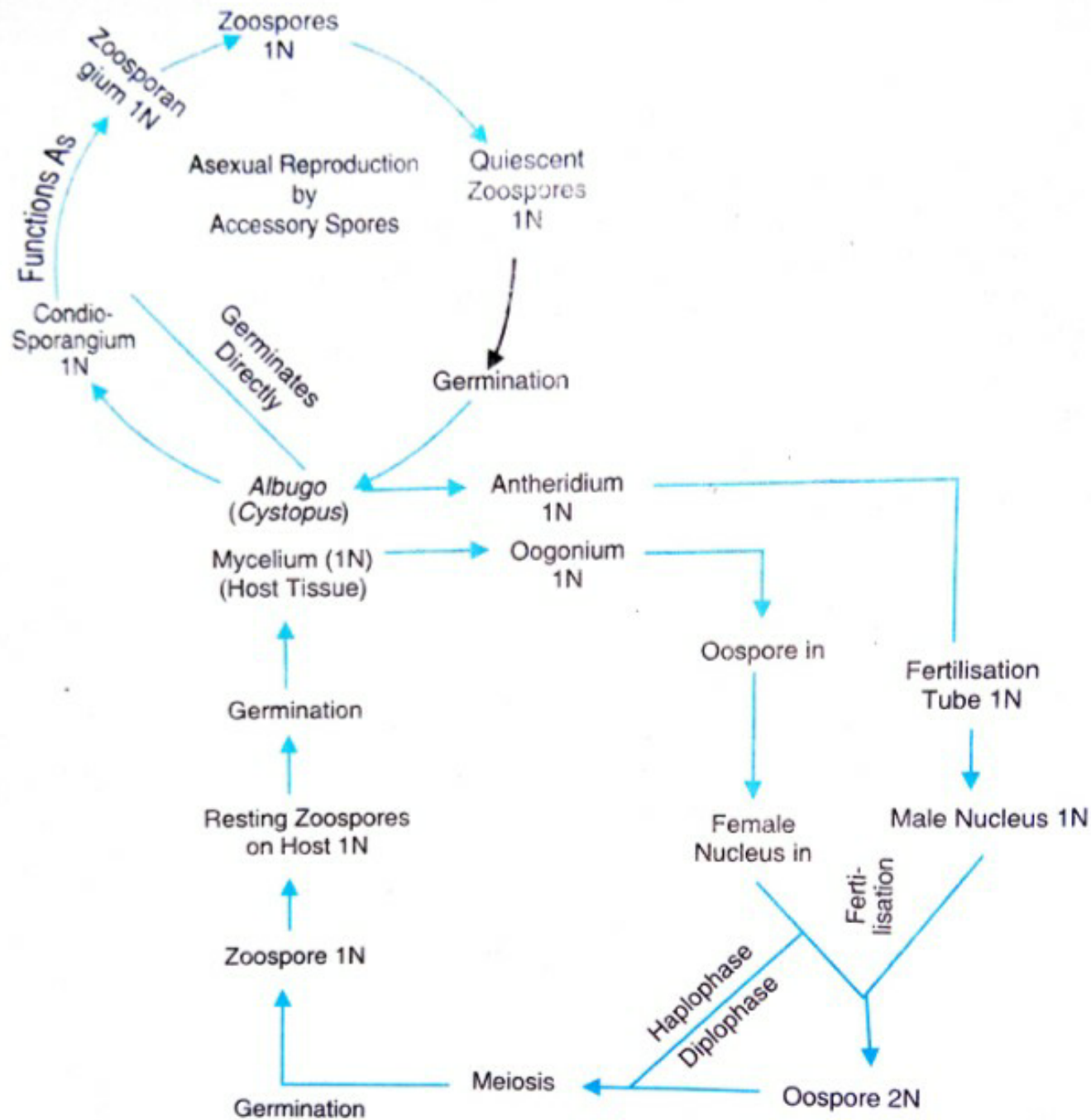


Fig. 6.60A. Graphic representation of life cycle of *Albugo (Cystopus)* with zygotic meiosis.

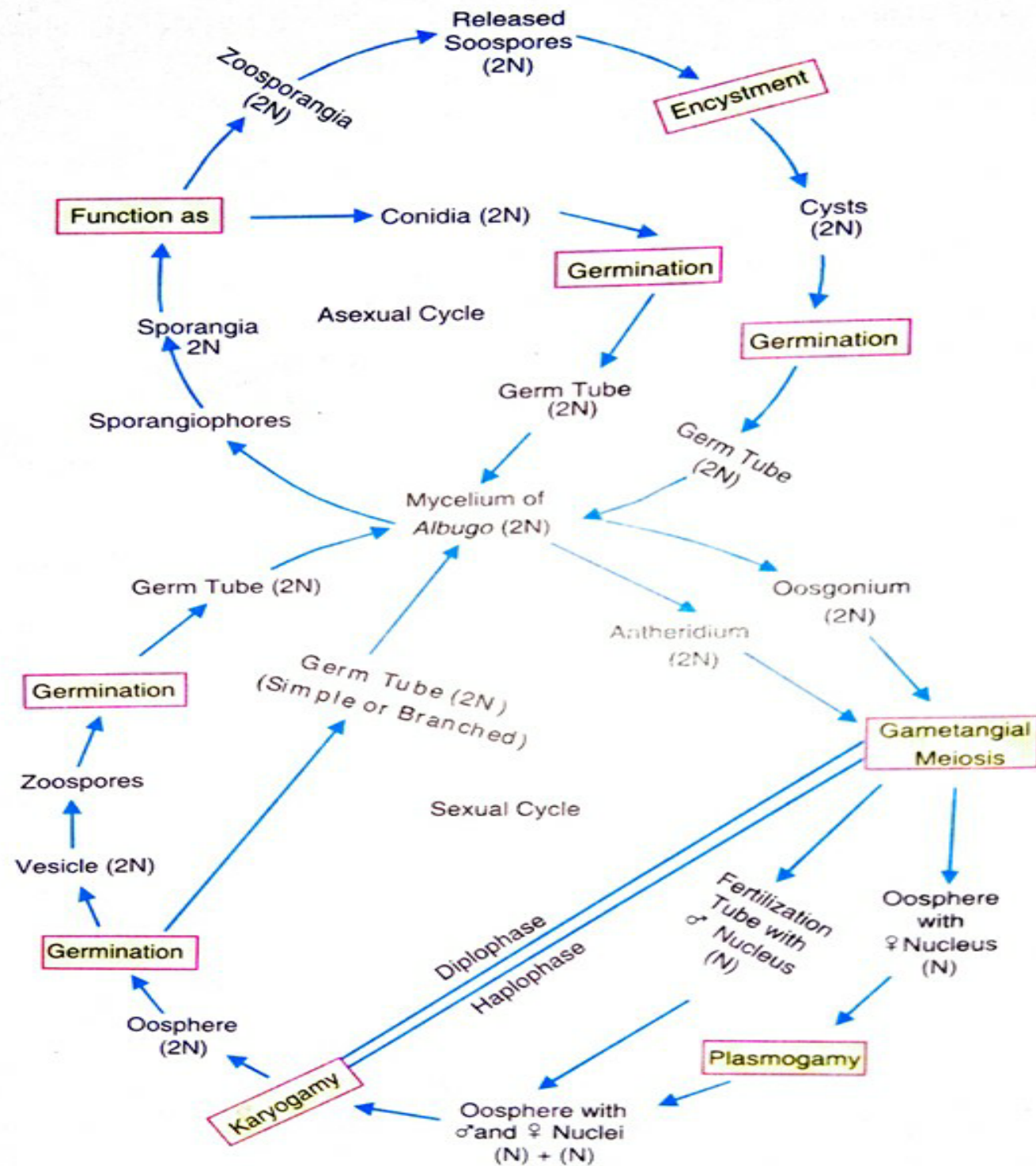


Fig. 6.60B. Graphic representation of the life cycle of *Albugo* (*Cystopus*) with gametangial meiosis.

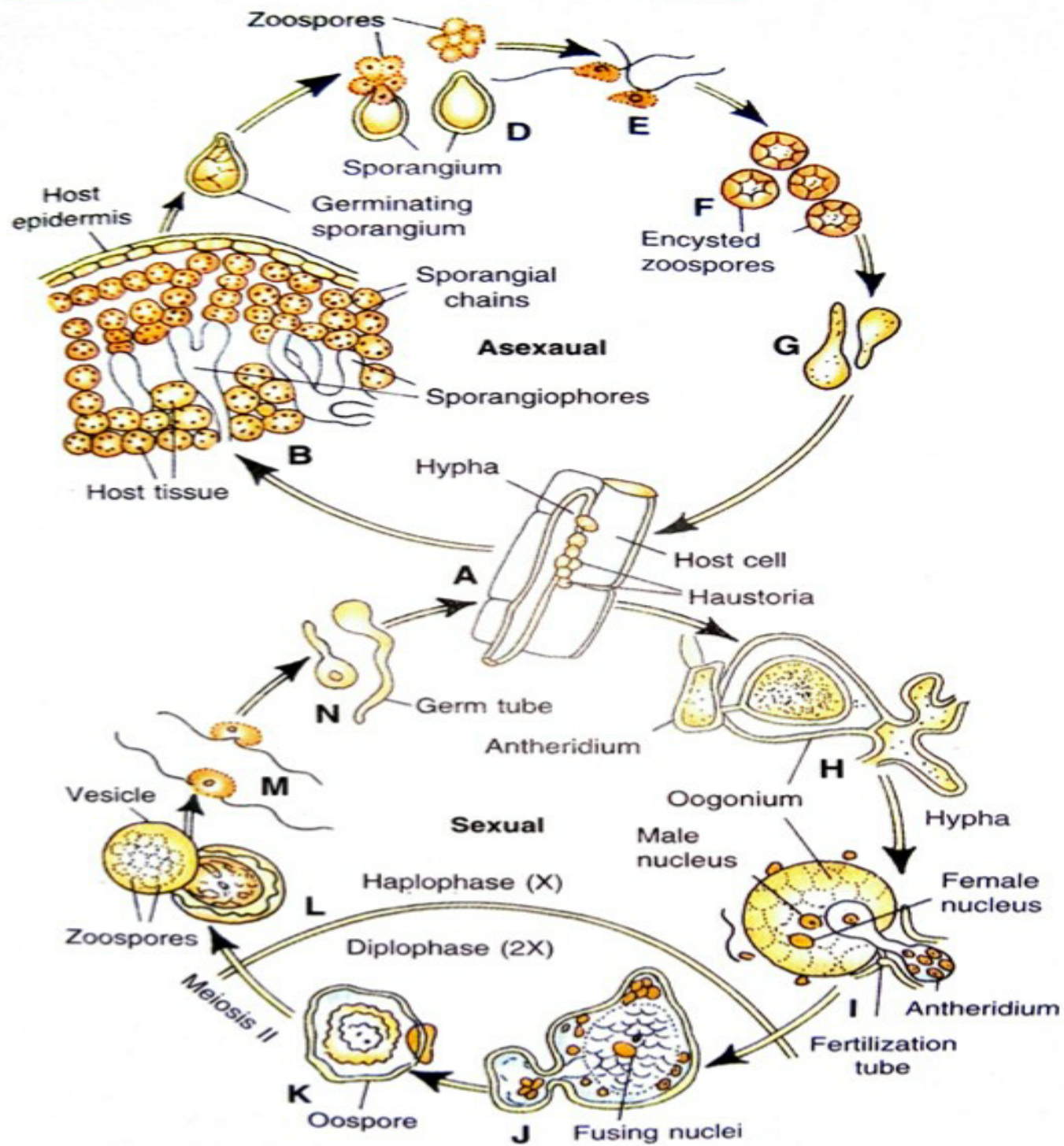


Fig. 6.61. Diagrammatic life cycle of *Albugo candida*.

Aspergillus/eurotium

Systematic position

Kingdom-mycota

division-eumycota

sub-division-ascomycotina

class-plectomycetes

order –aspergillales /eurotiales

family –aspergillaceae/eurotiaceae

Genus-aspergillus/eurotium

Vegetative character

Habit and habitat

Identify spp.132

Indian spp.30

1. a. Niger

2. a.Flavus

3. a.candidus

4. a.Fumigatus

5. a.glaucus

Saprophytic (fruit ,cheese,panir,wood,)Green mold/black mold

Disease-aspergillosis (in human)

Rot disease (anar,khajur)

Fungal body

Thaloidal, hyphae mycelium Filamentous,
branched homokaryotic, heterokaryotic

Gametophyte achlorophytic, septed.

Yellow colour

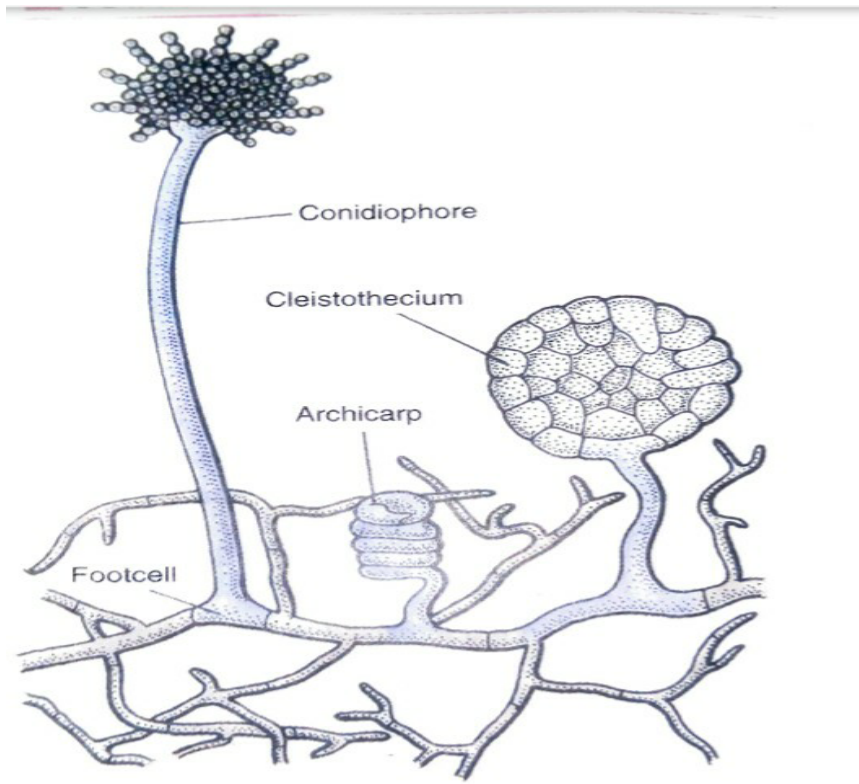


Fig. 10.1 (A). *Aspergillus* sp. A. plant consisting of a portion of mycelium bearing a conidiophore, an archicarp and cleistothecium.

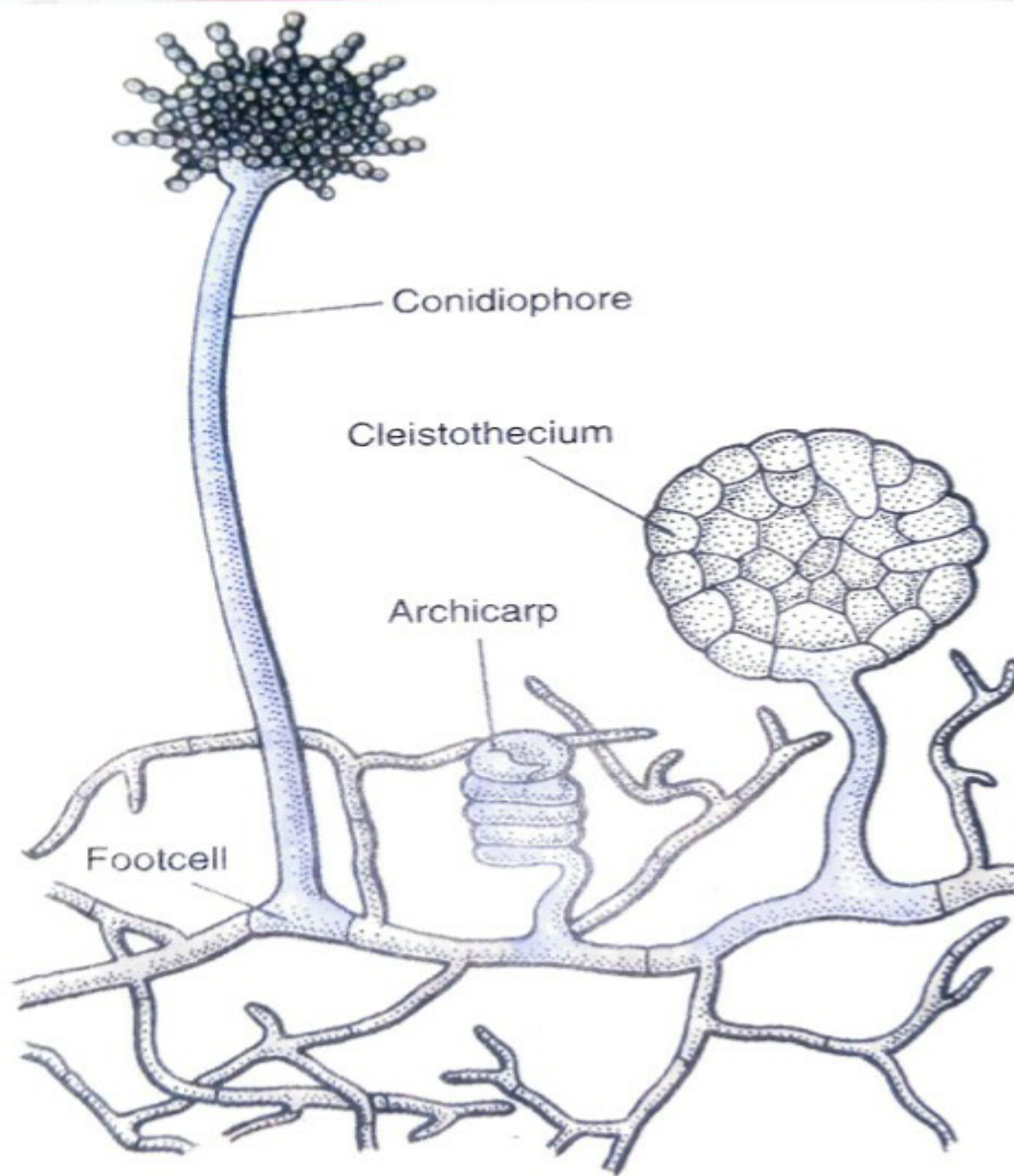


Fig. 10.1 (A). *Aspergillus* sp. A. plant consisting of a portion of mycelium bearing a conidiophore, an archicarp and cleistothecium.

Cellular character

Eukaryotic cell

Cell wall-chitin(n-acetylene glucosamine)

Plasma membrane(loamosome)-

Cytoplasm-

Nucleus, Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- oil droplets.

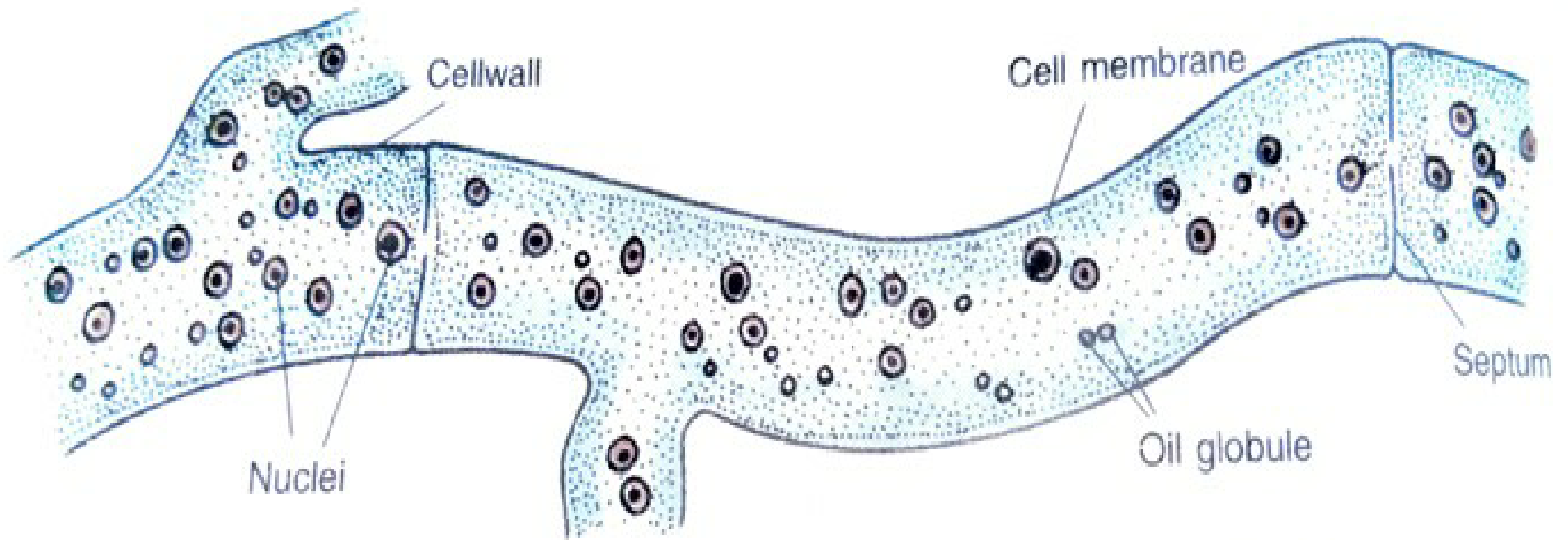


Fig. 10.1 (B). *Aspergillus sp.* A portion of a hypha enlarged to show details of structure as seen under light microscope. (After Miss Dale).

