

Division : Ascomycota
 Class : Dothideomycetes

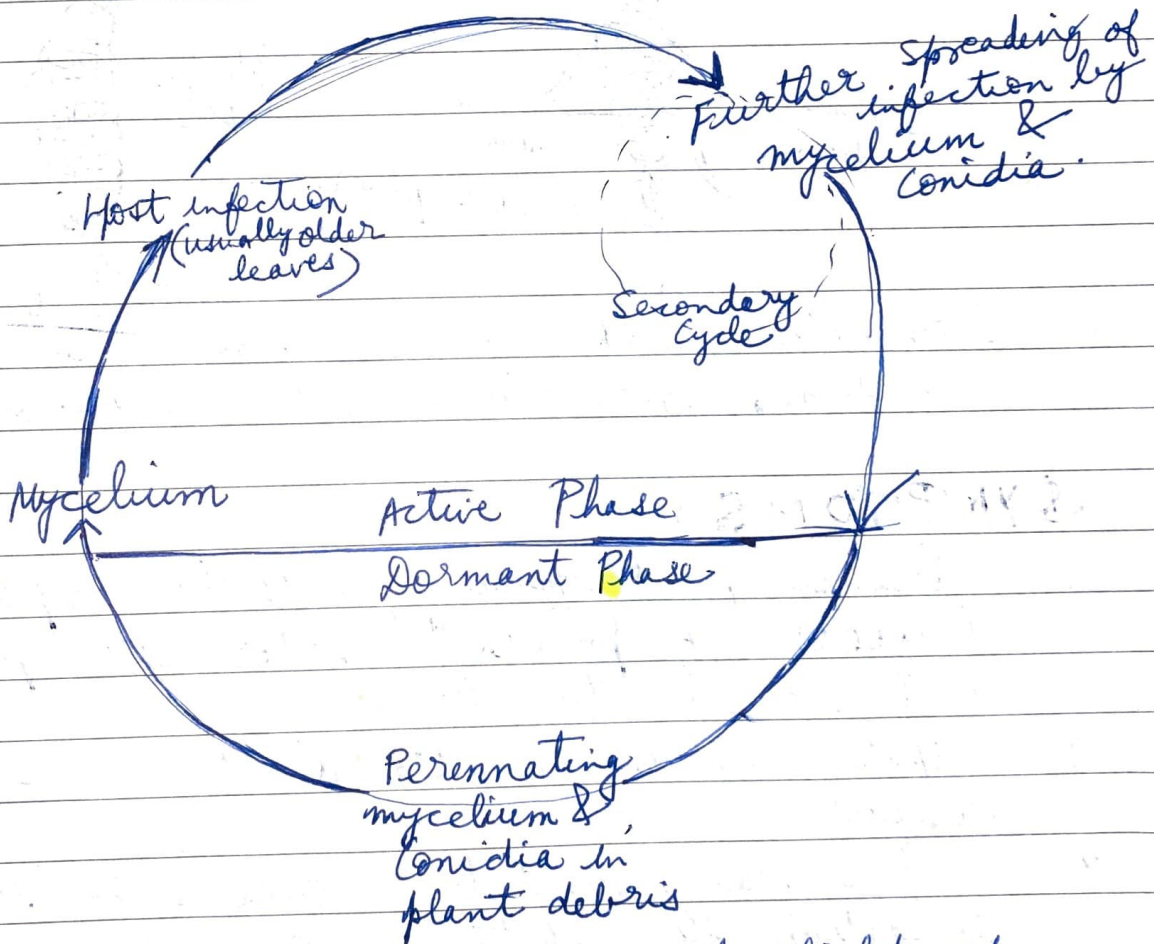
Order: Pleosporales
 Family: Pleosporaceae
 Genus: Alternaria

Early Blight of Potato.

Causal

Pathogen : Alternaria solani (Ell. & Mart.) Jones & Groot
 Class : ~~Ascomycota~~ (Sexual repⁿ absent)
 Order : ~~Dothideales~~ (asexual " by conidia)
 Family : ~~Dothideaceae~~ (conidia is produced in mycelium itself not in any fruiting body)

The disease is also known as 'leaf spot' & 'Alternaria blight'. (foliage disease.)