REPRODUCTION CHARACTER

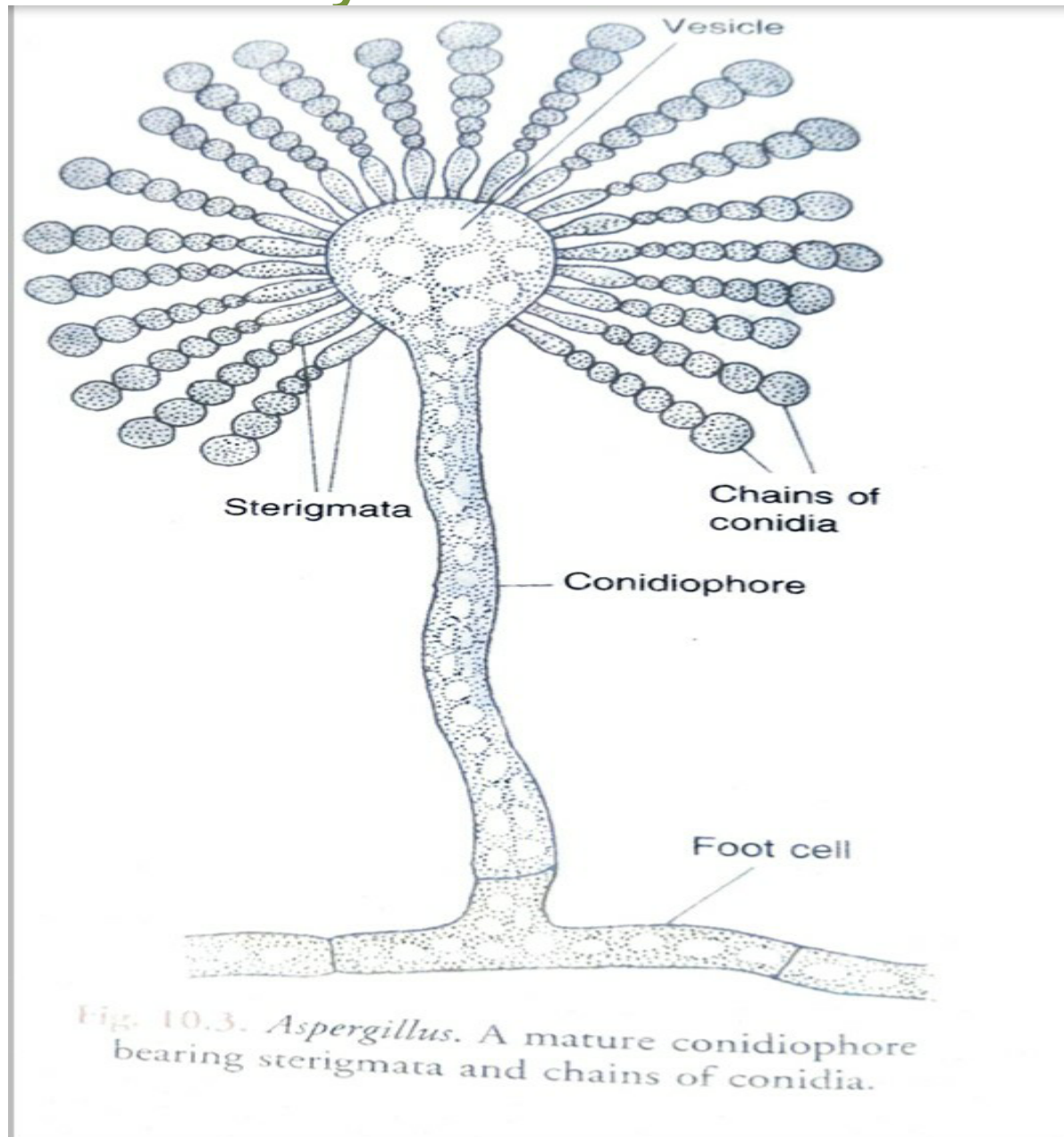
Generally three type reproduction show in fungi

1. Vegetative reproduction
2. Asexual reproduction
3. Sexual reproduction

Vegetative reproduction

By fragmentation

Asexual reproduction By conidia



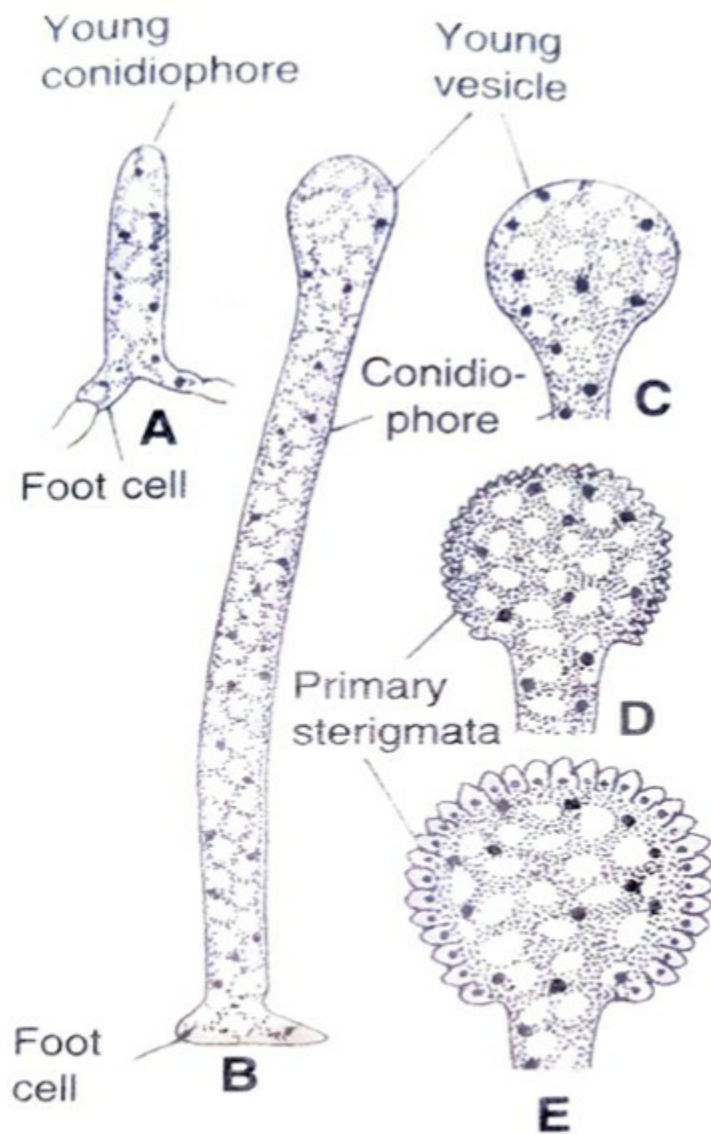


Fig. 10.2 (A–E). *Aspergillus* sp. Asexual reproduction. A, young conidiophore arising from the foot cell; B, older conidiophore with the tip slightly swollen to form a young vesicle; C, older vesicle; D–E, vesicle in optical section showing the development of primary sterigmata (Based on Thom and Raper).

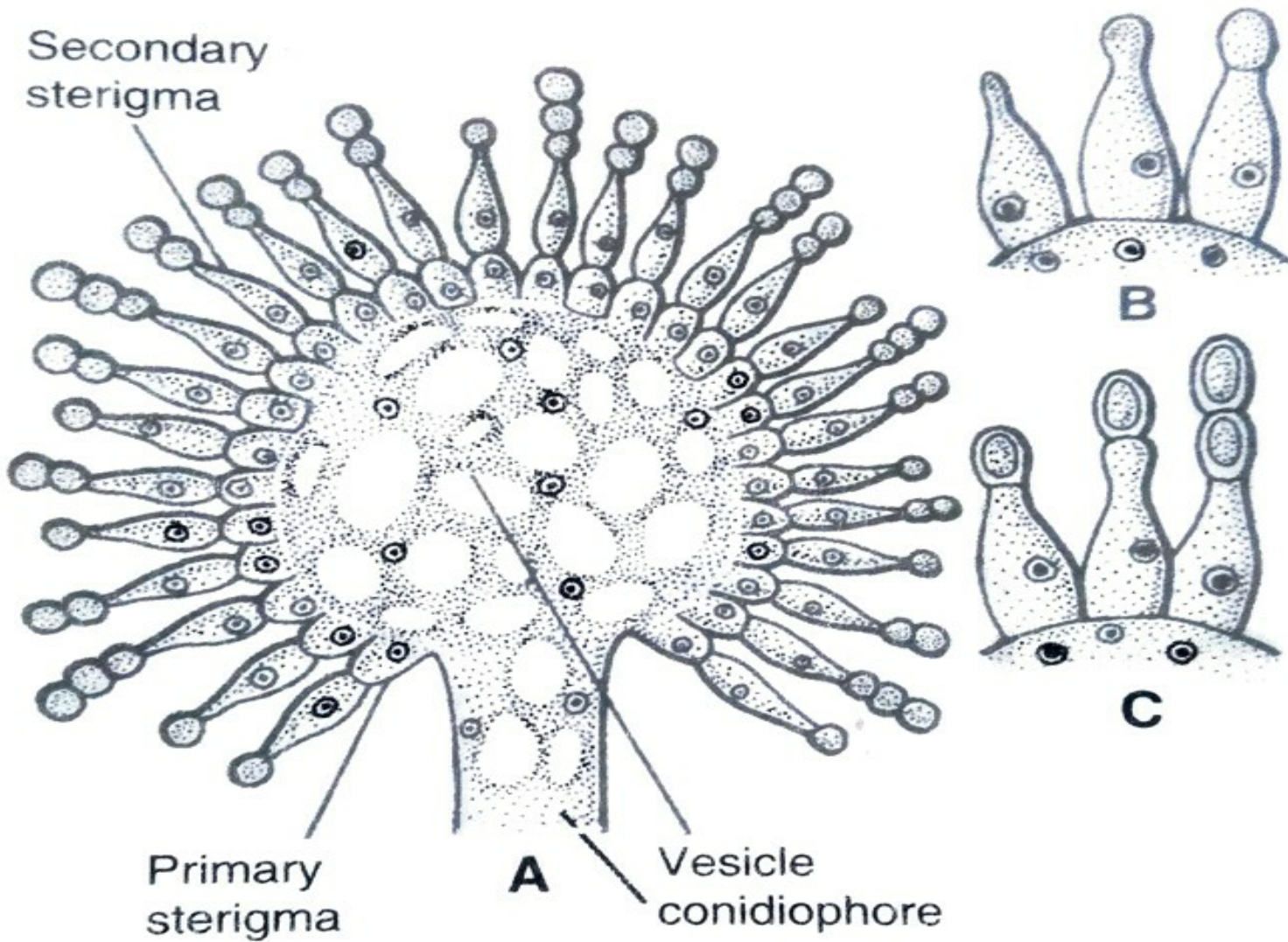


Fig. 10.4 (A–C). *Aspergillus* sp. Asexual reproduction (contd.). A vesicle with secondary sterigmata bearing conidia; B–C, stages in the abstriction of conidia. (Based on Thom and Raper)

Sexual reproduction

Homothallic (homokaryotic)

Heterothallic (heterothallic)

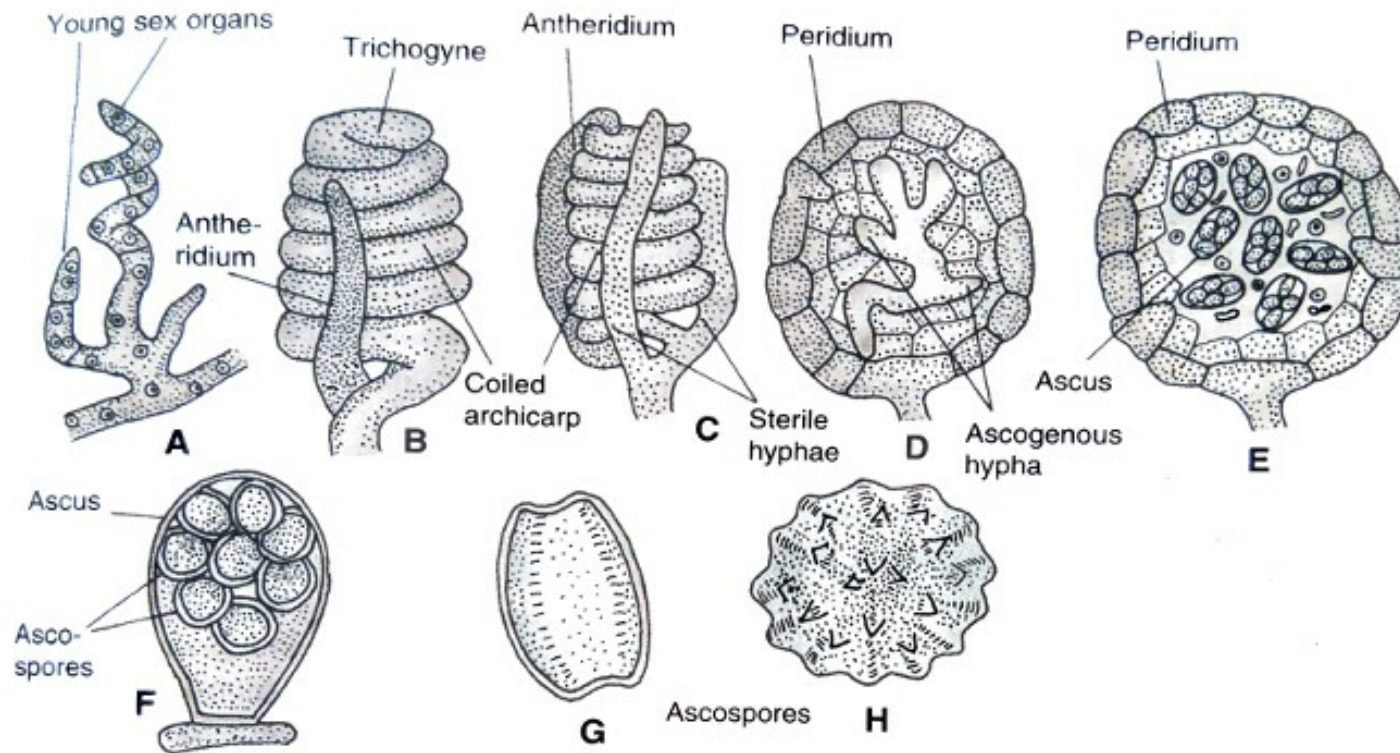


Fig. 10.5 (A-H). *Aspergillus* sp. Sexual Reproduction. A, Young sex organs; B, Coiled archicarp and an antheridium; C, archicarp enclosed by sterile hyphae, arising from its base; D, section of young cleistothecium showing ascogonium with ascogenous hyphae surrounded by peridium; E, section of mature cleistothecium showing asci surrounded by peridium; F, a single ascus containing 8 ascospores; G, ascospore from side view; H, ascospore (surface view).

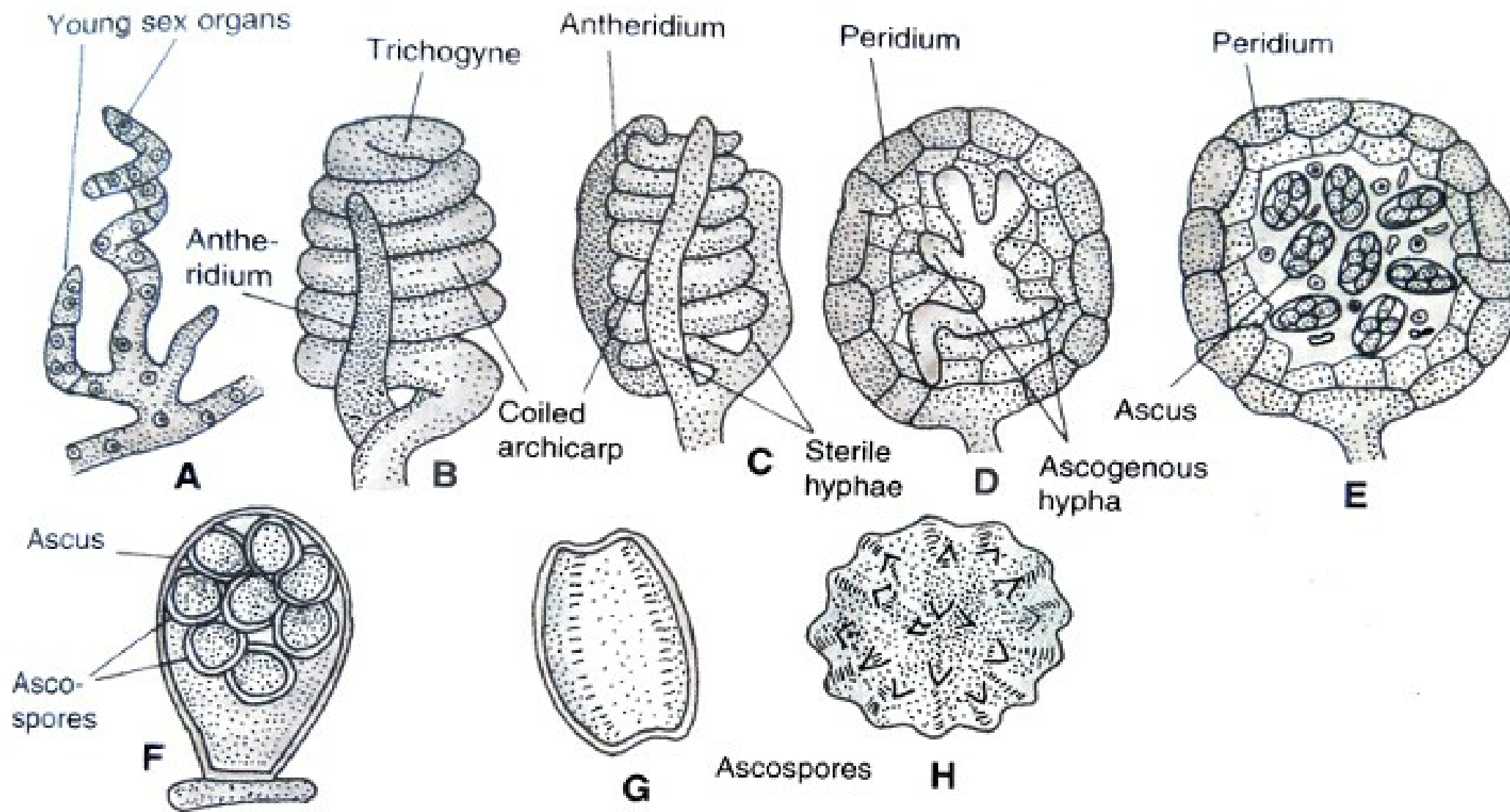


Fig. 10.5 (A–H). *Aspergillus* sp. Sexual Reproduction. A, Young sex organs; B, Coiled archicarp and an antheridium; C, archicarp enclosed by sterile hyphae, arising from its base; D, section of young cleistothecium showing ascogonium with ascogenous hyphae surrounded by peridium; E, section of mature cleistothecium showing asci surrounded by peridium; F, a single ascus containing 8 ascospores; G, ascospore from side view; H, ascospore (surface view).

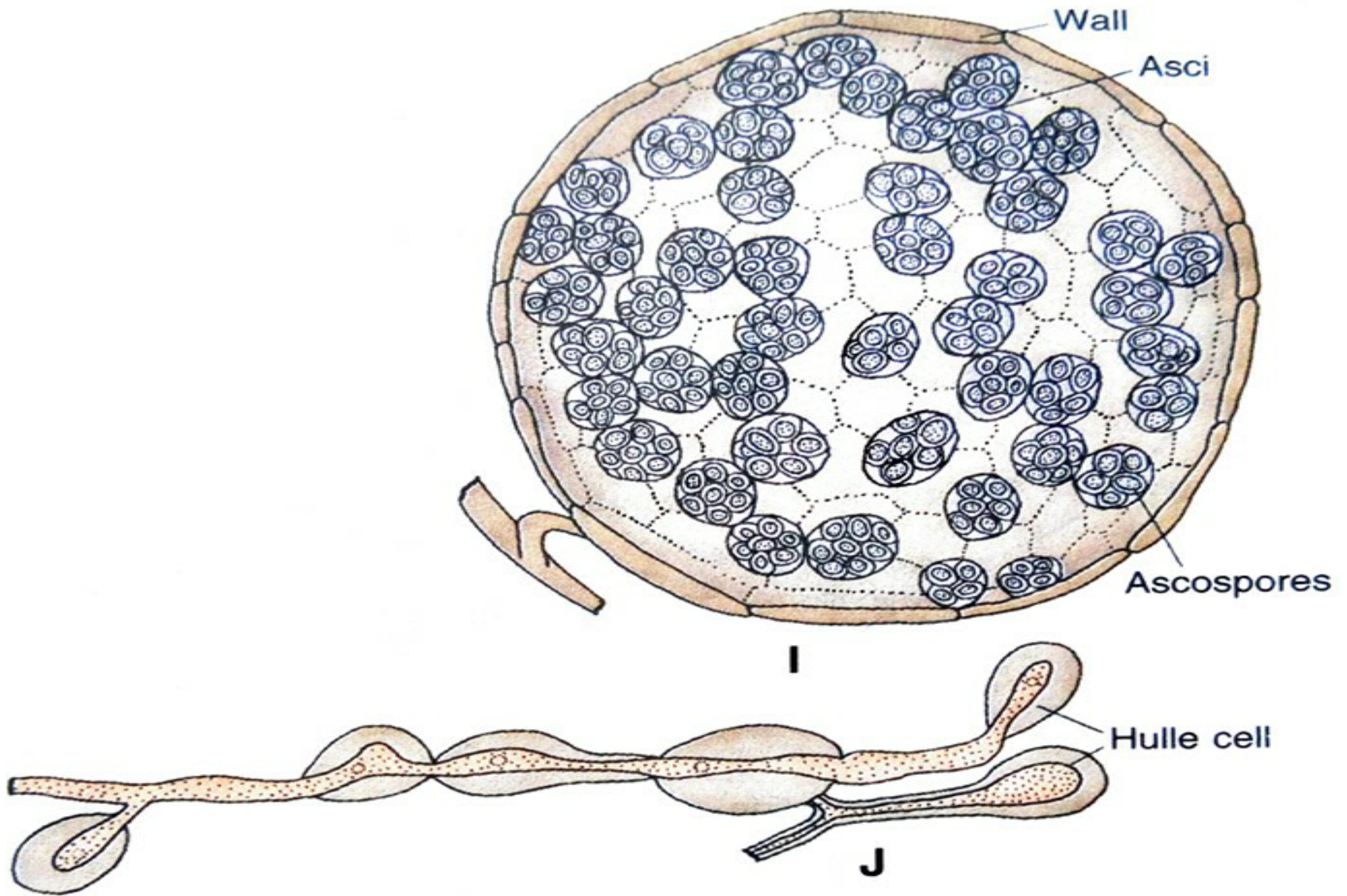


Fig. 10.5 (I-J). *Aspergillus*. I. A mature cleistothecium containing asci and ascospores; J. Hülle cells.

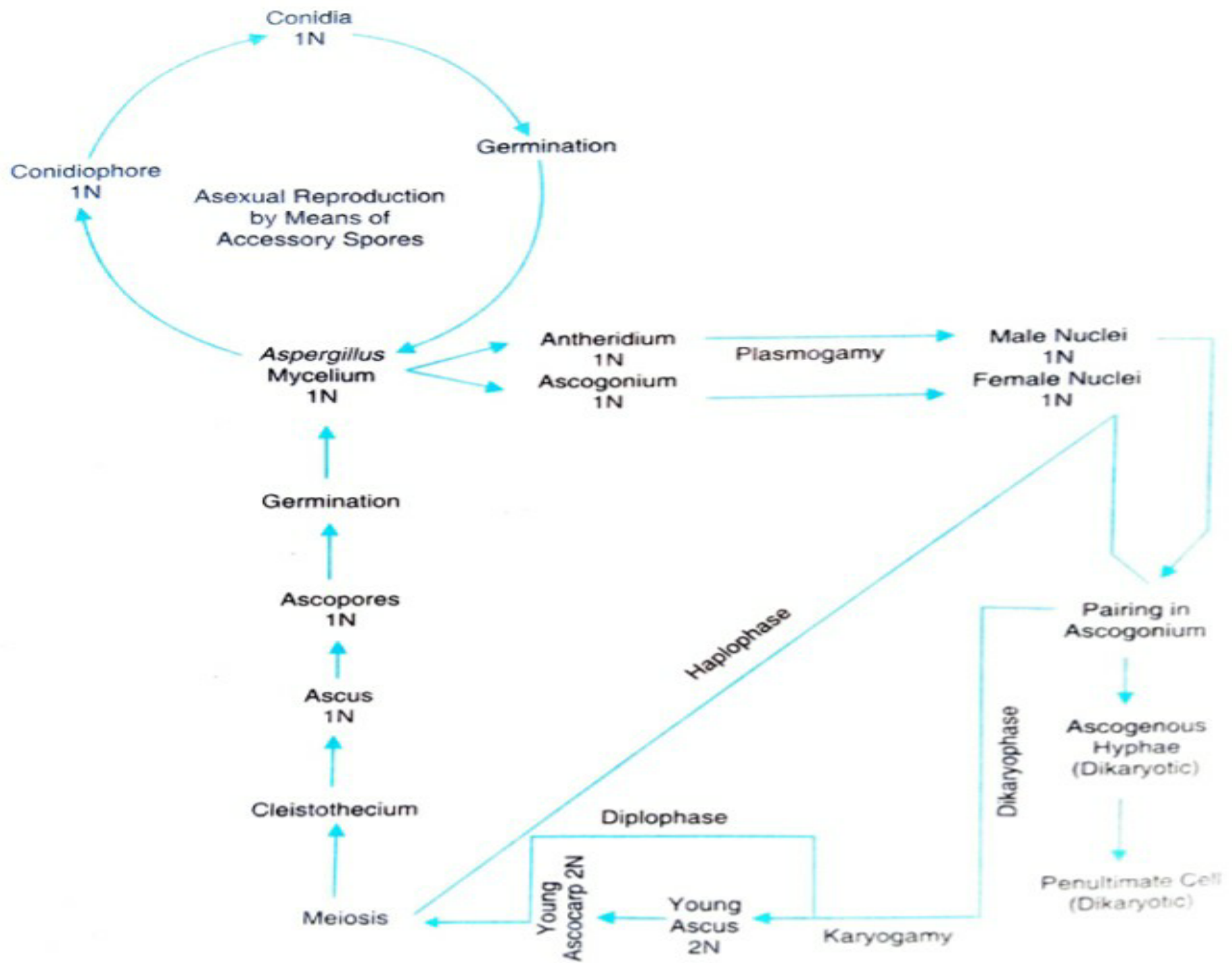


Fig. 10.6. Graphic representation of the life cycle of *Aspergillus (Eurotium)*.

Peziza

Systematic position

Kingdom-**algae**

division -**eumycota**

sub-division-**ascomycotina**

class-**discomycetes**

order-**pezizales**

family- *pezizaceae*

Genus-*peziza*

Vegetative character

Habit and habitat

saprophytic – animal dung, rotten wood,

Cup fungi

Identified spp. 100

Indian spp. 13

1. p. Fuckluence
2. p. subcularis
3. p. arenginea
4. p. Stiboidea
5. p. rependa
6. p. darjeelensis
7. p. Venosa
8. p. tubinella
9. p. aurantia
10. p. citrina
11. p. macrotis

Fungal body

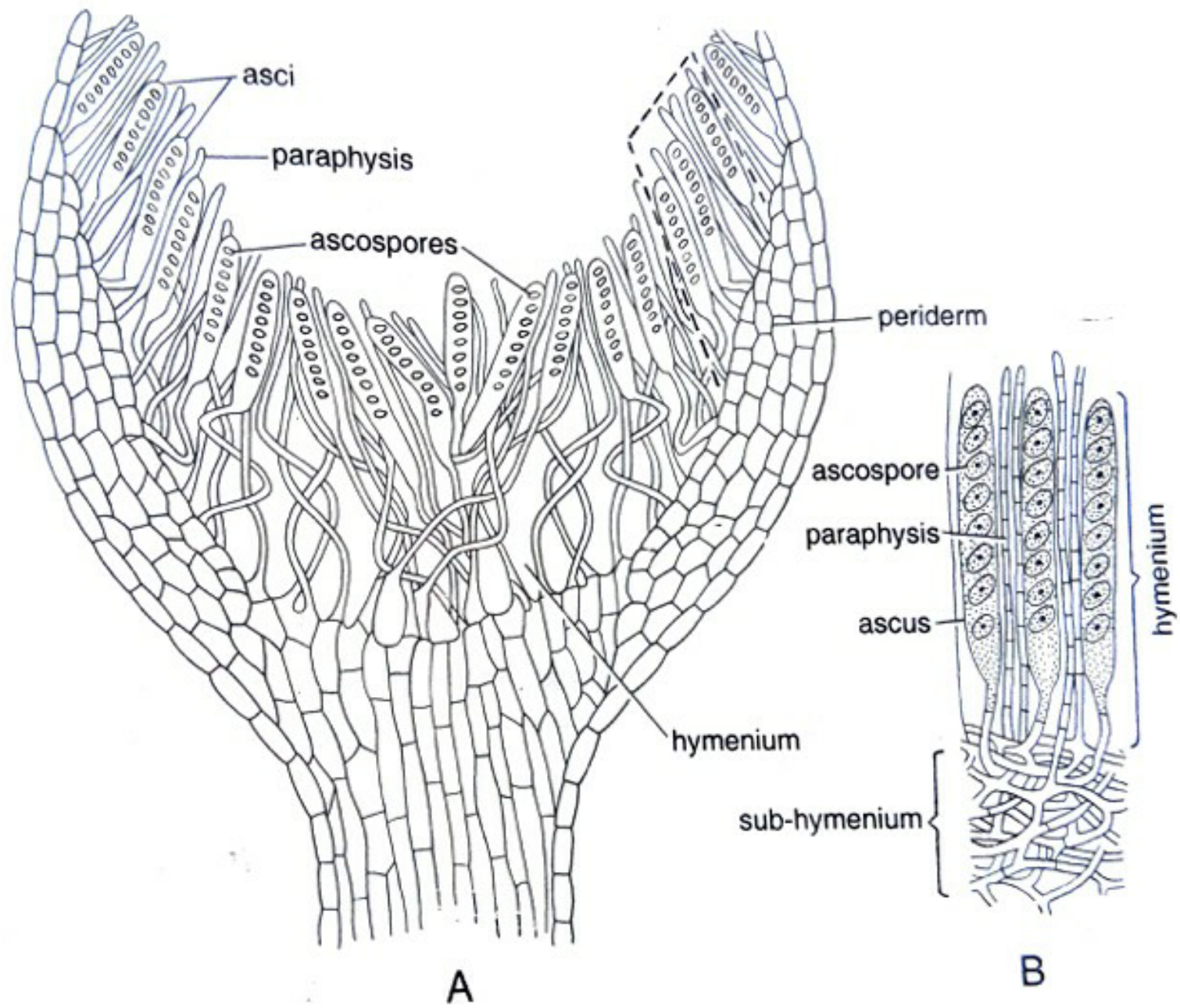
Thaloidal, hyphae mycelium Filamentous,
branched

Uninucleated fruiting body (apothecium)

Gametophyte achlorophytic, septed.

Golden colour





चित्र 5 A-B. पेज़ाइज़ा (*Peziza*) : A. एपोथीसियम की अनुदैर्घ्य काट, B. अनुदैर्घ्य काट के एक भाग का विस्तृत चित्र।

structure. The sexual process does take
 lified and consists in the association of
 i in a pair. The adult mycelium consists
 e. Certain vegetative cells in the centre
 have been seen to possess nuclei which
 . These pairs of nuclei are called the

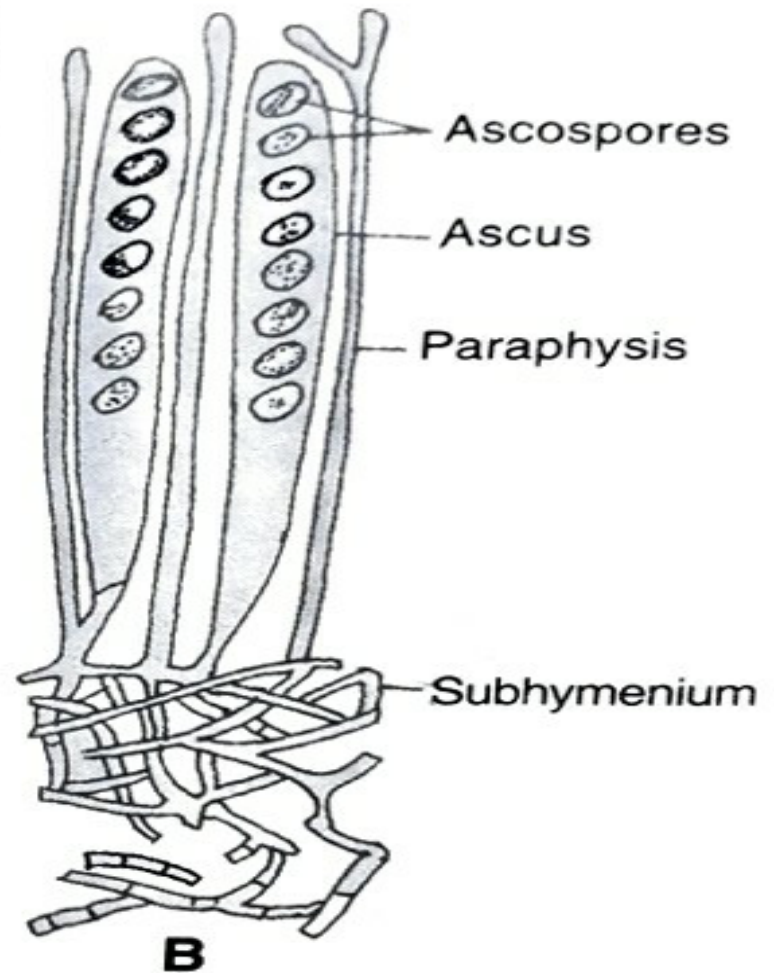
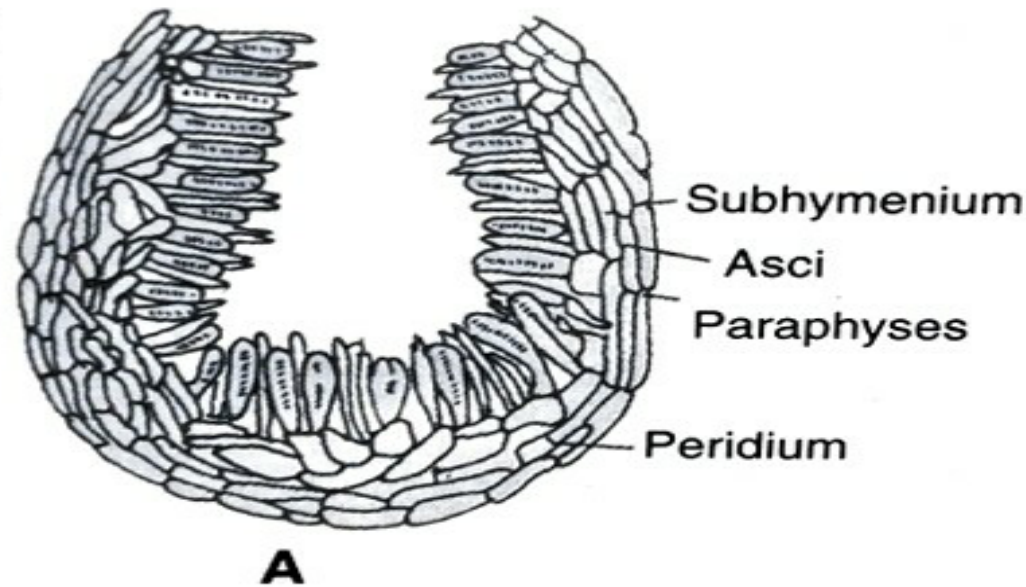


Fig. 12.13 (A-B). *Peziza*. A, V. S. entire fructification (apothecium);
 B, Portion of the same to show details. (Diagrammatic).

cellular character

Eukaryotic cell

Cell wall-chitin(n-acetylene glucosamine)

Plasma membrane(loamosome)-

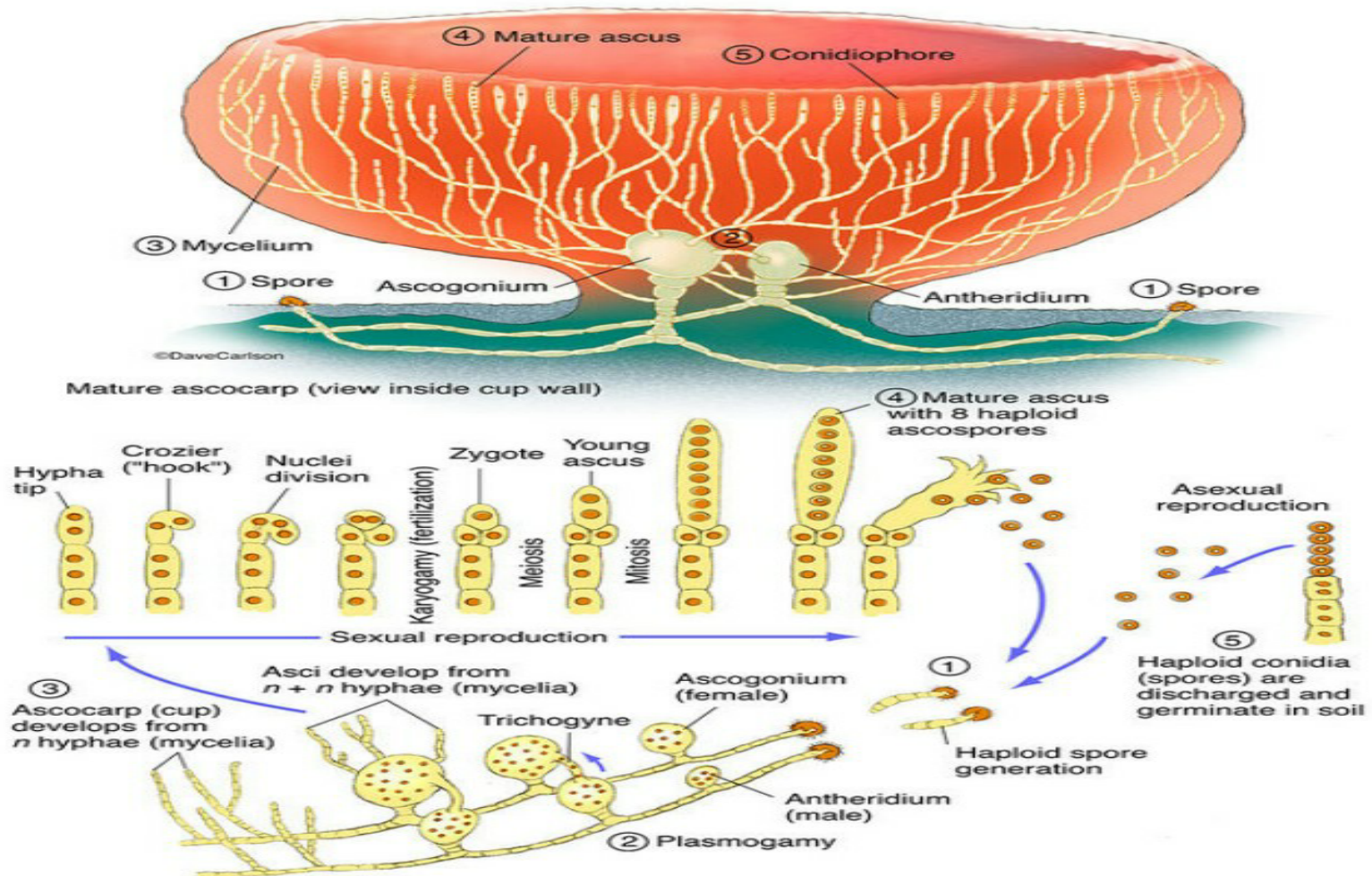
Cytoplasm-

Nucleus, Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- oil droplets.

Reproductive character

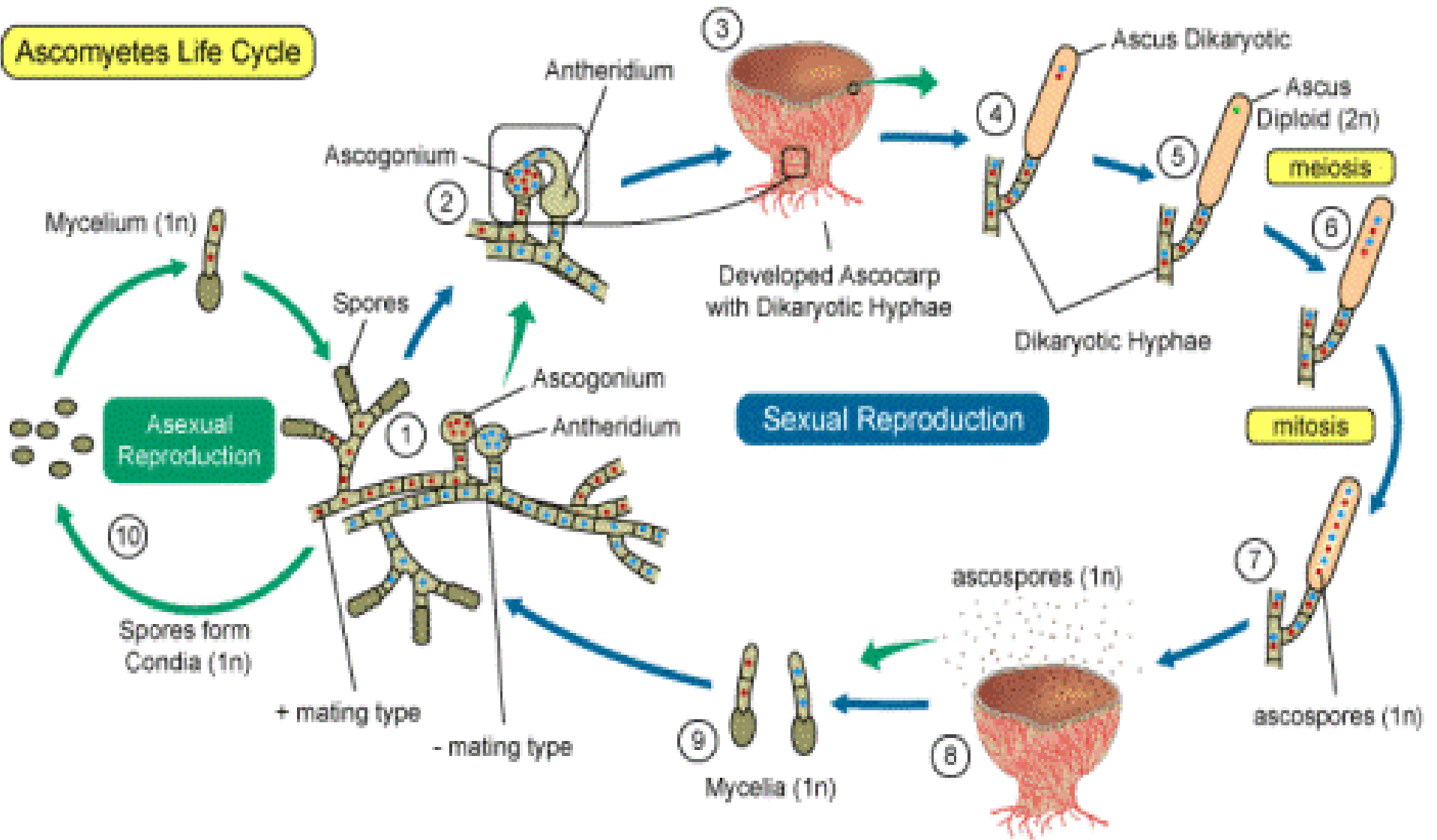
1. Asexual reproduction By conidia
2. sexual reproduction somatogamy



2.sexual reproduction

Somatogamy type

Ascomyetes Life Cycle



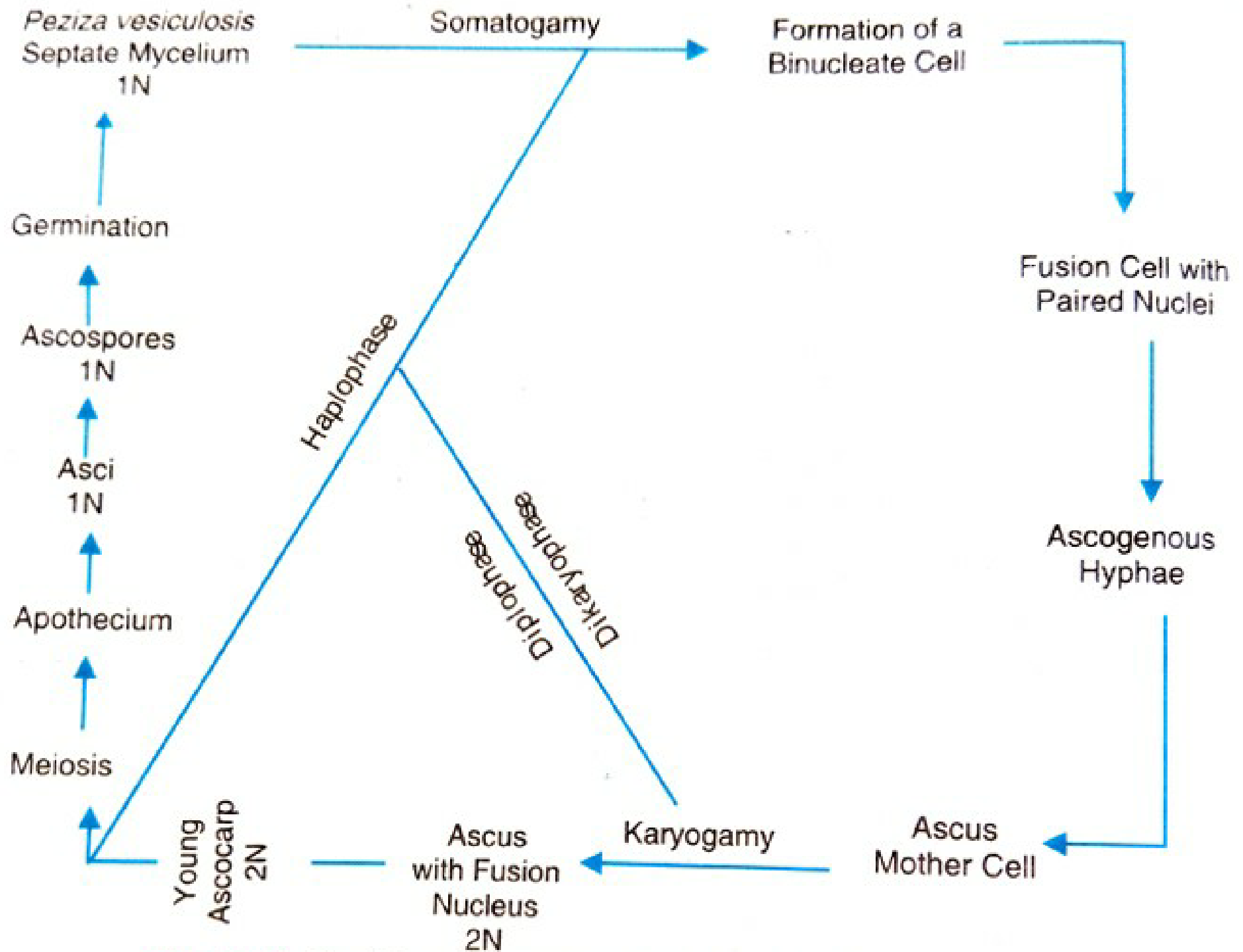


Fig. 12.14. Graphic representation of the life cycle of *Peziza*.

Agaricus /mushroom

Classification

Kingdom-algae

division-eumycota

Subdivision-basidiomycota

class-hymeniomycetes

order-agaricales

family-Agaricaceae

Genus-Agaricus

Vegetative character

Habit and habitat

Indian spp.25

1. a.Campestris
2. a.Macrophallous
3. a.bisporous

saprophytic ,parasitic ,(fairy ring show)

Fungal body

Thaloidal, hyphae mycelium (primary, secondary) Filamentous, branched homokaryotic

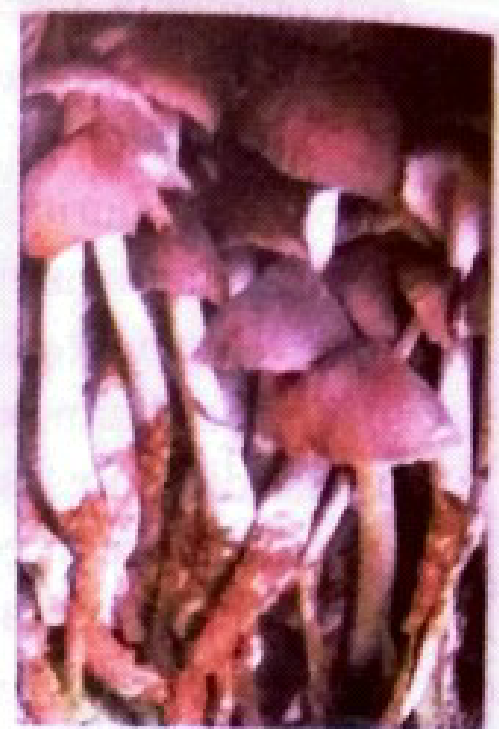
Fruiting body- basidiocarp, heterokaryotic, Gametophyte, achlorophytic, septate.