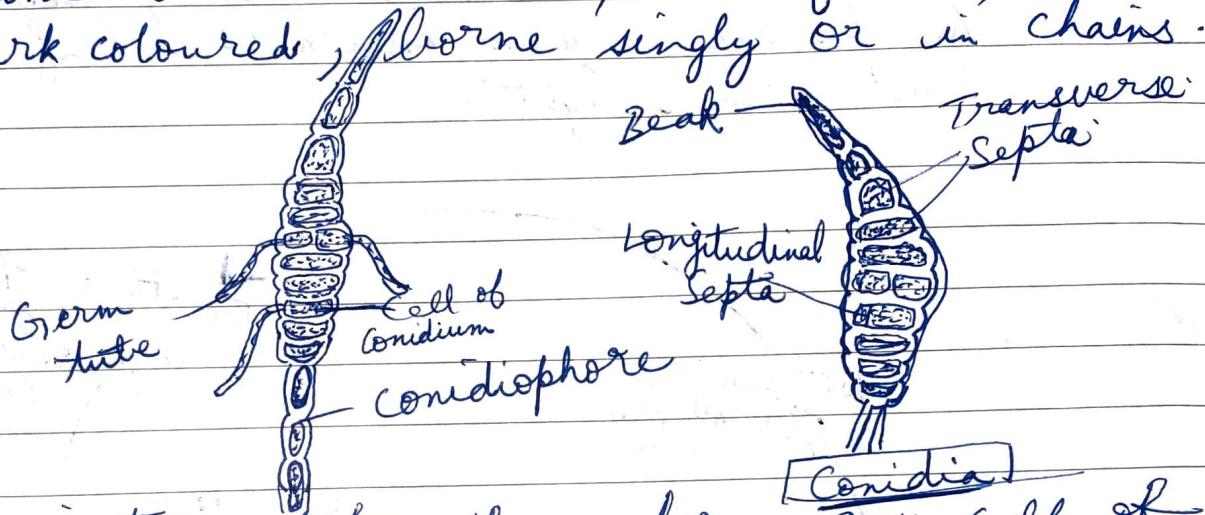
Disease cycle of Early Blight of potato.

Causal organism : 1. Alternaria solani (Ell. & G. Martin)
 L. R. Jones & Groot.

2. The fungus possesses septate, branched mycelium which becomes dark coloured with age.
3. Mycelium ramifies in intercellular spaces & penetrates ^{cells of} host tissue (potato leaf)

4. Once invaded tissue is filled with mycelium of ^{From mycelium arises} short, dark coloured, septate & erect Conidiophores, which emerge from the stomata or from older diseased host tissue.

5. Conidia are beaked, ^{resembling course of bricks in arrangement} ~~uniform~~, dark coloured, borne singly or in chains.



6. Germination takes place from any cell of Conidium, Germ tubes enter leaf & cause new infection.

SYMPTOMS:

1. Disease first appears as yellow spots on leaflets of potato plant. Later the spots become dark brown to black.
2. Spots remain scattered on the surface of leaflets.
3. Spots are rounded or oval. In severe condition the spots merge with each other forming bigger lesions. In severe conditions whole leaf is covered with angular spots.
4. These circular spots are dead areas with concentric rings or ridges producing a characteristic "target-board effect".
5. Lowest leaves are affected first.
6. Disease progresses upwards.
7. Leaves of potato dry up & droop & have broken irregular margins.

8. In severe conditions disease spreads to petioles, stems & tubers.
9. Skin of infected tuber become dark brown & has rounded spots. These spots are slightly sunken & vary in size upto 2 cm in diameter.
10. Pulp of tuber beneath ~~the~~ infected skin becomes rusty & brown.
- 11.) ~~Severe~~ Foliage injury causes small tuber, soft skinned, deficient in starch poor quality tubers.