Edible Mushrooms



Agaricus campestris



Termitomyces eurhizus



Calocybe indica



Poisonous Toadstools



Volvariella volvacea

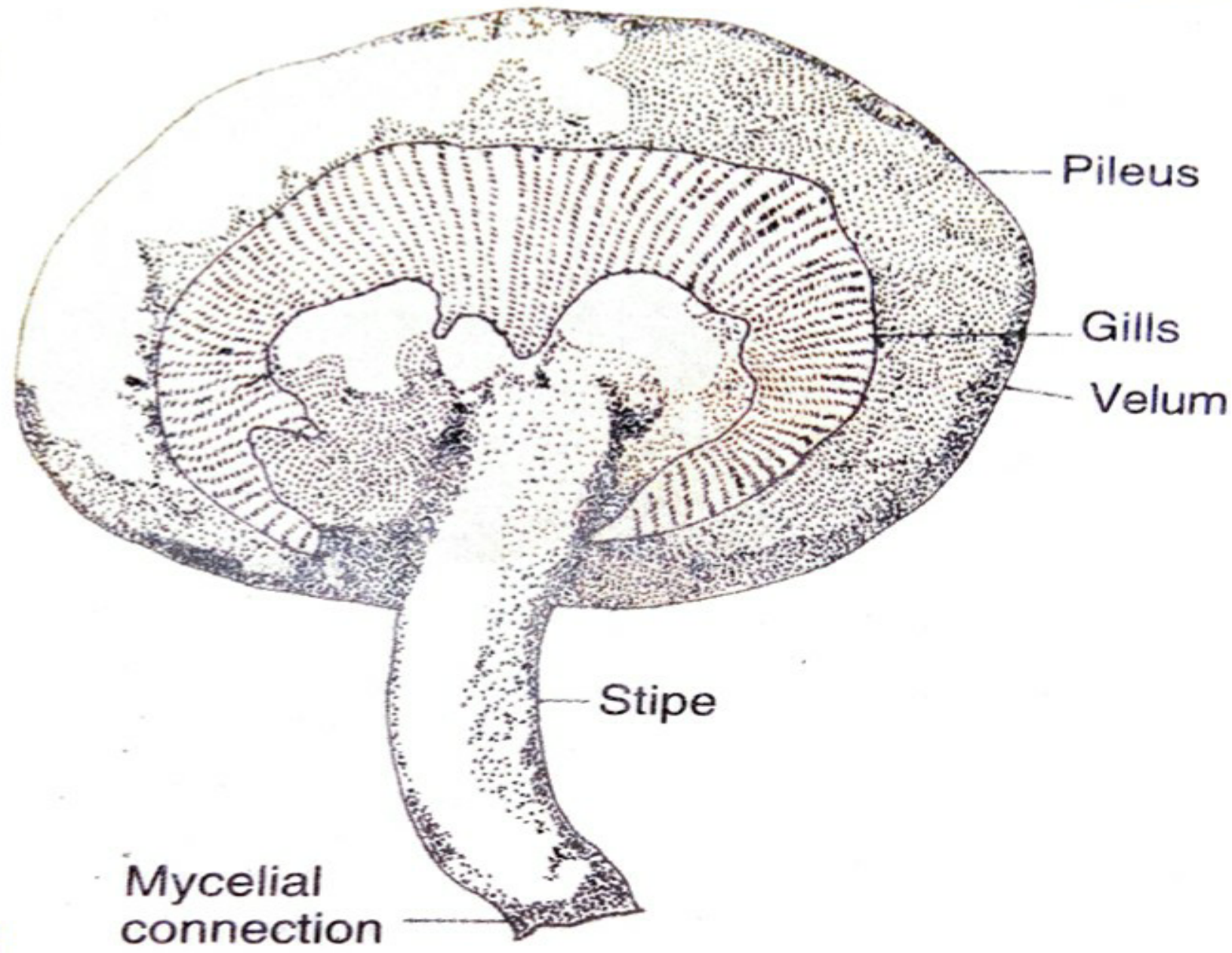


Fig. 15.1. Basidiocarp of *Agaricus sp.*

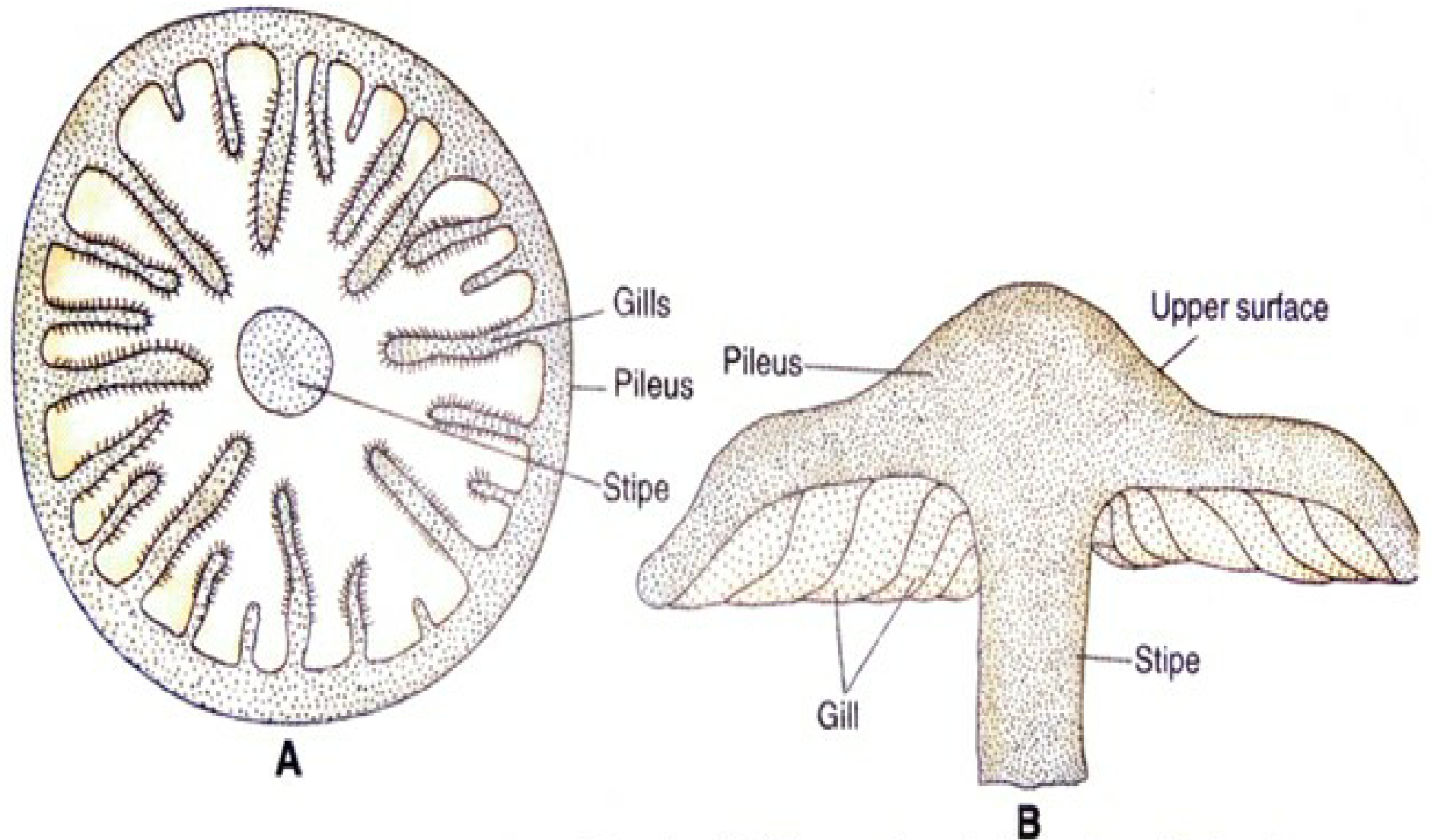


Fig. 15.4 (A-B). A, T. S. Pileus of *Agaricus*; B, Pileus cut lengthwise to show gills hanging from the under-surface and radiating towards the stipe.

cellular character

Eukaryotic cell

Cell wall-chitin(n-acetyte glucosamine)

Plasma membrane(loamasome)-

Cytoplasm-

Nuceus,Mitochodria,golgi body, endoplasmic reticulam,vacules carbohydrade,protien, volutile oil carotinoid pigment etc.

Food material- oil droplets.

mycelium

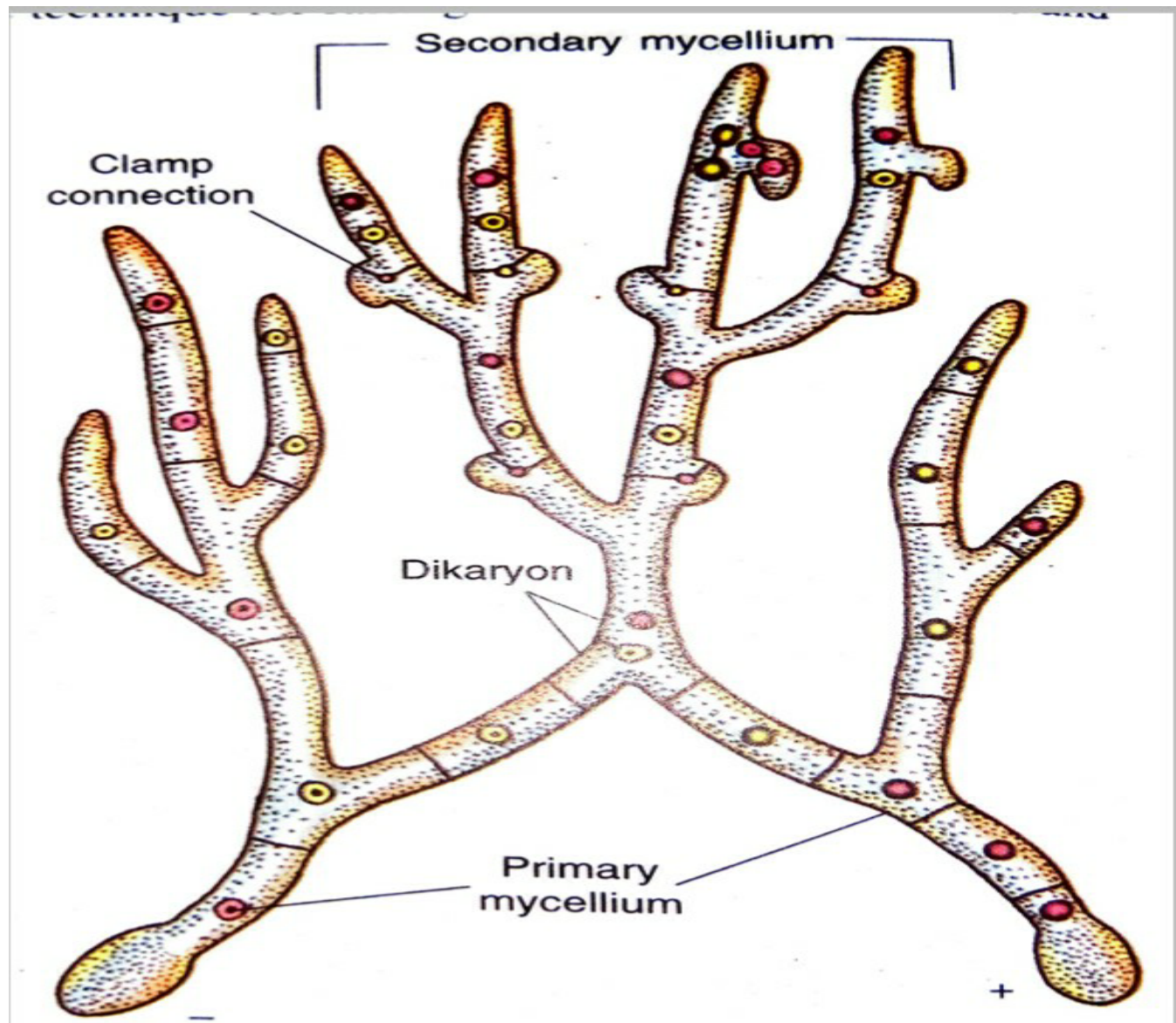


Fig. 15.2. *Agaricus*, diagram showing somatogamous copulation.

body (basidiocarp)

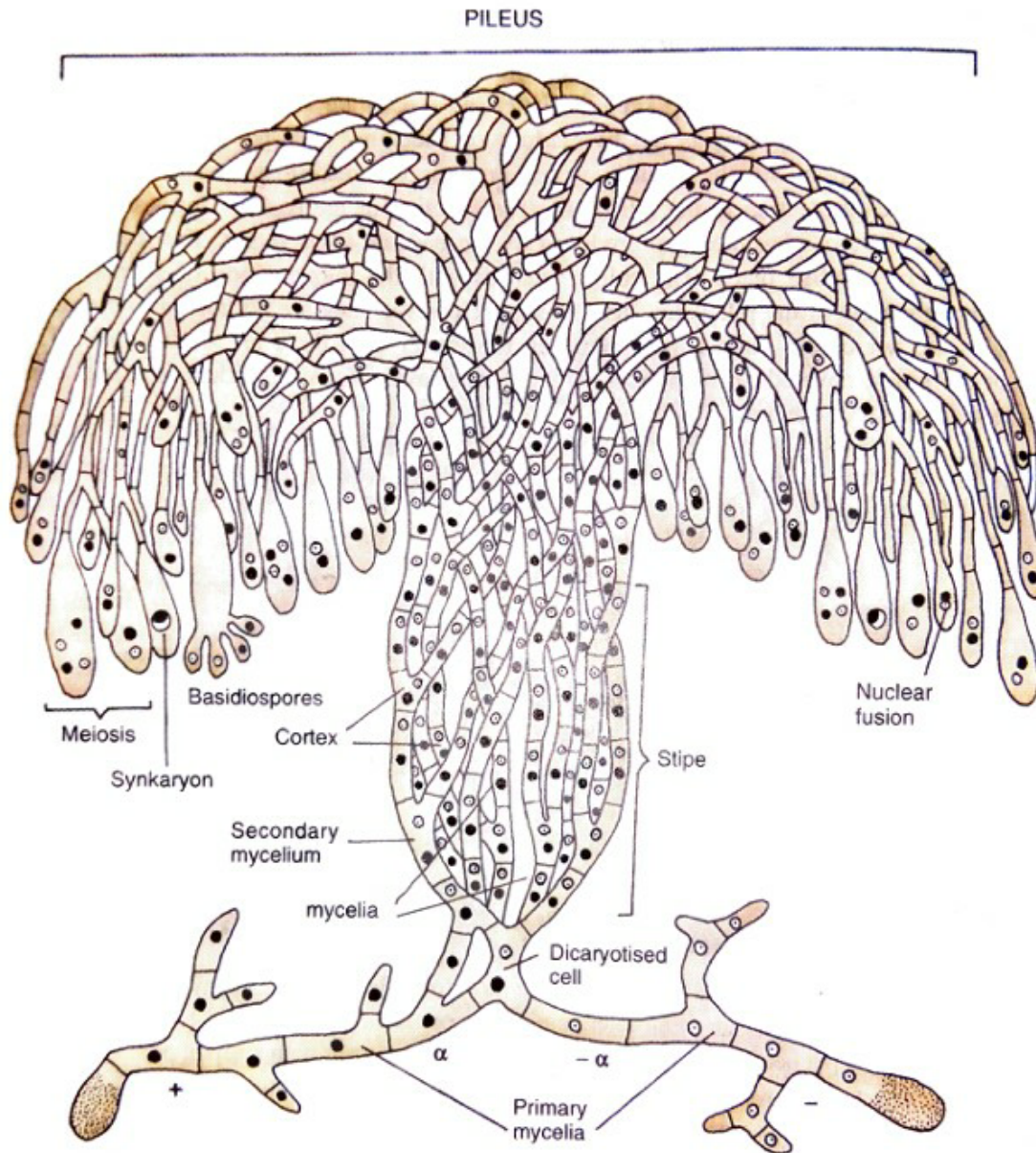


Fig. 15.5. *Agaricus campestris*. A scheme representing diagrammatically the anatomy of the basidiocarp developed from a secondary mycelium originating by the fusion of two haploid hyphae (+ and -) of opposite strains of mycelia.

Development of basidiocarp

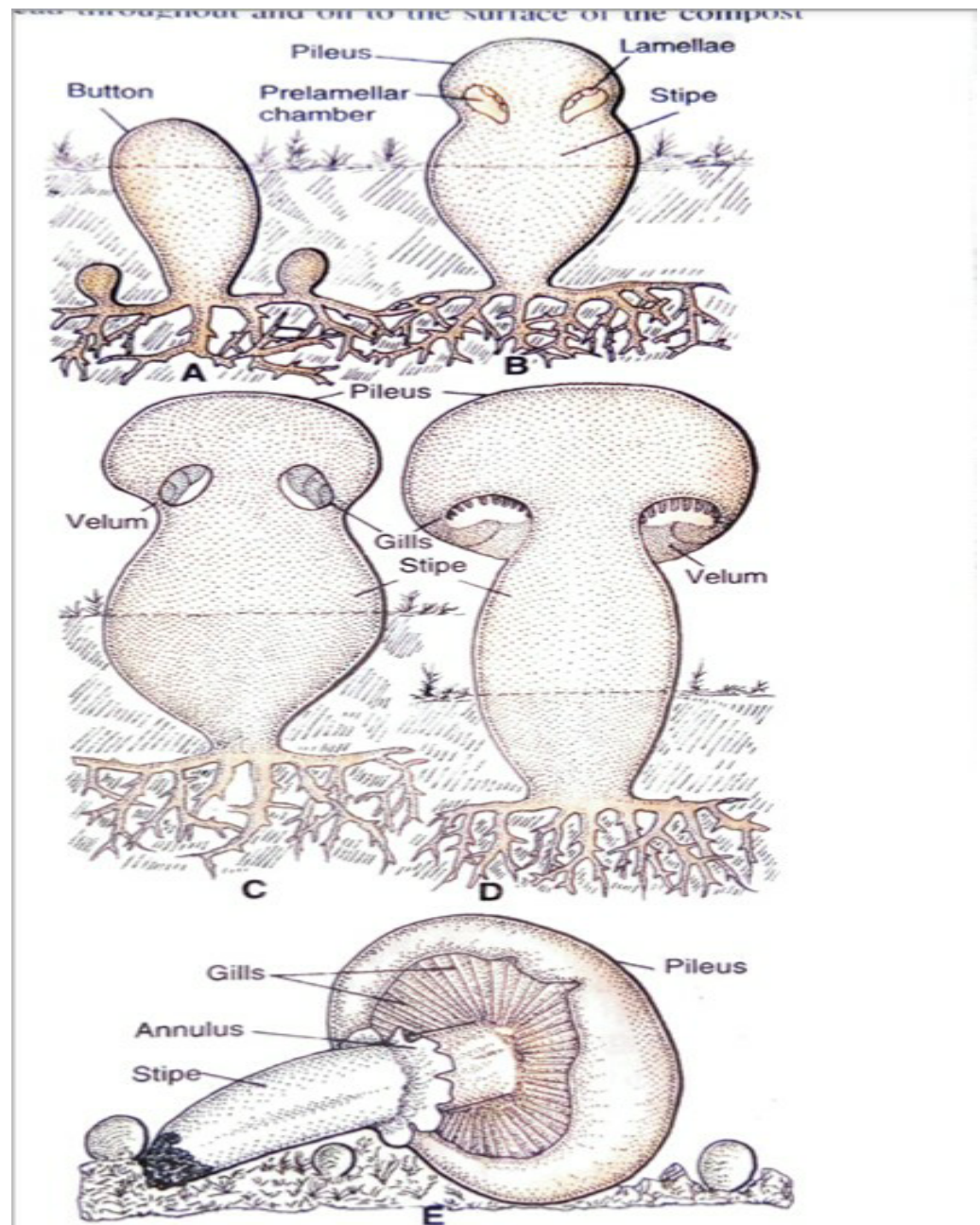
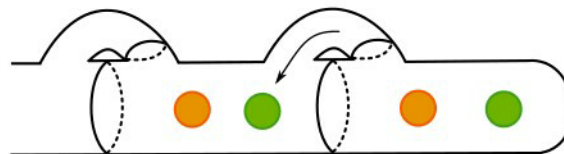
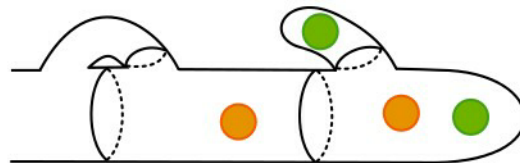
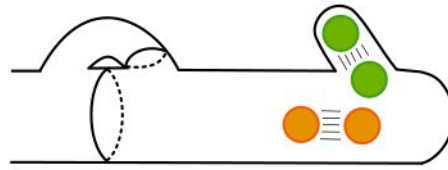
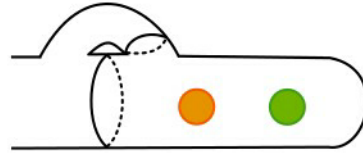


Fig. 15.3 (A-E). *Agaricus campestris*. Stages in the development of basidiocarp. A, button stage; B, showing the formation of prelamellar chamber in the pileus region; C, differentiation of gills in the prelamellar chamber; D, a later stage; E, shows rupture of velum and formation of annulus. B-D, vertical section of developing basidiocarp. (Based on Smith).

Clamp connection

Clamp connections in Mitosis



Clamp connection formation between two nuclei (one shown in green, the other orange)

REPRODUCTION CHARACTER

Generally three type reproduction show in fungi

1. Vegetative reproduction-by fragmentation
2. Asexual reproduction-by oidiospore
3. Sexual reproduction-somatogamy type

Sexual reproduction-somatogamy type

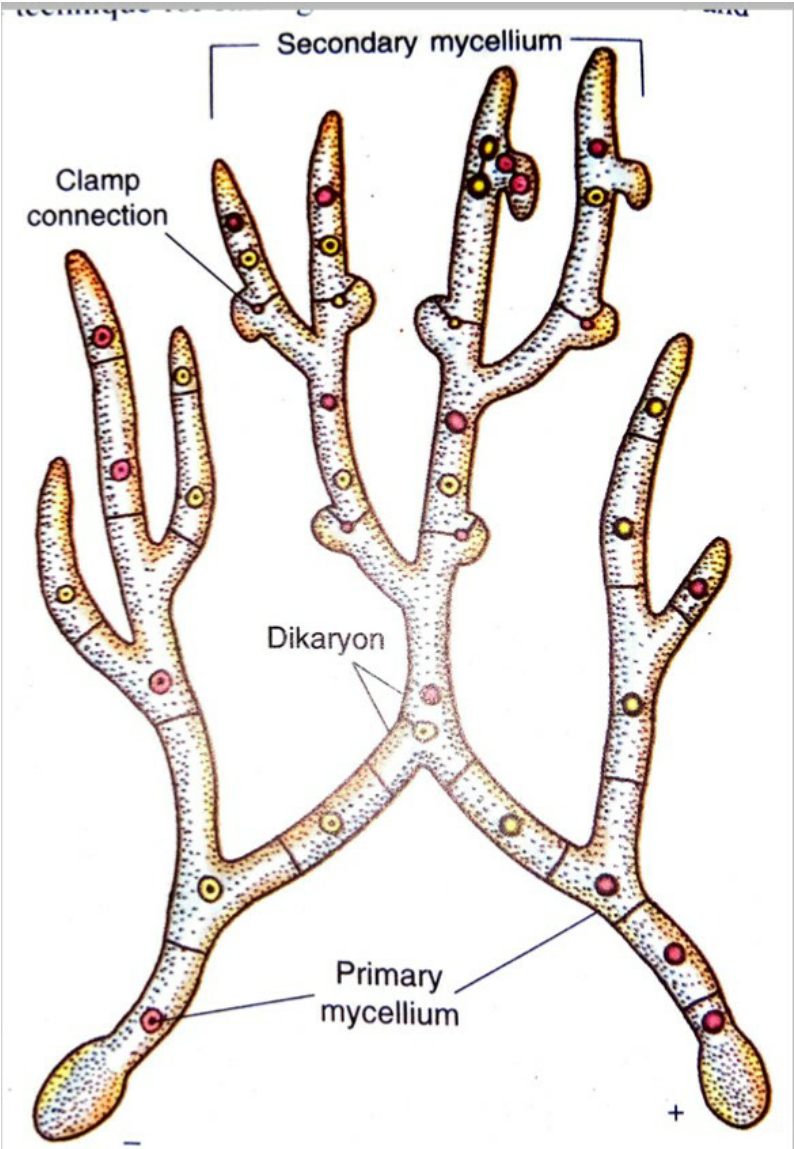


Fig. 15.2. *Agaricus*, diagram showing somatogamous copulation.

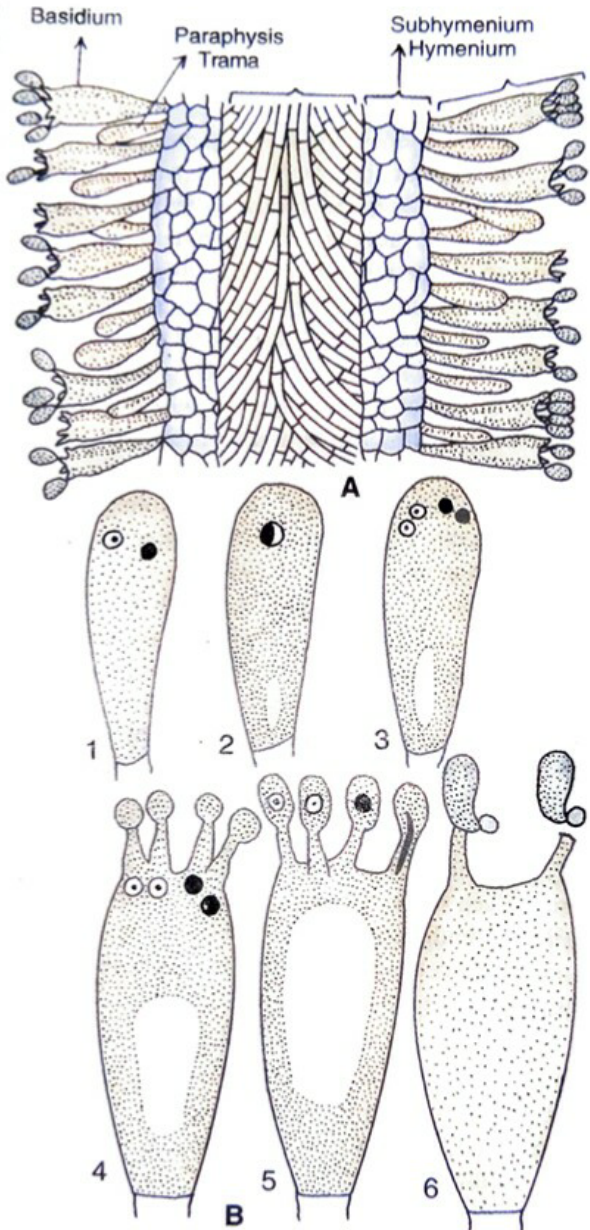


Fig. 15.6 (A-B). *Agaricus campestris*. A, cross section of the gill showing structure; B₁₋₆, stages in the development of the holobasidium.

Germination of basidiospore

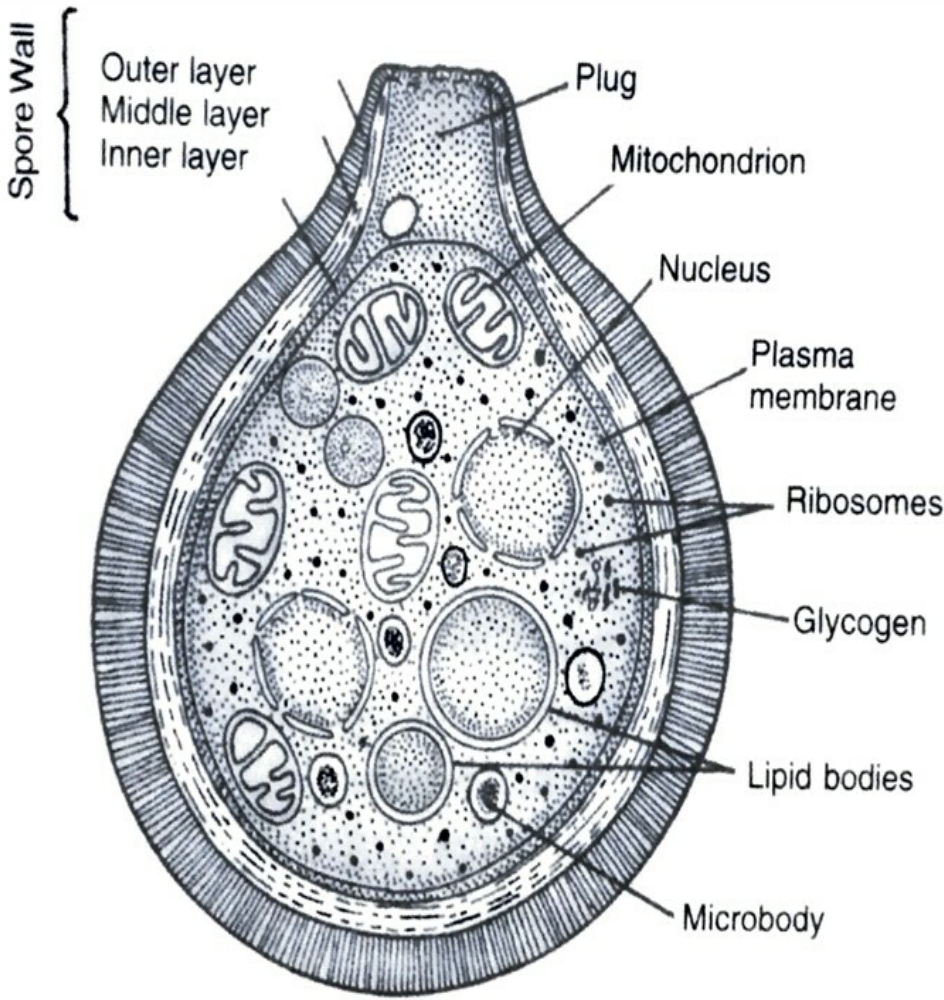


Fig. 15.8. *Agaricus bisporus*. Diagrammatic representation of the basidiospore showing fine structure (Based on Greuter and Rast).

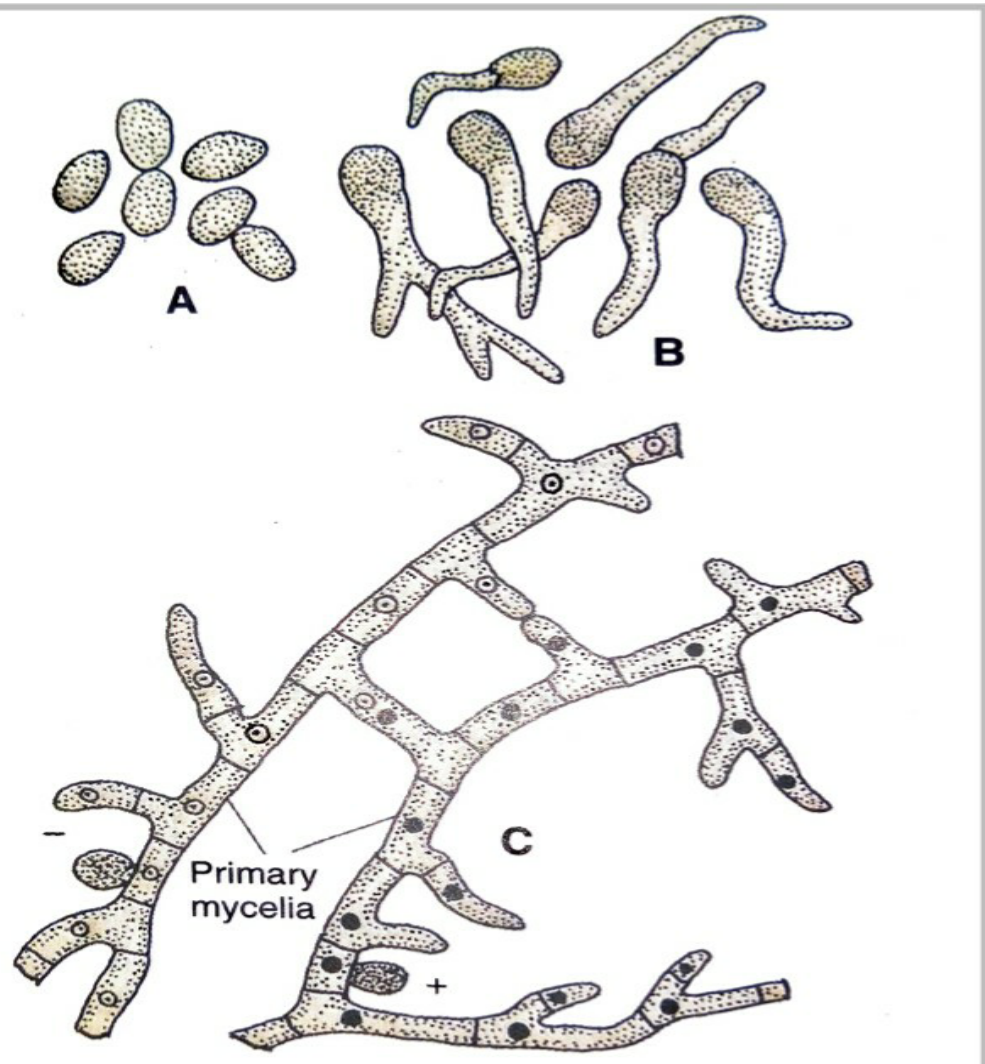


Fig. 15.9 (A-C). A, Basidiospores; B, germinating basidiospores; C, Hyphal fusions between primary mycelia of opposite strains.

Diagrammatic life cycle of mushroom

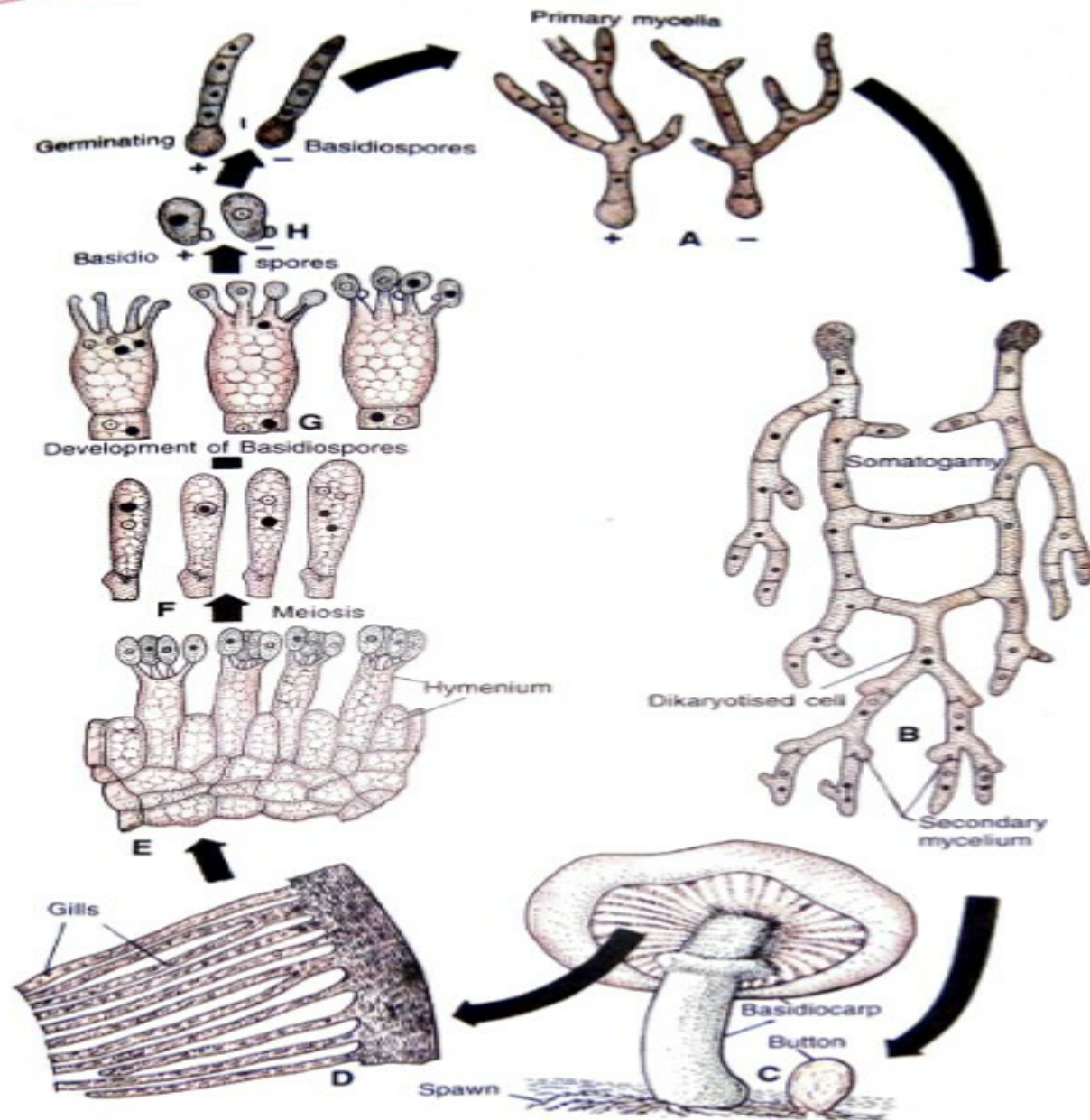


Fig. 15.11 (A-I). Pictorial life cycle of *Agaricus*. Some mycologists hold that *Puccinia* is homothallic. In that case secondary mycelium which bears the basidiocarps will be formed by fusion between hyphae of the same mycelium.

Ustilago

Systematic position

Kingdom-fungi

division -eumycota

sub division- basidiomycotina

Class-hemibasidiomycetes

order-ustilaginales

family- Ustilaginaceae

Genus-Ustilago

VEGETATIVE CHARACTER

Habit and habitat

Identified spp.-300

Indian spp.-108

Parasitic –wheat,maiz

Disease –

Loose smut of wheat

Loose smut of barely

Loose smut of oat

Smut of corn

White smut of sugarcane

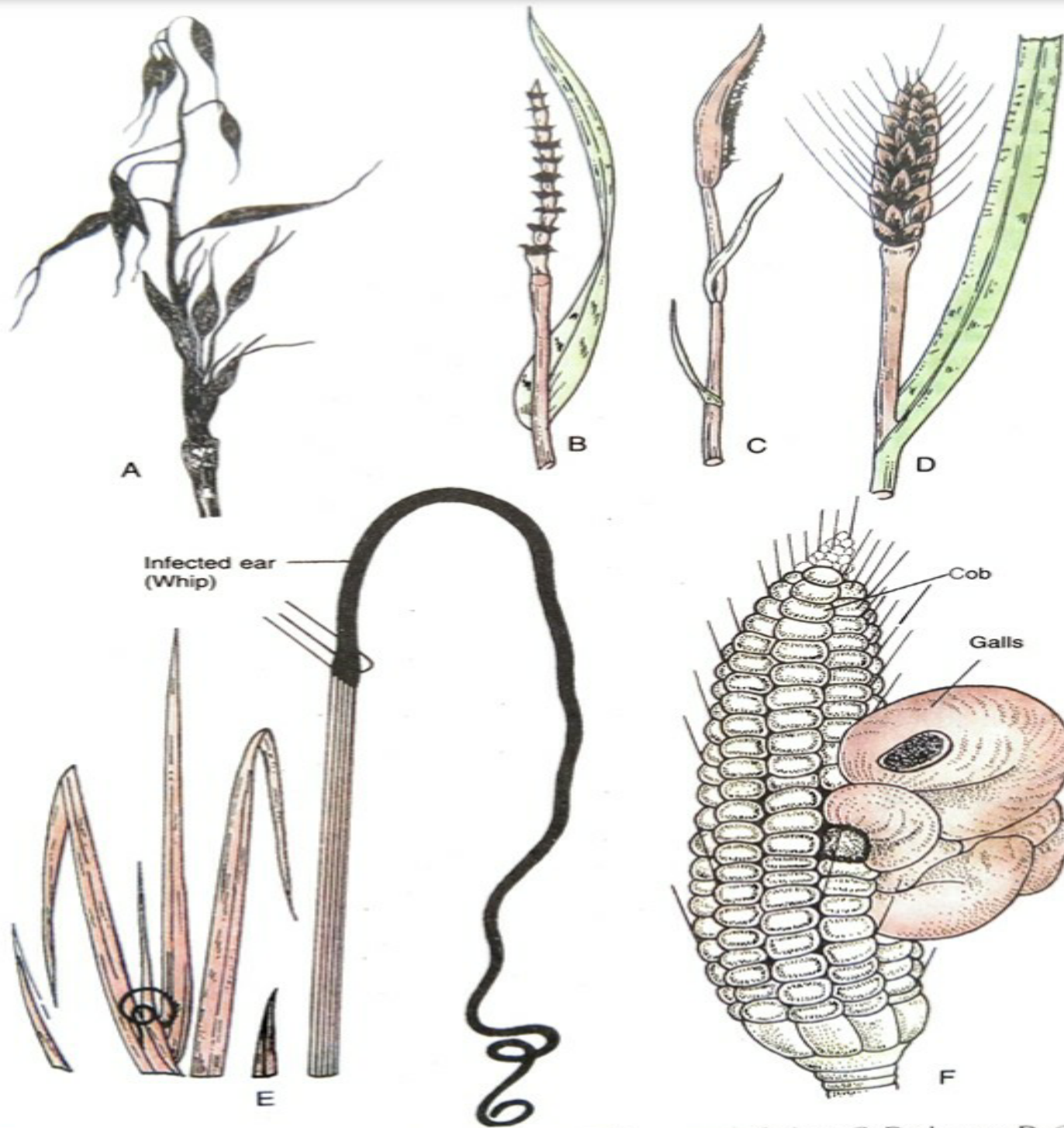


Fig. 14.1. Smuts caused by *Ustilago* sp. A, smut of oats; B, Loose smut of wheat; C, Doob smut; D, Covered smut of Barley; E, Smut of sugarcane; F, Corn smut.

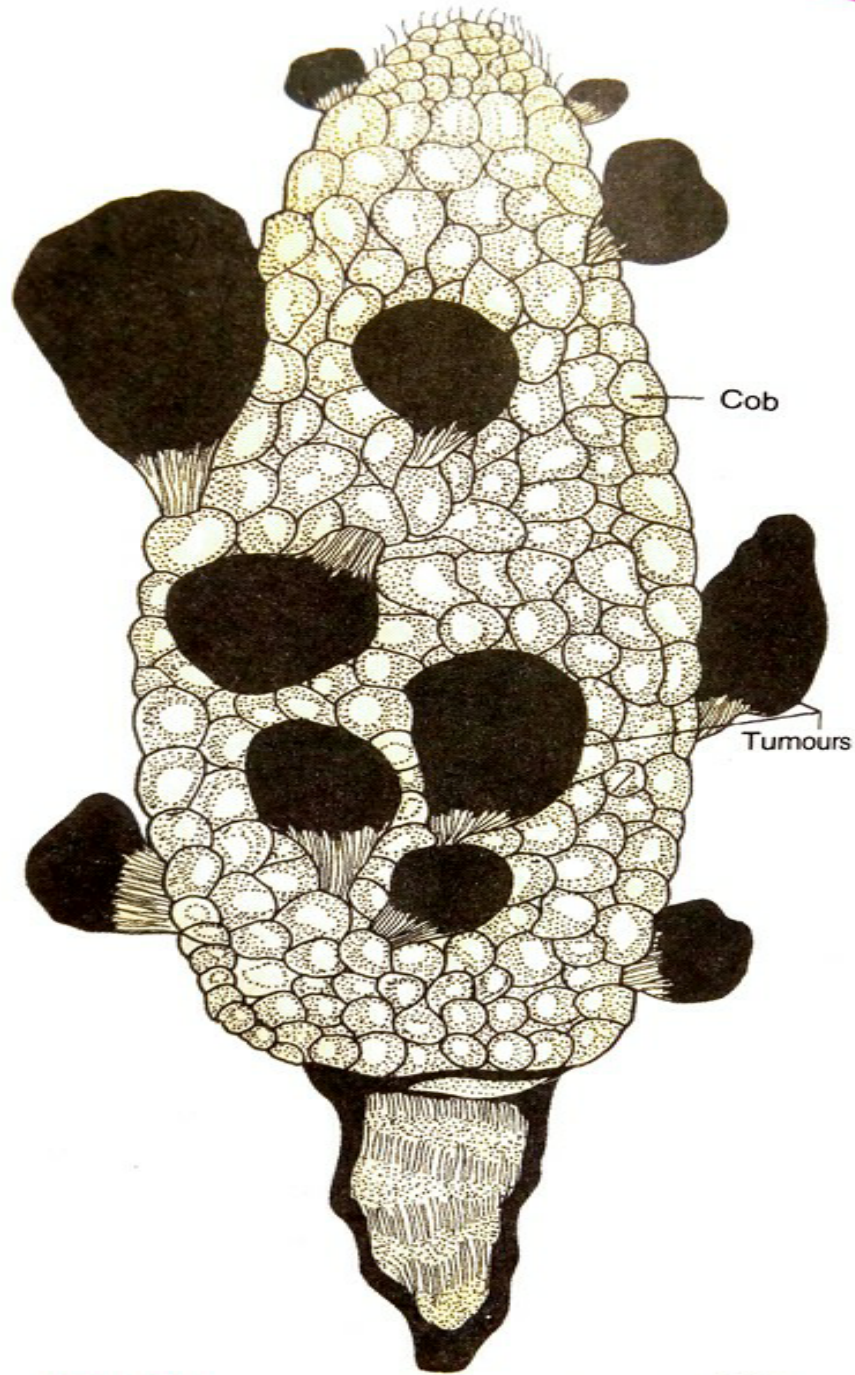


Fig. 14.8. *Ustilago maydis*. Infected cob of Maize showing tumours.

Fungal body

Thaloidal, hyphae mycelium (primary, secondary) Filamentous, branched
homokaryotic, heterokaryotic, Gametophyte,
achlorophytic,
septate.

cellular character

Eukaryotic cell

Cell wall-chitin(n-acetylene glucosamine)

Plasma membrane(loamosome)-

Cytoplasm-

Nucleus, Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- oil droplets.