Disease Cycle: This is a Soil-borne disease

- 1.) Primary inoculum for primary infection is Conidia which remains viable upto seventeen months. Even new conidia develop from mycelium of previous year's crop & cause fresh infection (dry infected leaves)
- 2.) Conidia germinate at an optimum temp. of 28°C to 30°C.
- 3.) Moist weather followed by high temp. help in abundant production & germination of Conidia. (incubation period is shortened to 48 to 72 hrs.)
just after 3 days of infection.
- 4.) Fungus penetrates the host through stomata & even epidermis.
- 5.) Conidia are ^{detached &} carried by air wind to fresh mature potato plants ~~for~~ where they cause infection.

Control:

1. Crop rotation - is a successful measure to avoid primary infection from conidia that have survived from previous year's infected plant.
2. Sanitation - Plant debris & dead haulms should be collected & burned after harvest.
3. Spraying of fungicides: timely spraying.

disease.

- a.) Copper fungicide or Zineb at 15 days interval
- b.) Weekly spraying of Bordeaux mixture (5:5:50) throughout growing period,
- c.) Foliar sprays are

Fungicide as

- Dithene M-45 (0.2%)
- Dithene Z-78 (2 lb / 100 gallon)
- Biltor-50 (0.25%)
- difolatan & captan (0.2%)
- Zineb (0.2%)

four to five sprays.

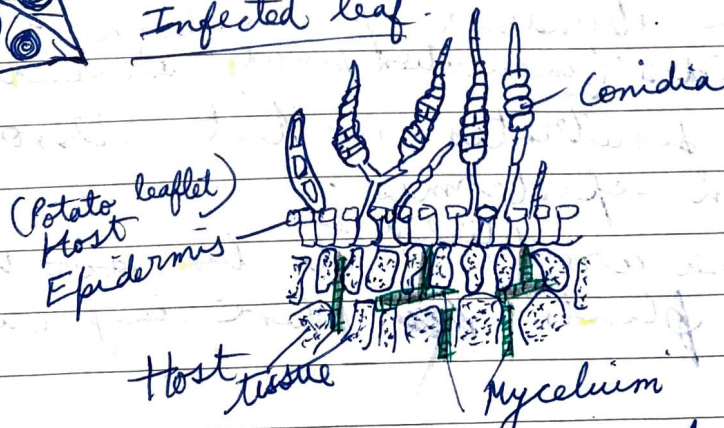


Target board effect



Infected tuber

Infected leaf



Section of infected leaf showing mycelium, Conidiophores & Conidia

Aspergillus (200 sps.)

Kingdom - Fungi
 Div. - Ascomycota
 Class - Eurotiomycetes.
 Order - Eurotiales
 Family - Trichocomaceae (Saprob, colonization strategies)
 Genus - Aspergillus
 also have teleomorph stage → SEXUAL STAGE

Ecology → Saprophytic fungus.
 → Grows on moist bread under bell jar
 → Grow on moist leather, rotten wood, horse dung, rotten vegetables, rotten fruits & other dead organic materials.
 → This fungus is called **blue-green mould** due to presence of **smoky green conidia** in abundance.

Mycelium - White cottony mycelium is found on the surface of the substratum. Hyphal ends penetrate the substratum to absorb food material.
 It is profusely branched, brownish, septate.
 Each cell is Coenocytic & has oil globules, protoplasm & other cell organelles.
 There is a central septal pore to keep adjacent cells in communication.

Rep ⁿ	Sexual rep ⁿ	Conidia
1	Asexual rep ⁿ	Ascoconium, Antheridium
2	Sexual rep ⁿ	Cleistothecium, Ascus, Ascospores

- 1.) Asexual rep.ⁿ takes place by means of conidia produced on conidiophores. Conidiophores are aseptate. Conidiophores have swollen terminal portion called vesicle. On the vesicle many bottle shaped, multinucleate sterigmata are produced (primary & secondary sterigmata). From the sterigmata conidia are produced in basogenous chain. Conidium is spherical multinucleate & smoky green.

Conidiophores of *Aspergillus* are unbranched & develop from any vegetative cell called 'Foot cell'.