REPRODUCTION CHARACTER

Generally two type reproduction show in fungi

1. Asexual reproduction-by conidia
2. Sexual reproduction-somatogamy type
Basidiospore chlamydospore

1. Asexual reproduction-by conidia

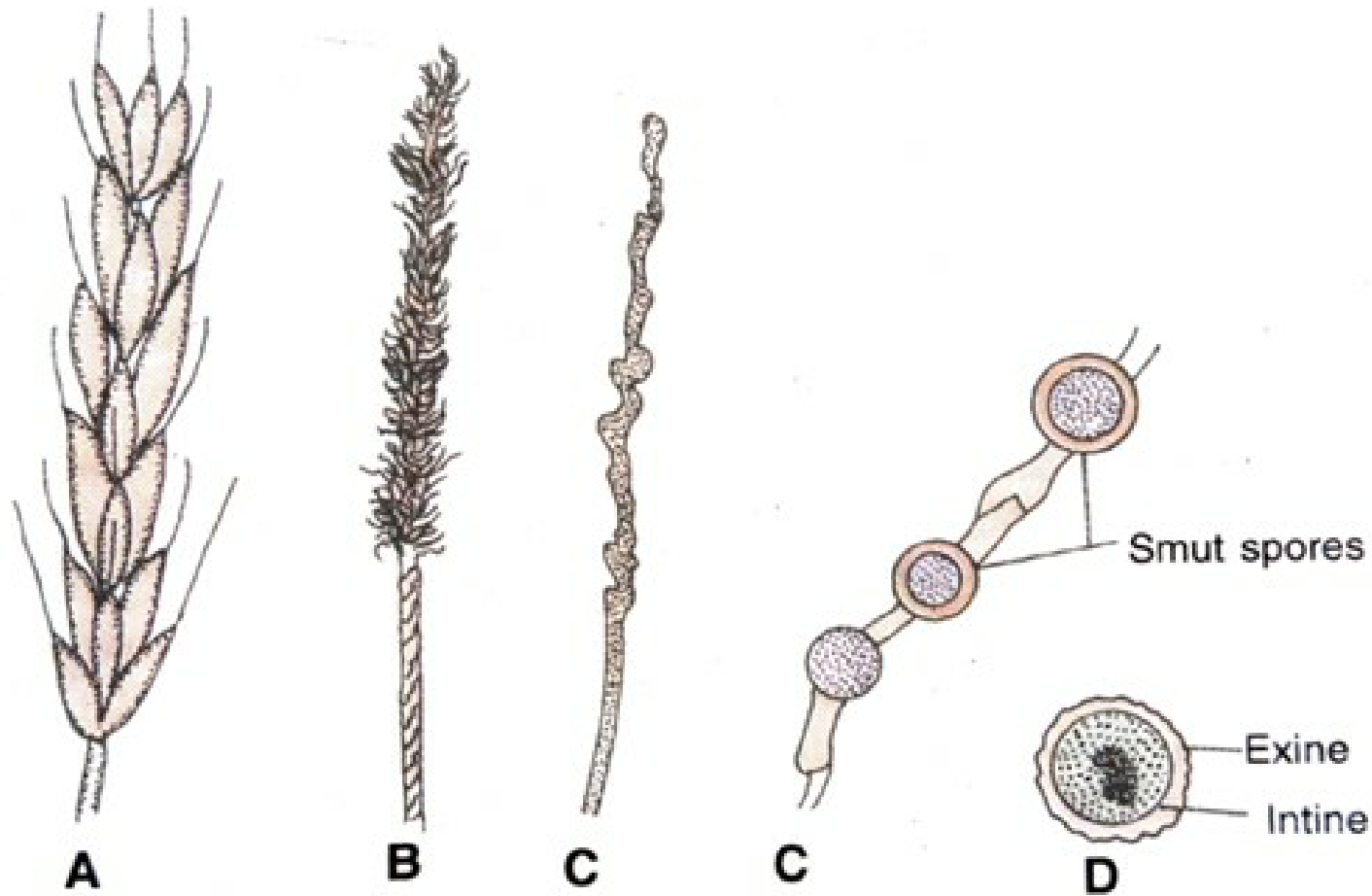


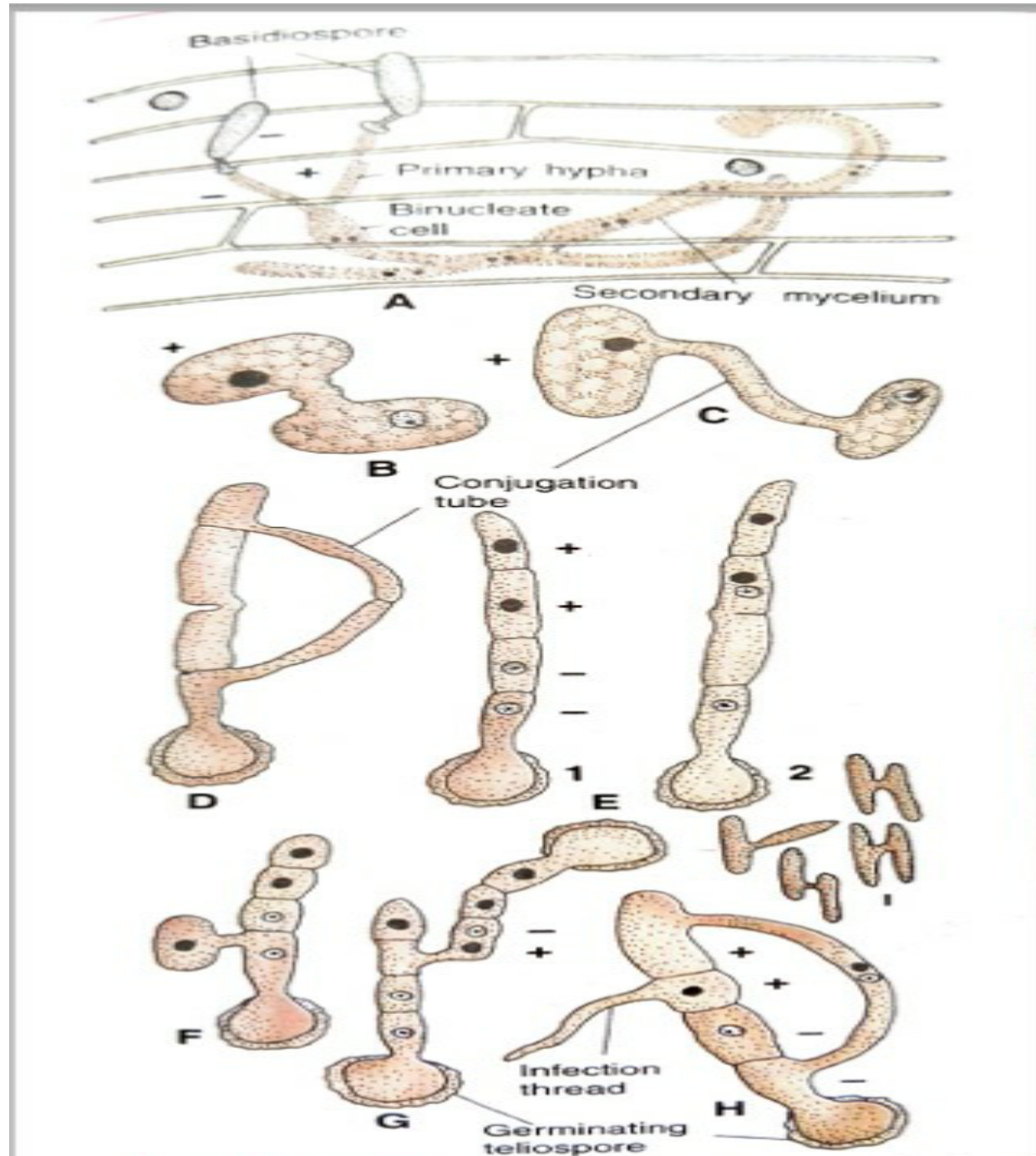
Fig. 14.3 (A-C). *Ustilago tritici*. A, Normal ear of wheat; B, Smutted ear of wheat; C, Naked, rachis left after the spores are blown away by wind; C, A portion of a hypha with smut spores; D, A binucleate smut spore.

2. Sexual reproduction-or dikaryotization

somatogamy type-

Basidiospore

chlamydospore



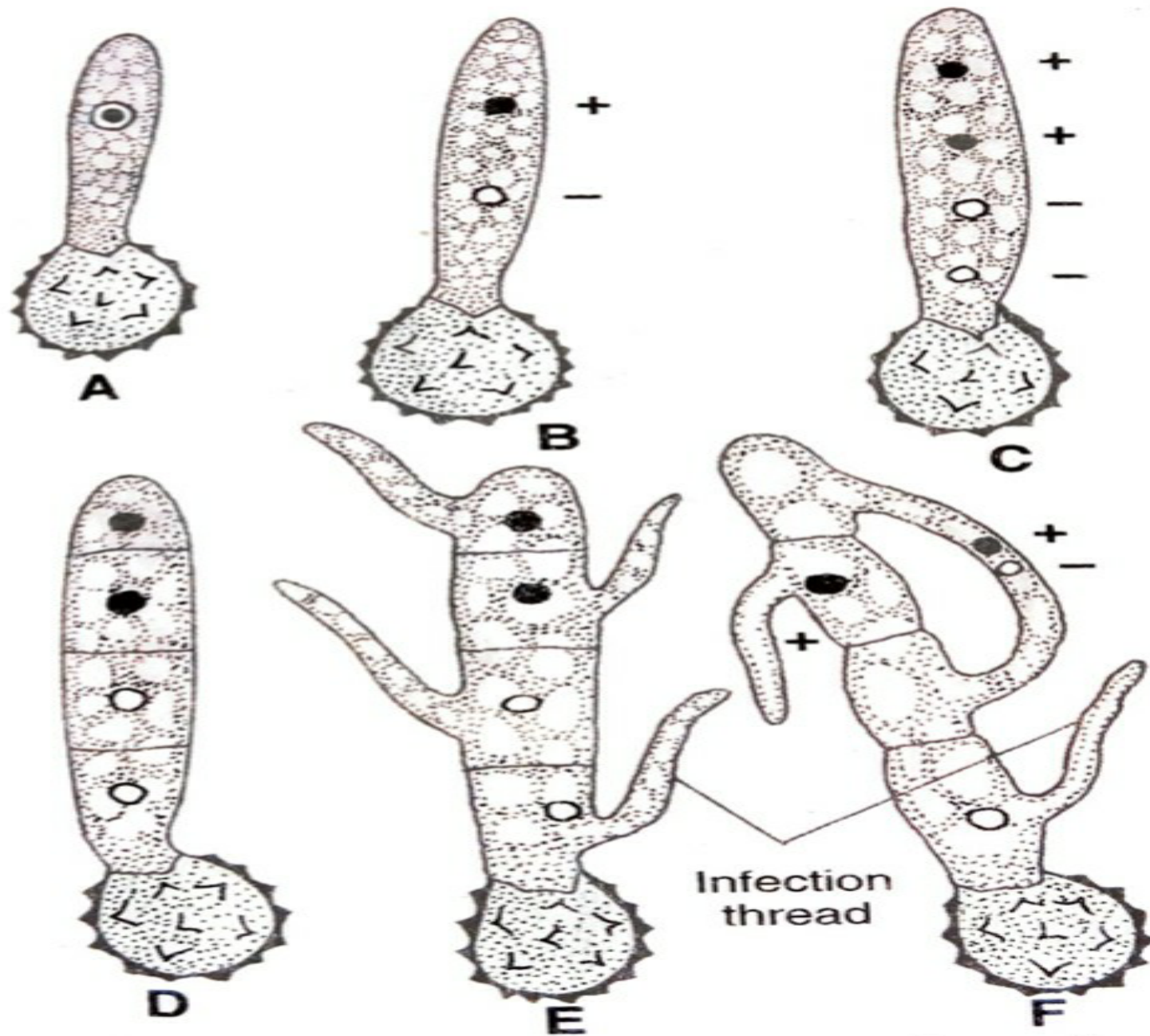


Fig. 14.5 (A-F). *Ustilago tritici*. Stages in the germination of smut spore and development of basidium and formation of infection threads instead of basidiospores.

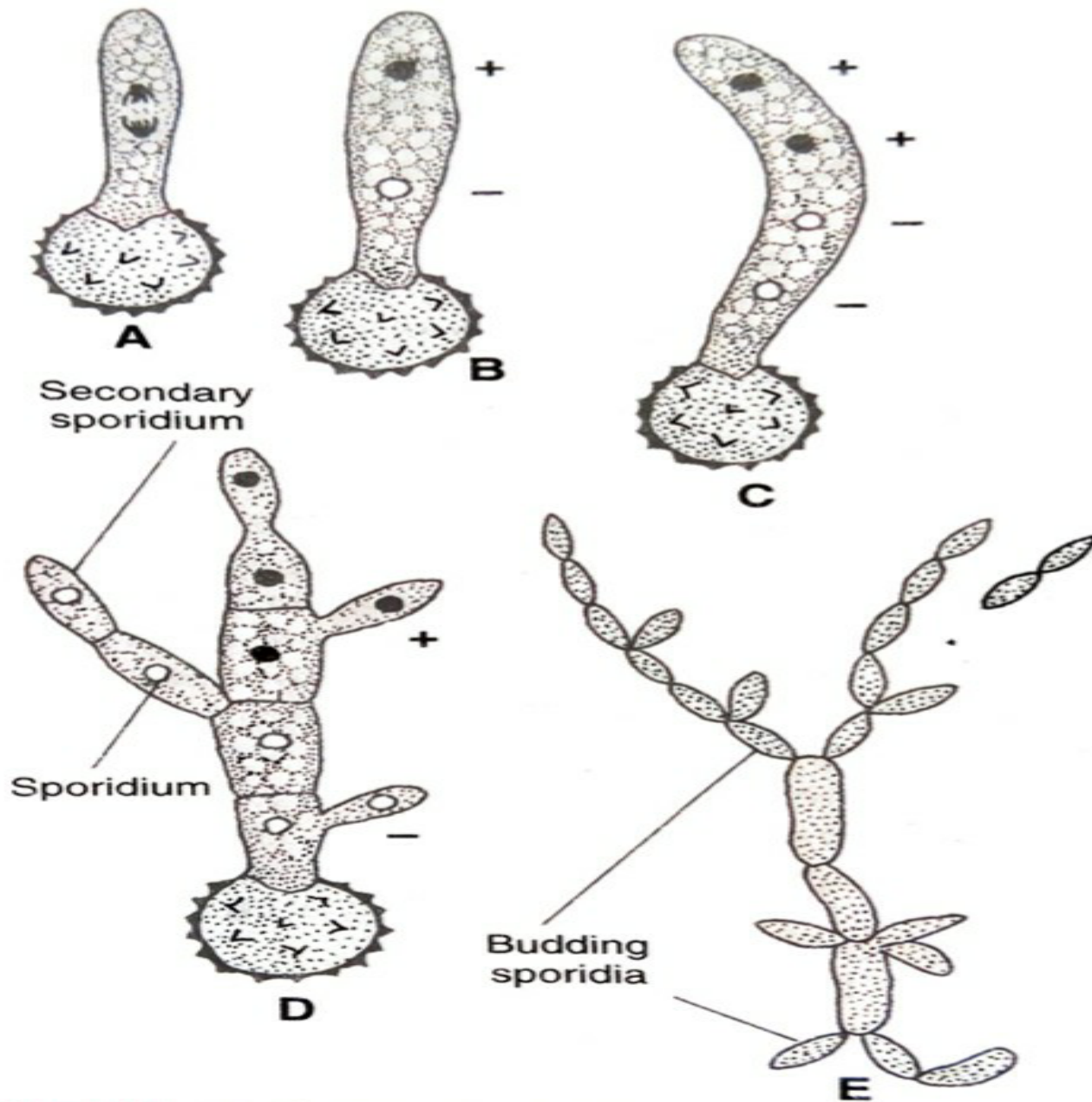


Fig. 14.4. *Ustilago maydis*. A-D, stages in the germination of smut spore and development of a phragmobasidium which bears the basidiospores or sporidia; E, promycelium budding to form numerous secondary sporidia or sprout cells.

Diagrammatic life cycle of ustilago

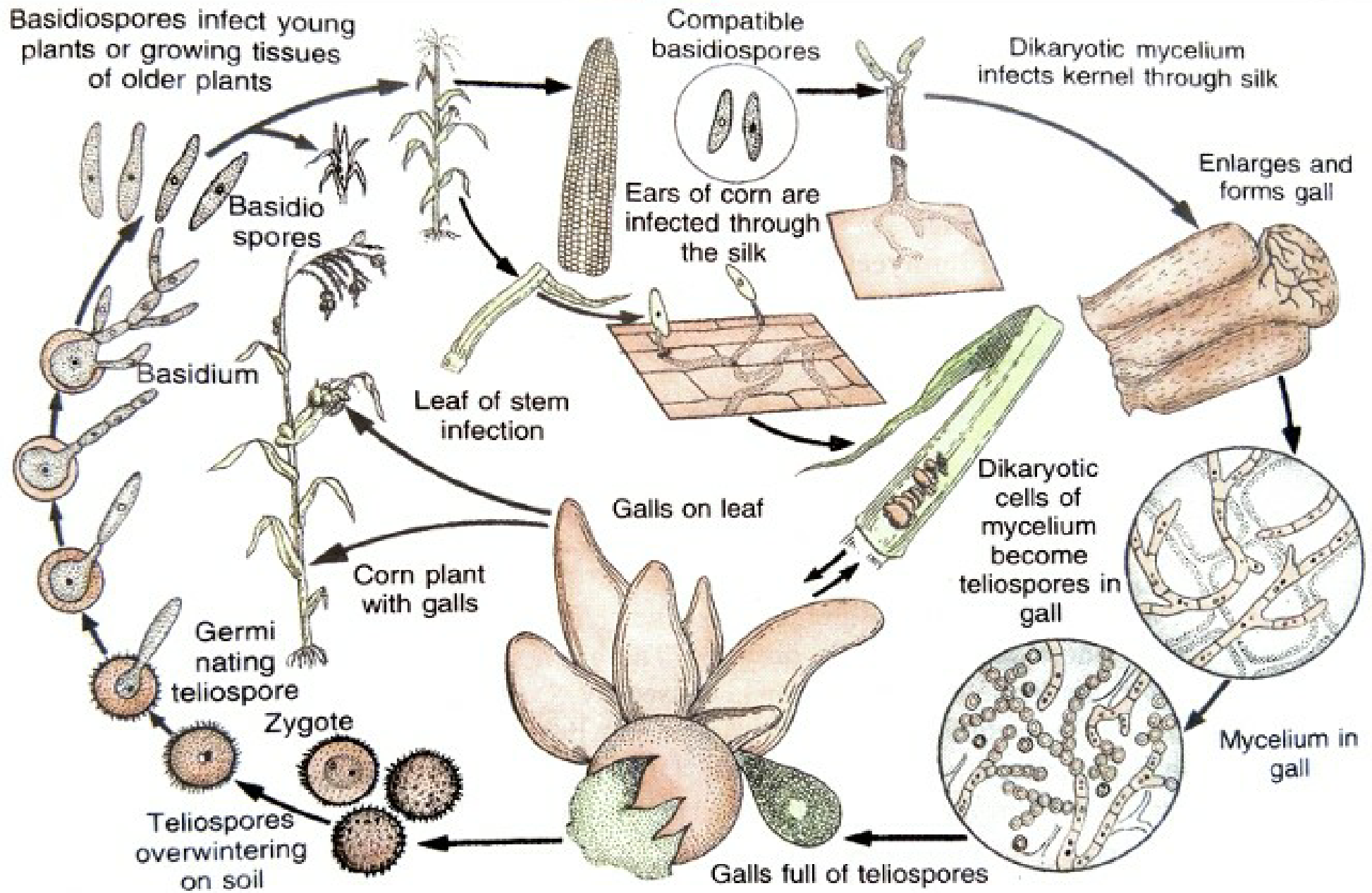


Fig. 14.9. *Ustilago maydis*. Diagrammatic disease cycle.

puccinia

❖ Systematic position

Kingdom-fungi

division-eumycota

sub-division-basidiomycotina

class-teliomycetes

Order-uridinales

family-Pucciniaceae

genus-Puccinia

Vegetative character

Habit and habitat

Identified spp.-1800

Indian spp.-147

Heterococious-life cycle complete in two different host(wheat,berberis,soil)

Obligate **Parasitic**-wheat ,maiz,berberis

Disease-

1. black rust- p.graminis tritici
2. yellow/orange rust –p.striformis
3. brown rust p.recondita

Fungal body

Thaloidal, hyphae mycelium, monokaryotic
obligate parasite, heterokaryotic, Gametophyte,
achlorophytic, septate.

cellular character

Eukaryotic cell

Cell wall-chitin(n-acetylene glucosamine)

Plasma membrane(loamosome)-

Cytoplasm-

Nucleus, Mitochondria, golgi body, endoplasmic reticulum, vacuoles carbohydrate, protein, volatile oil carotenoid pigment etc.

Food material- oil droplets.

Reproductive character

Spermatization

Polymorphic ,macrocyclic

Host spore

1. Wheat- uredospore,teleutospore

2. Soil - basidiospore

3. Barberis - pycnidiospore,acidiospore

1. Life cycle on Wheat

uredosorus (uredospore)

Teleutosorus (teleutospore)

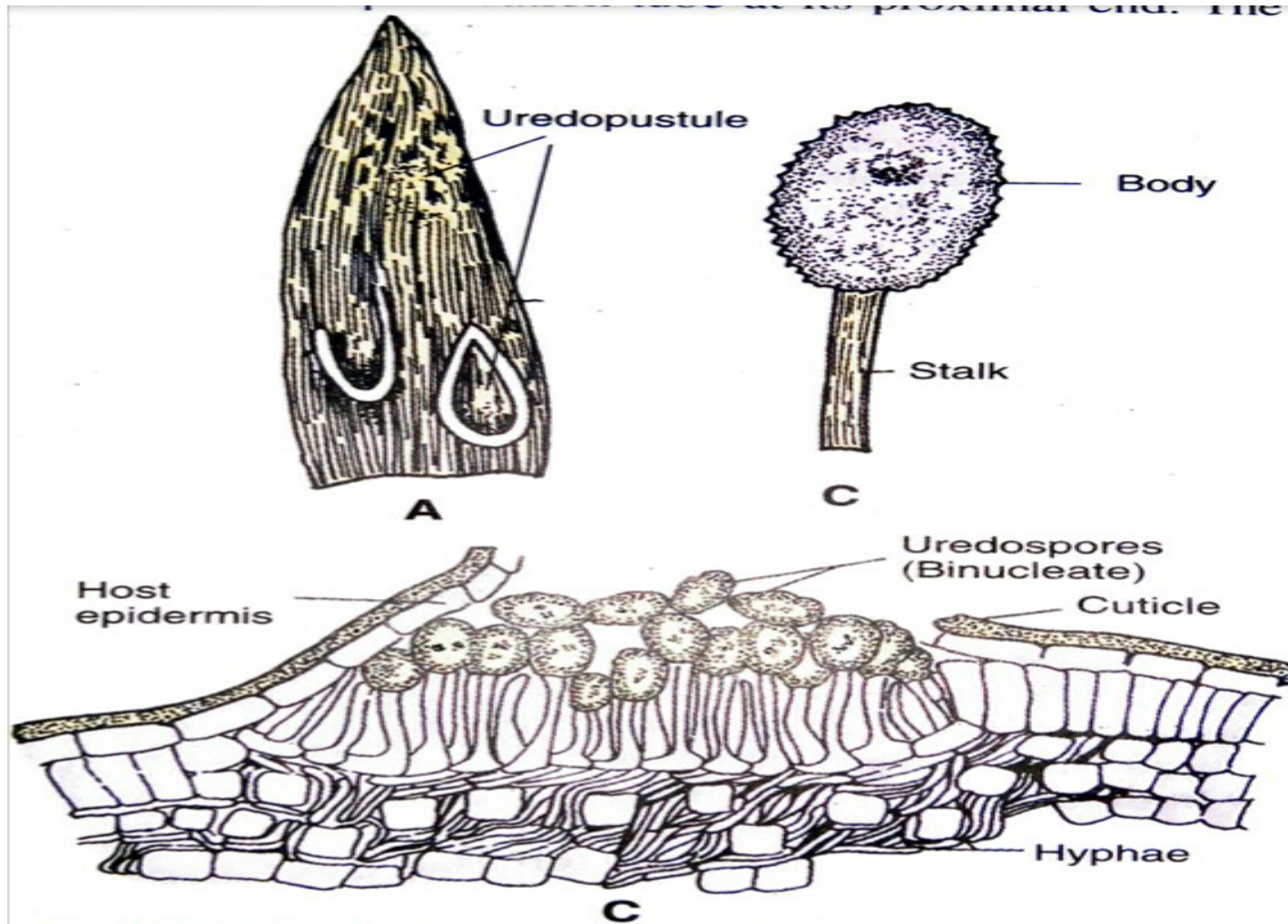


Fig. 14.14 (A-C). Uredineal stage of *Puccinia graminis tritici*. A, Uredosori on wheat leaf; B, A section through the uredosorus; C, A single uredospore.

Germination of uredospore

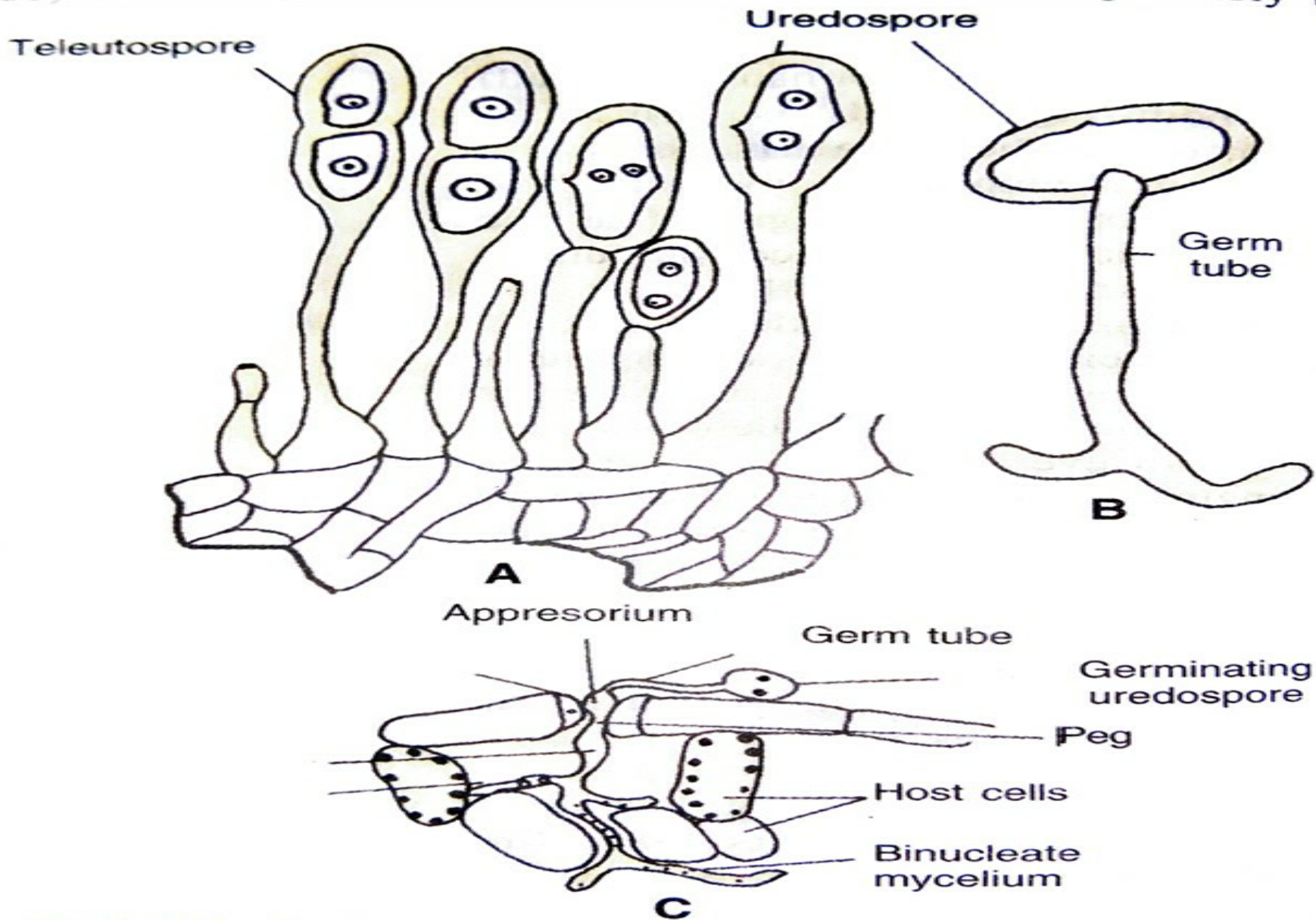


Fig. 14.15 (A-C). *Puccinia graminis tritici*. A, Sorus with both uredo and teleutospores; B, Germination of uredospore; C, Infection of wheat leaf by a germ tube through a stoma.