Conidia are dispersed by winds. They germinate to produce germ tube that develop into new mycelia.

- 2.) Sexual rep.ⁿ -

Female sex organ is called archicarp or ascogonium.

Male sex organ is called antheridium or pollinodium.

→ An outgrowth comes out from any cell of the hypha. It grows & becomes convolute & septate & multicellular.

This structure is called Ascogonium. It has 3 parts =

- 1.) Uppermost receptive part is called



DATE _____

- the trichogyne
- 2.) Central part is the oogonium
 - 3.) Basal septate part is the Stalk.

By the side of the oogonium on the same hypha or other hypha, Antheridium develops. It is also septate, multinucleate & its uppermost cell actually acts as antheridium. Lower cell is the stalk. Antheridial stalk grows. Antheridium coils around the oogonium. Its tip reaches the trichogyne & makes contact.

The contact wall dissolves. Protoplasm of the antheridium along with nuclei passes to the oogonium through trichogyne.

Each male nucleus makes a pair with the female nucleus (they do not fuse).
By now, the oogonial part of oogonium become septate. Ascogenous hyphae develop from the septate parts. Ascogenous hyphae have both ♀ & ♂ nuclei lying side by side in pairs.

The ultimate & penultimate cells develop into ASCI. The ♀ & ♂ nuclei in these ascogenous cells fuse & form Ascus with $2n$ nucleus.

This diploid cell (Ascus) grow in size & become Sac like.

The $2n$ nuclei undergo reduction

division followed by mitotic divisions to produce 4-8 ascospores which are haploid.

Many asci produced arrange themselves in a closed fruiting body called cleistothecium which are covered by sterile asexual hyphae.

Asci are spherical or pyriform
Ascospore(n) is elliptical, echinulate & biconvex

Ascospores release by bursting of cleistothecium.

They germinate producing germ tube which branch to produce hyphae & then mycelium.



DATE _____

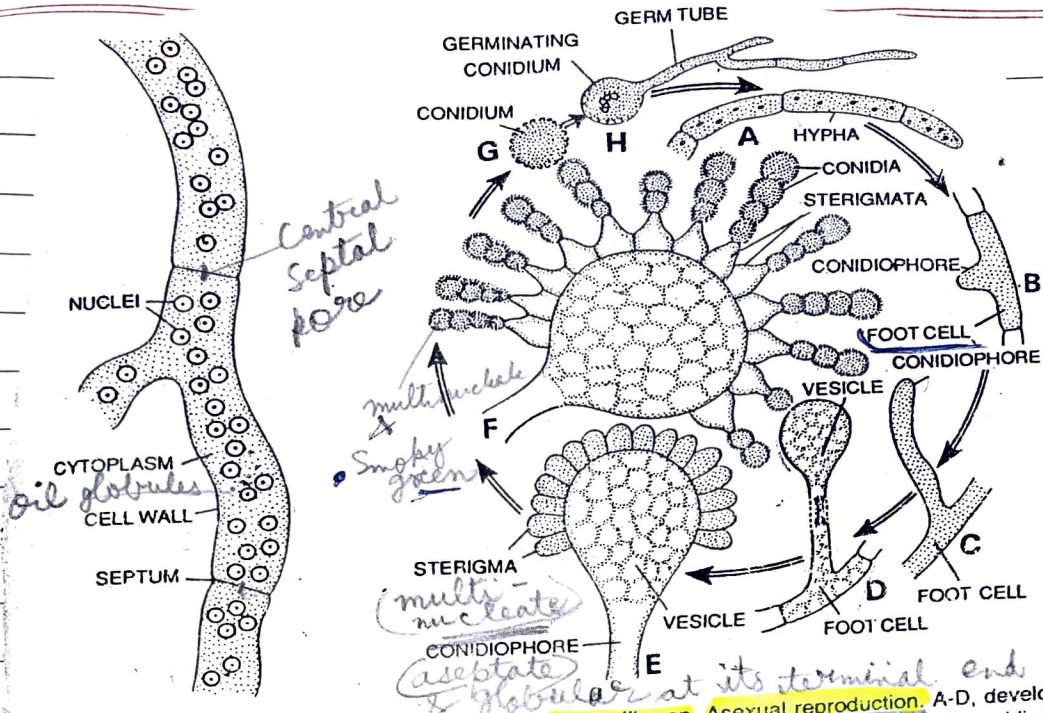
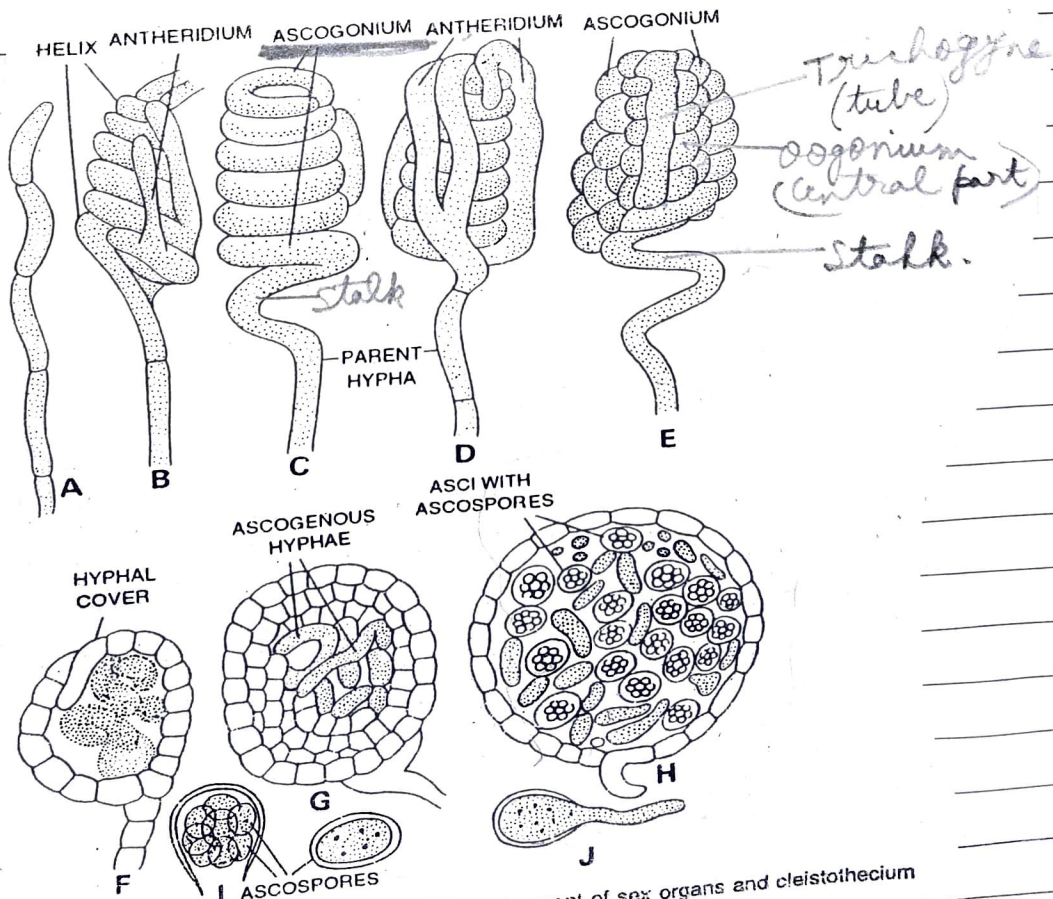


Fig. 12.24. *Aspergillus*. Mycelium. Hypha showing multinucleate cells.

Fig. 12.25. *Aspergillus* sp. Asexual reproduction. A-D, development of conidiophore, E, conidiophore with sterigmata F, conidiophore with sterigmata; G-H, conidia and germination of conidium.



Sexual reproduction in *Aspergillus repens*. Development of sex organs and cleistothecium (A-E), cleistothecium (F-H), cleistothecium with ascospores (I-J).