Teleutosorus (teleutospore)

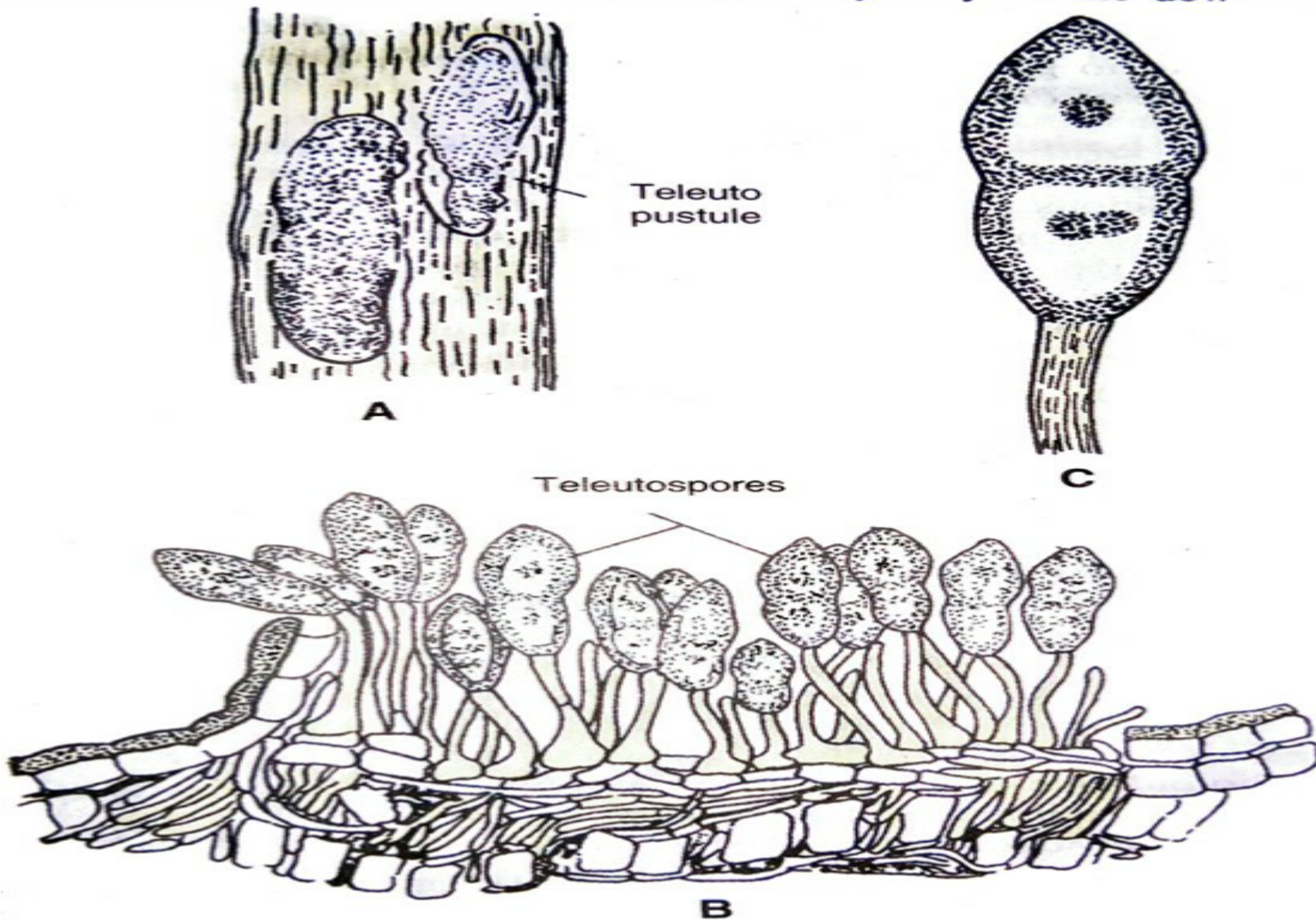


Fig. 14.16 (A-C). Telial stage of *Puccinia graminis tritici*.
A, Teleutosori on wheat; B, A section through the teleutosorus;
C, Single teleutospore with a fusion nucleus in each cell.

2. Life cycle on Soil basidiospore

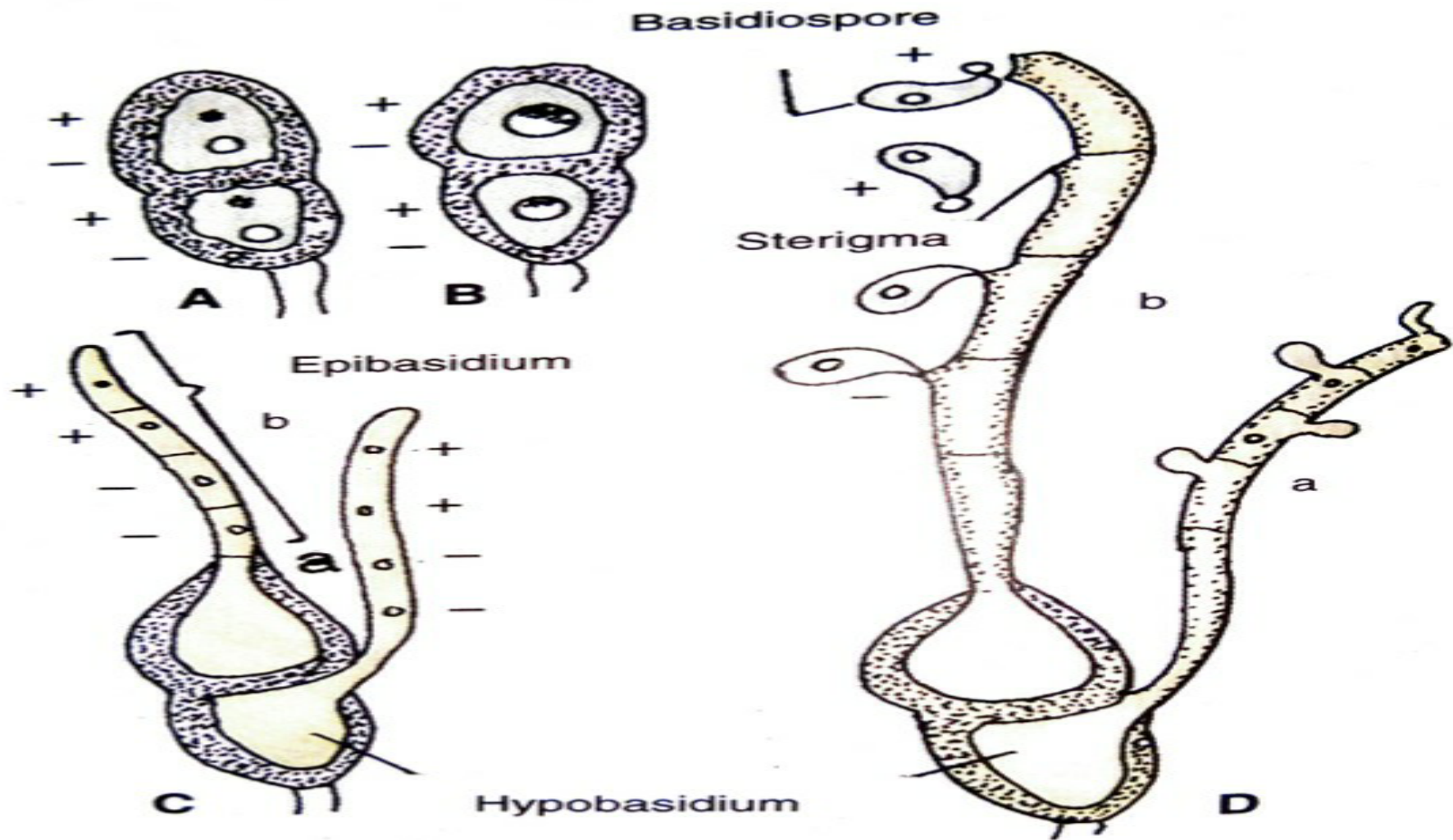


Fig. 14.17 (A-D). *Puccinia graminis tritici*. A, Young teleutospore; B, mature teleutospore; C, germinating teleutospore and meiosis; D, basidial stage.

3.Life cycle on Barbers-

• pycnidiospore,acidiospore

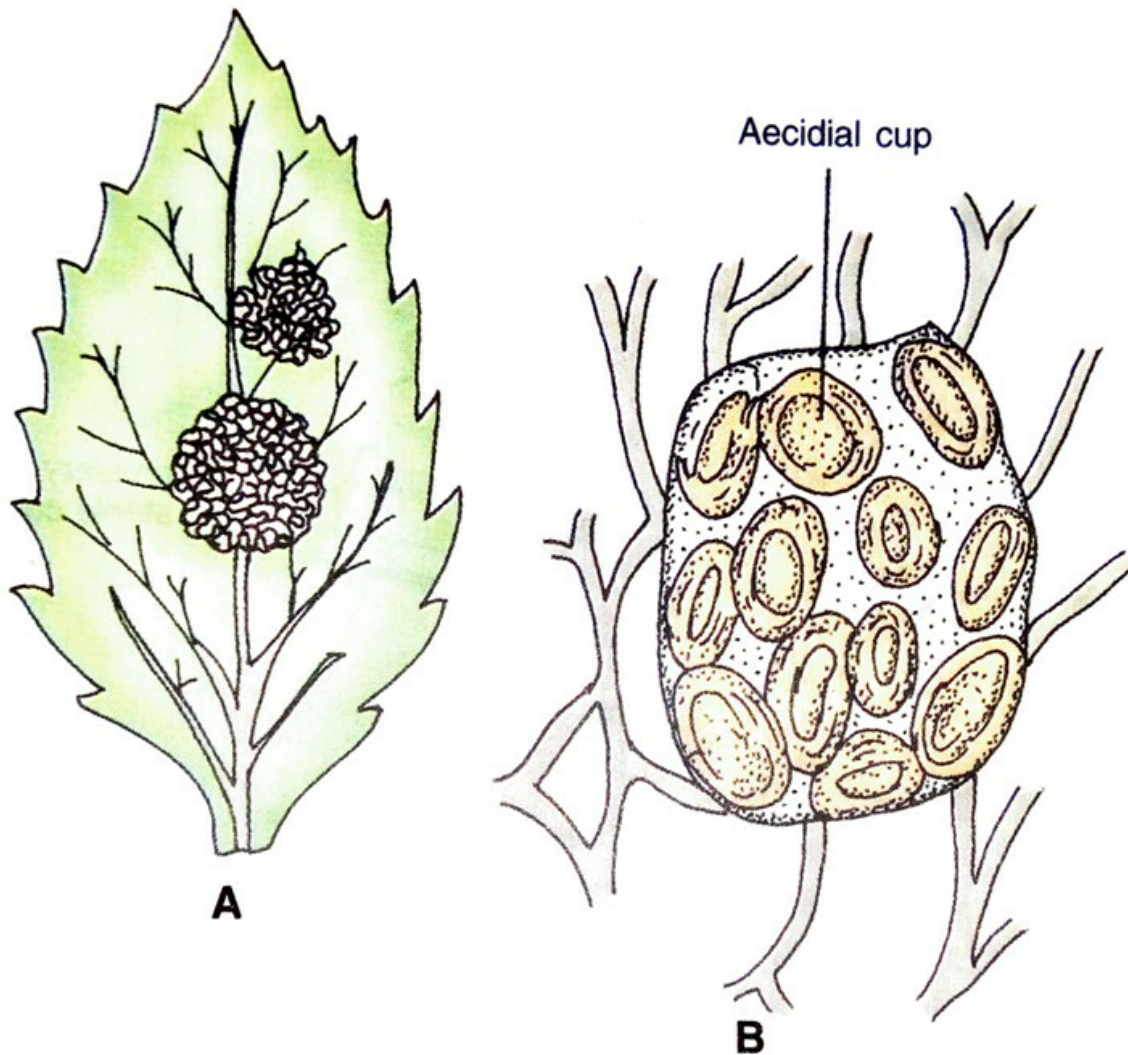


Fig. 14.21 (A-B). *Puccinia graminis tritici*. A, An infected leaf of *Barberis* with acedial cups on the lower surface; B, The same enlarged

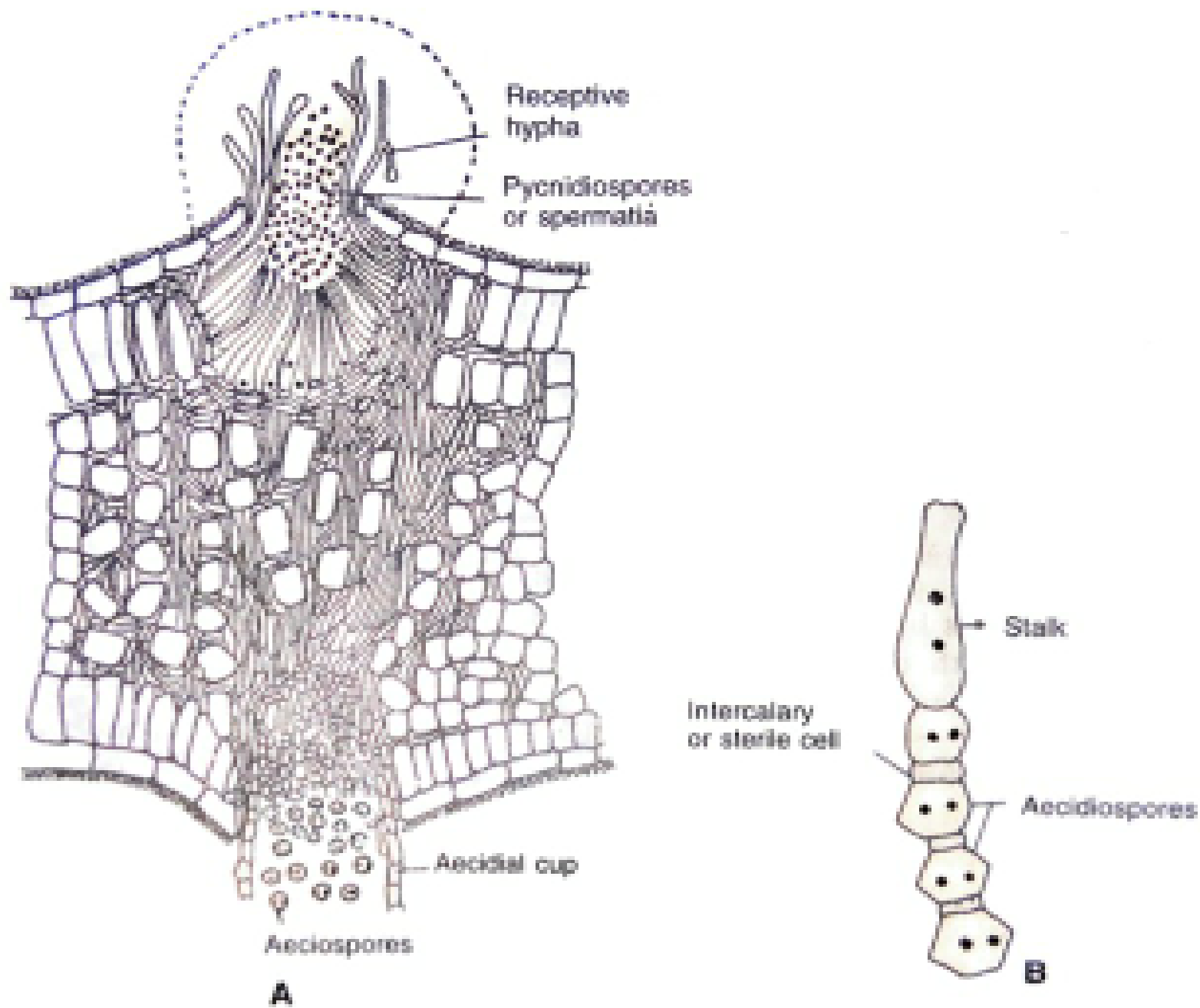


Fig. 14.22 (A-B). *Puccinia graminis tritici*. Spermatogonial and acedial stages. A, V. S. Berberis leaf showing a spermatogonium (pycnidium) on the upper surface and an acedial cup on the lower surface; B, showing mode of development of acediospores.

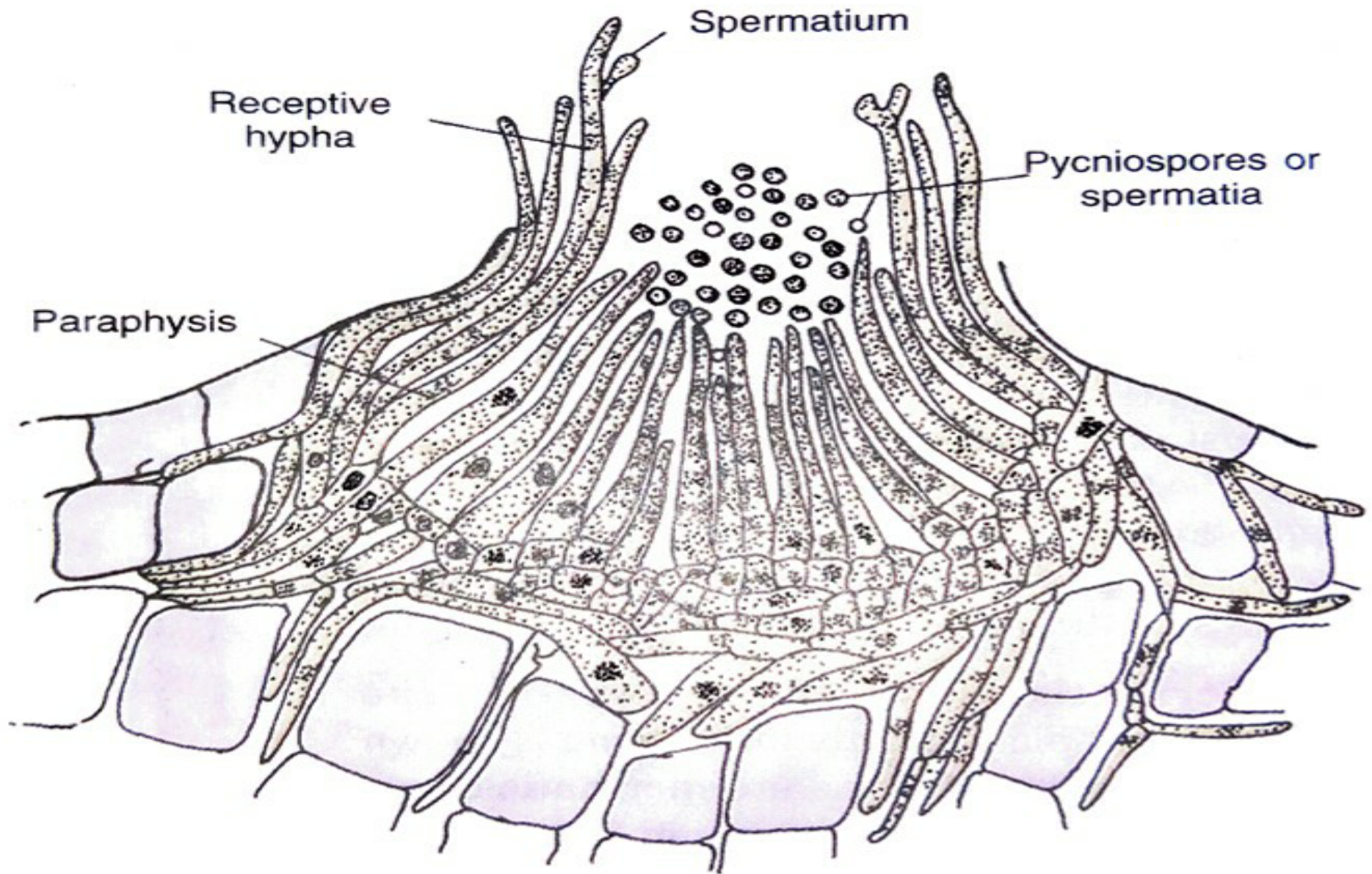


Fig. 14.18. *Puccinia graminis tritici*. A mature spermogonium in section.

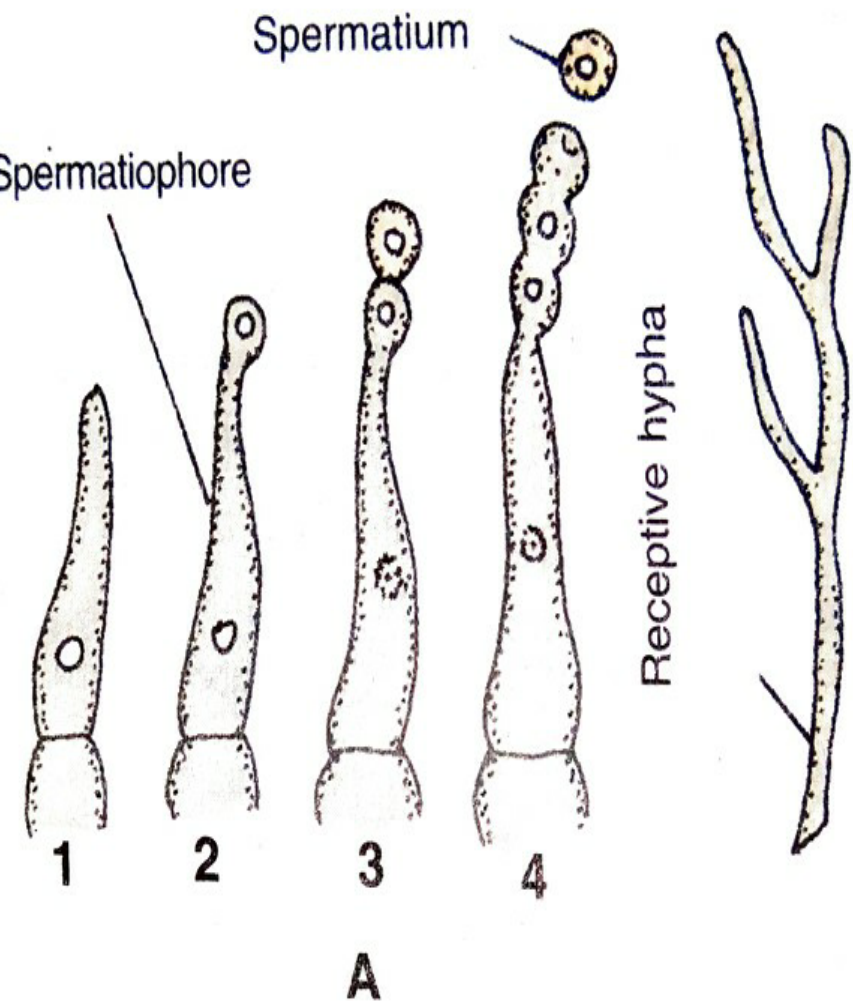


Fig. 14.19 (A-B). *Puccinia graminis tritici*. A, steps in the development of spermatia at the tips of spermatophores; B, receptive or flexuous hypha (Based on Allen).

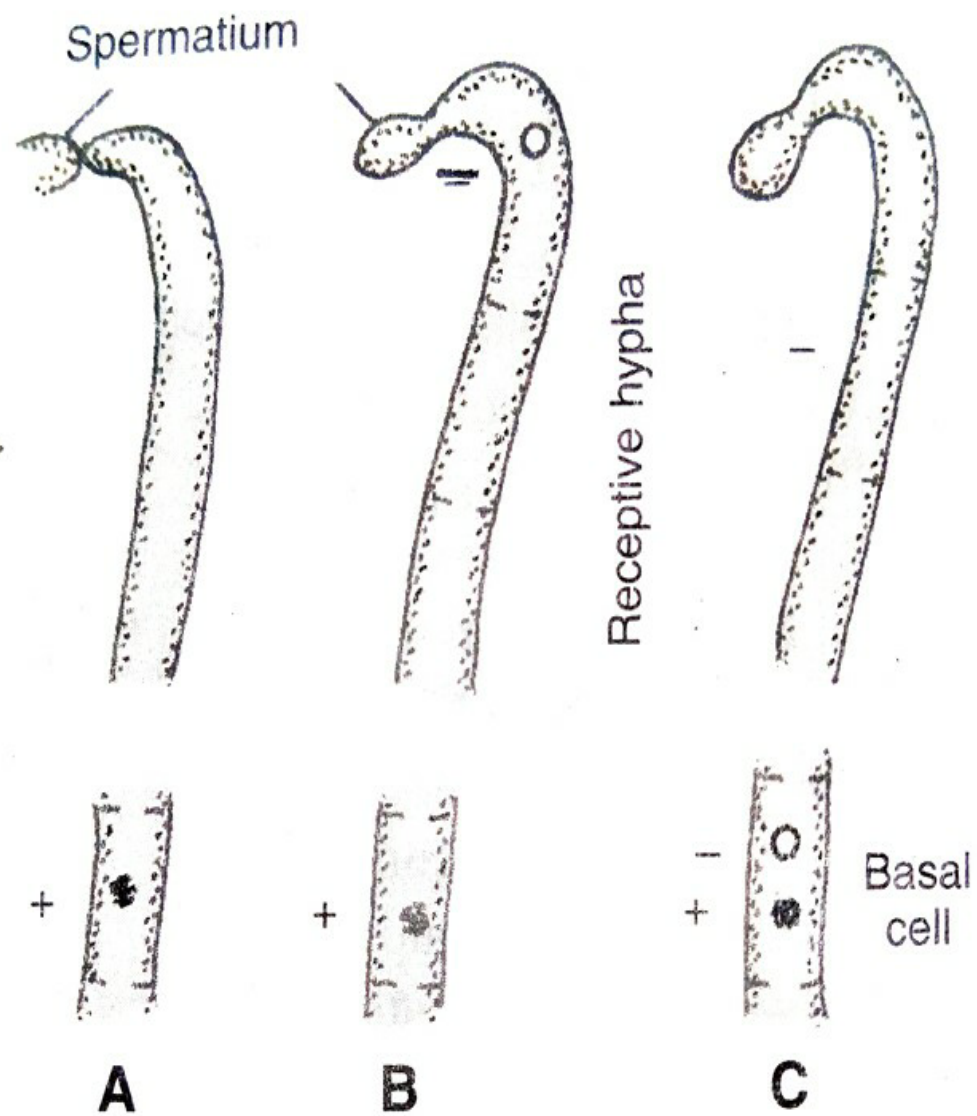


Fig. 14.20 (A-C). *Puccinia graminis tritici*. Stages in spermatisation of flexuous or receptive hyphae (Diagrammatic).

Diagrammatic life cycle of puccinia

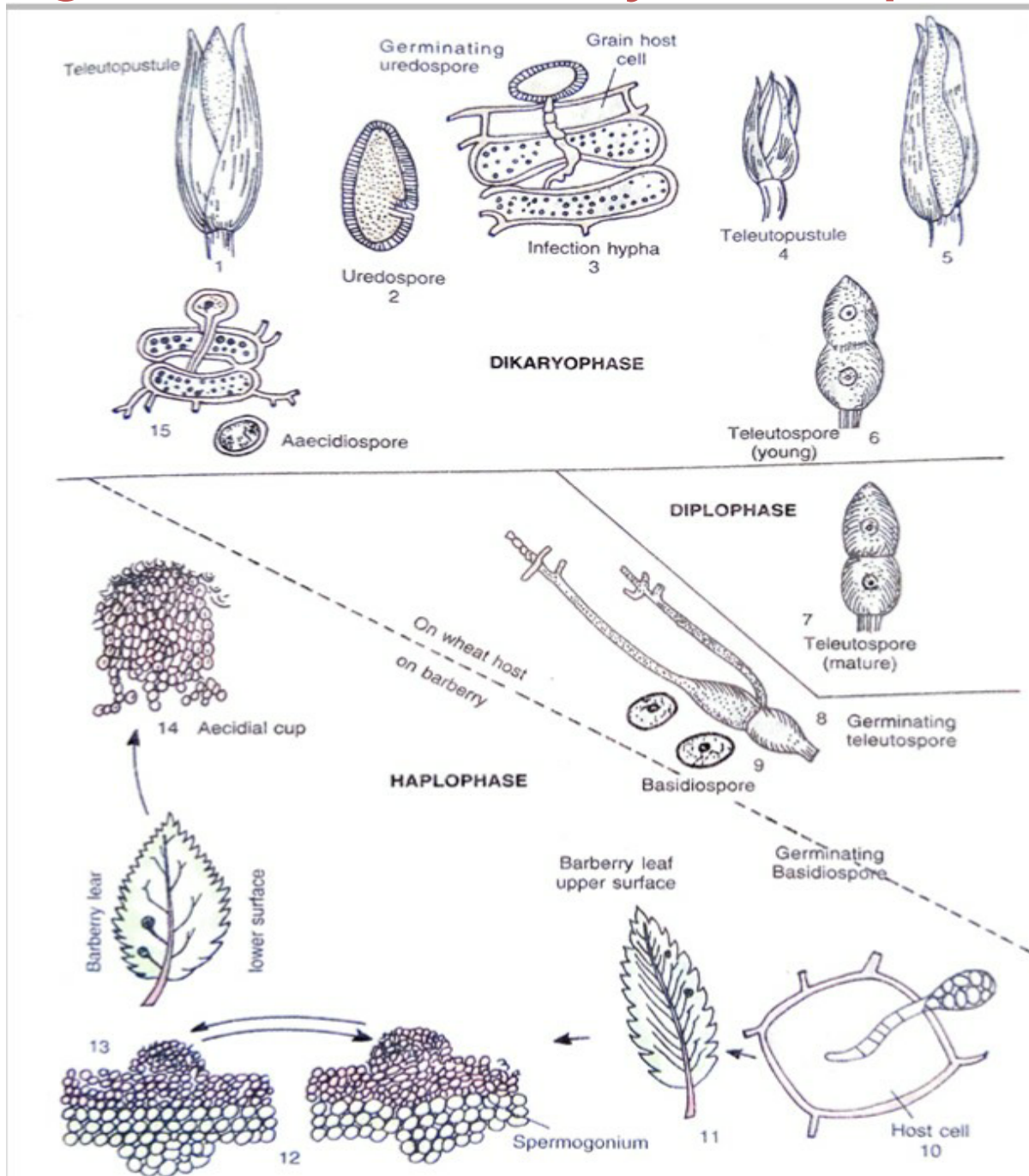


Fig. 14.24. Diagrammatic representation of the life cycle of *Puccinia graminis*.

Alternaria

Systematic position

Kingdom-fungi

division-eumycota

sub-division-deuteromycotina

class-deuteromycetes

Order-moniliales

family-dematiaceae

genus-alternaria

Vegetative character

Habit and habitat

Parasitic ,saprophytic ,cosmopolitan

Alternaria brassica

Alternaria brassicicola

Alternaria alternata

Alternaria solani

Disease –

early blight disease of potato -Alternaria
solani

Black point disease of wheat -alternaria tenuis

Fungal body

- Mycelium

Short, septate, branched, intracellular, brown/yellow colored multinucleated.

- Disease-early blight disease of potato
- Pathogen – *A.solani*
- Host- potato
- Disease symptoms – yellow round or angular spot on leaf
- Necrosis
- Black spot premature defoliation

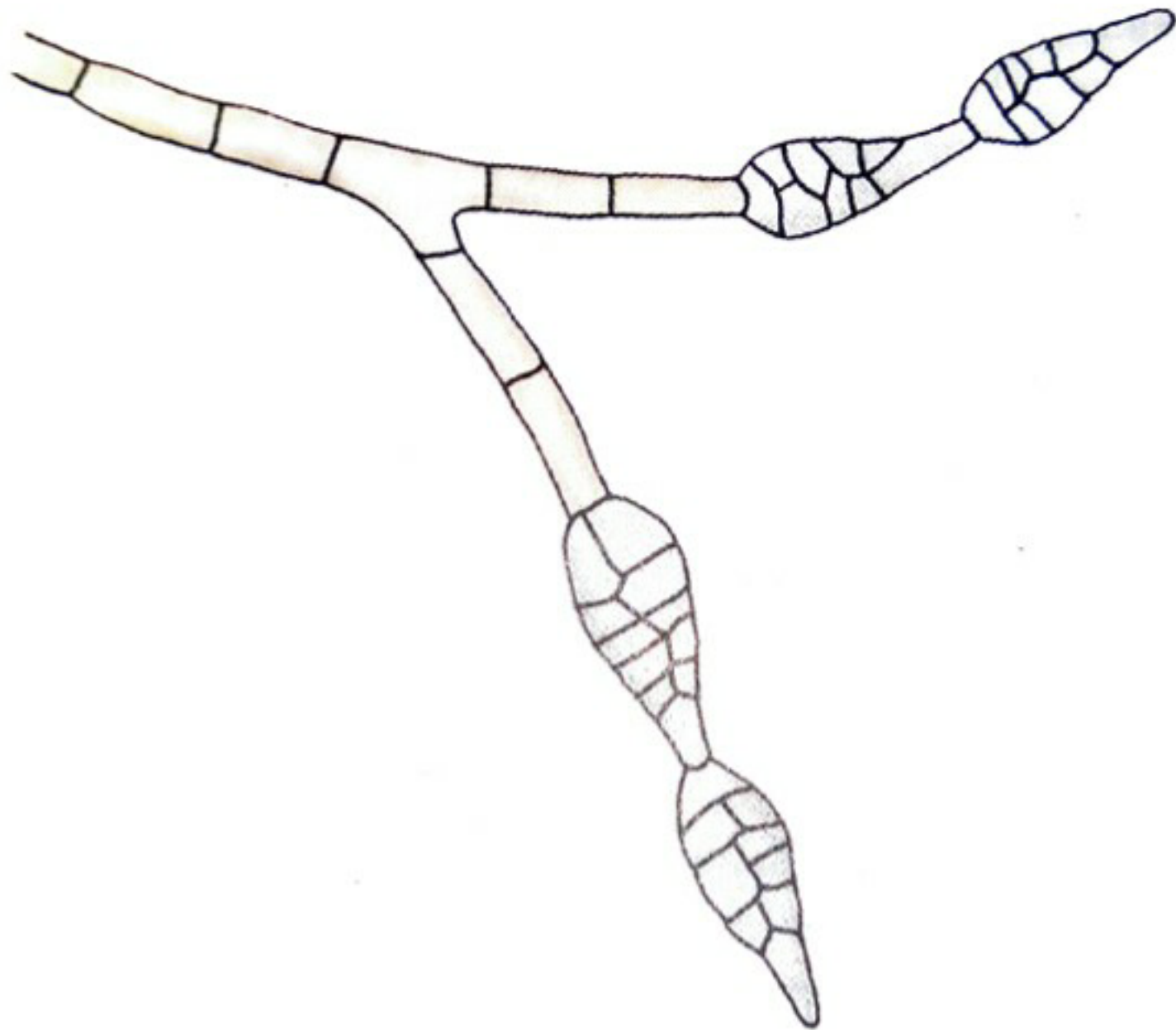


Fig. 16.9. *Alternaria sp.* Hyphae bearing multicellular muriform conidia.

Reproductive character

Asexual reproduction

By conidia

Conidia- multicellular, setae, longitudinal, transverse septa, yellow / brown colour.

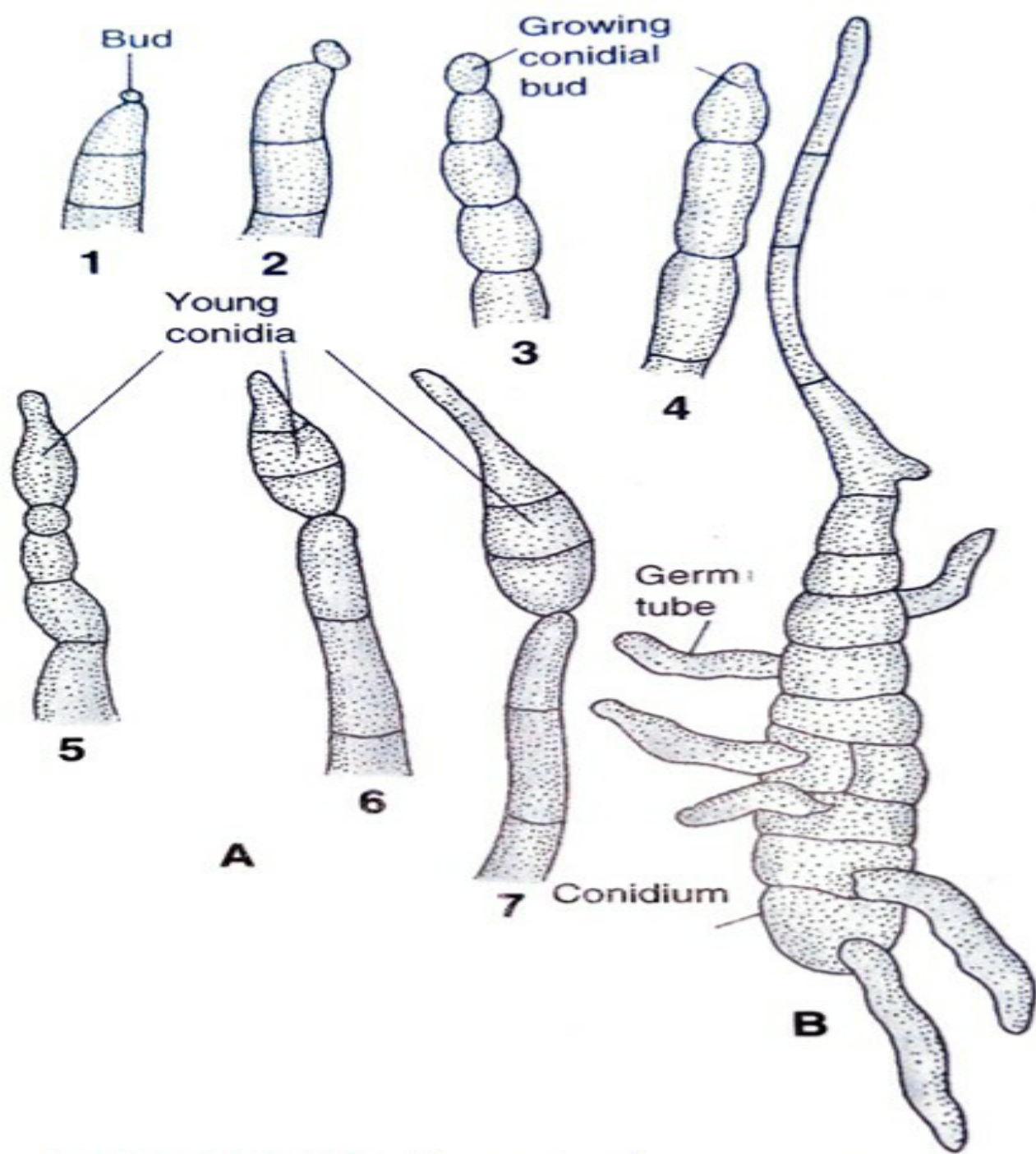


Fig. 16.10 (A-B). *Alternaria solani*. A₁₋₇, stages in the development of conidium; B, germinated conidium. (After Rands).

Cercospora

Systematic position

Kingdom-fungi

division-eumycota

sub-division-deuteromycetes

class-hyphomycetes

order-moniales

family-dematiaceae

genus – Cercospora

Species-Personata

Vegetative character

Habit and habitat

Identified spp. 3800

Indian spp.700

c.personata/arachidichola

c.Oryzae

c.nicotiana

c.indica

c.beticola

c.coffeicola

Saprophytic, parasitic

(Tikka disease)

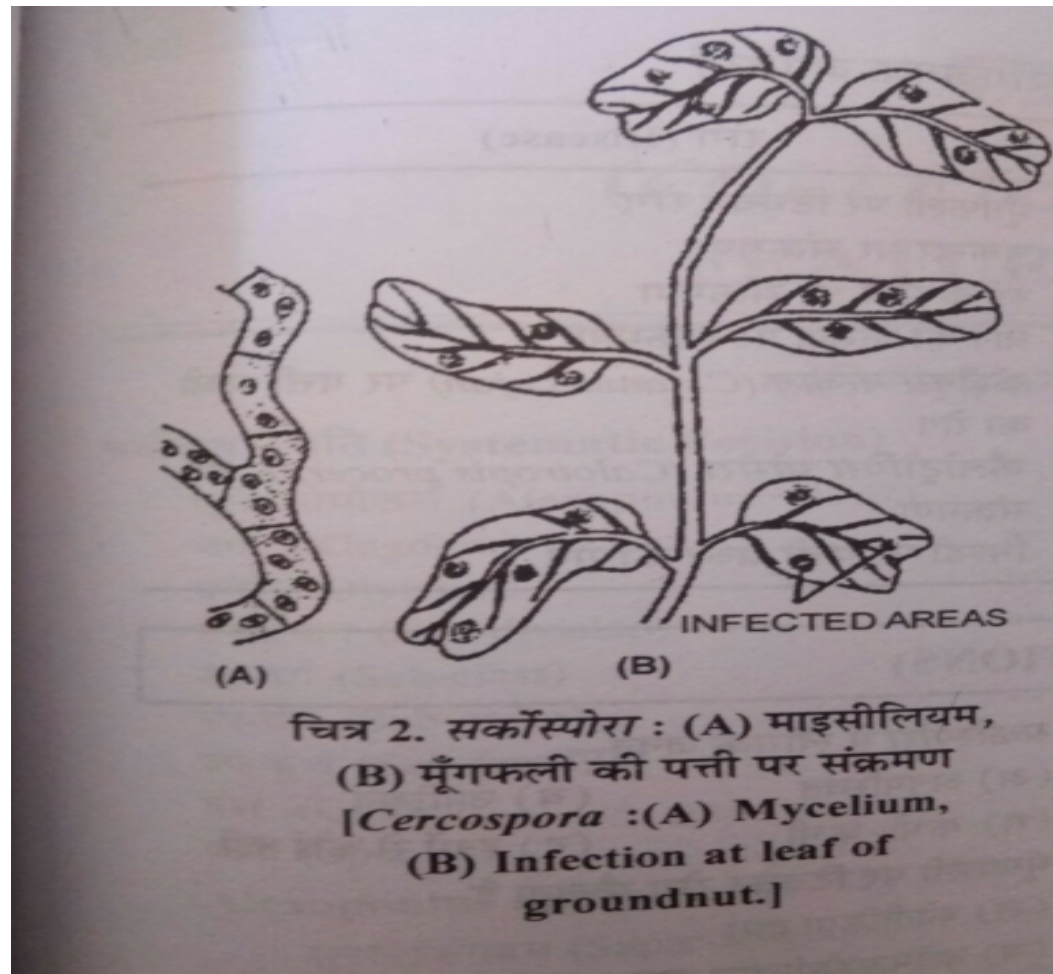
Tikka disease

- Pathogen-cercospora personata/cercospora arachidichola
- Host-groundnut
- Symptoms-
 1. yellow leaf spot
 2. Necrosis
 3. Black leaf spot



Fungal body

Hyphae mycelium branched multicellular septate houstoria.



Reproductive character

Asexual reproduction

By conidia

Conidia-

multisped

Brown, black colour.

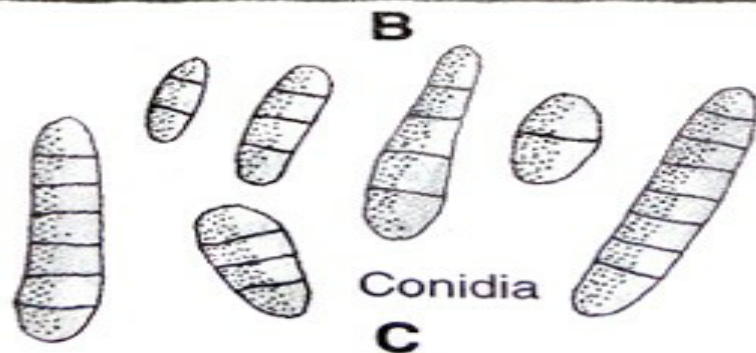
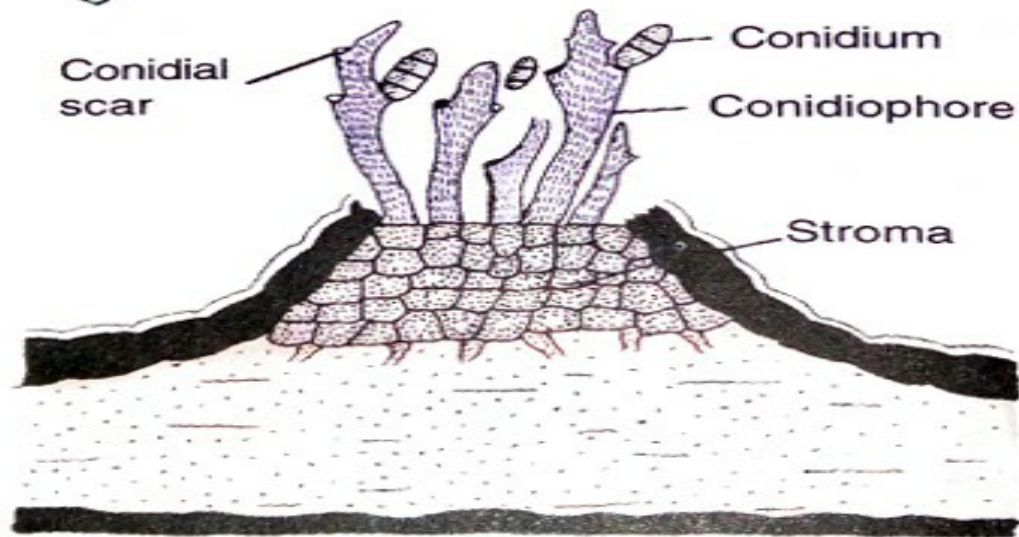
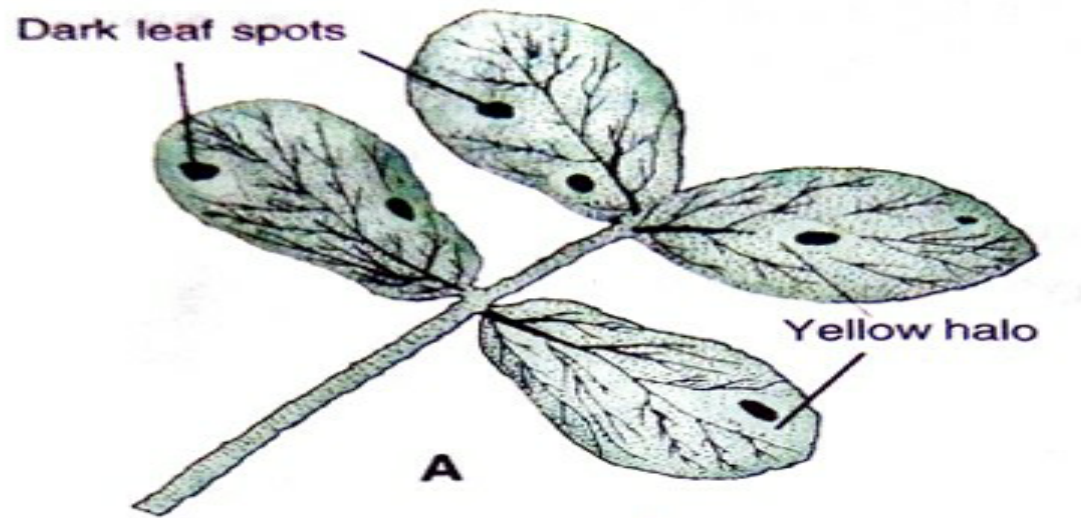


Fig. 16.11 (A-C). *Cercospora* sp. A, Leaf spots on the leaflets of *Arachis hypogaea*; B, L.S. acervulus with the geniculate conidiophores emerging; C, conidia.

VAM FUNGI