DATE _____

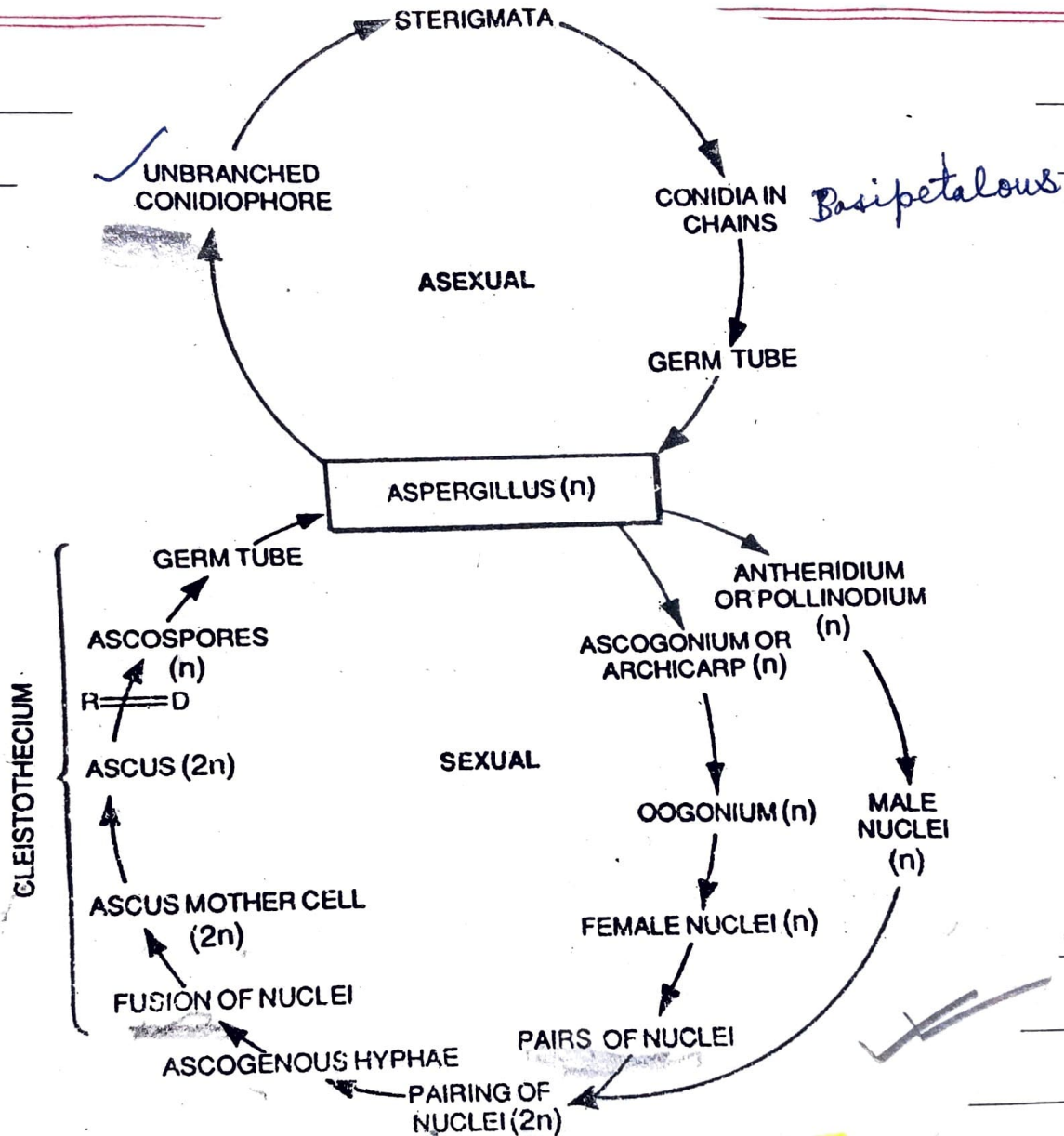


Fig. 12.29. Graphic life-cycle of *Aspergillus*.

Yeast.

1-)

classmate

Date _____

Page _____

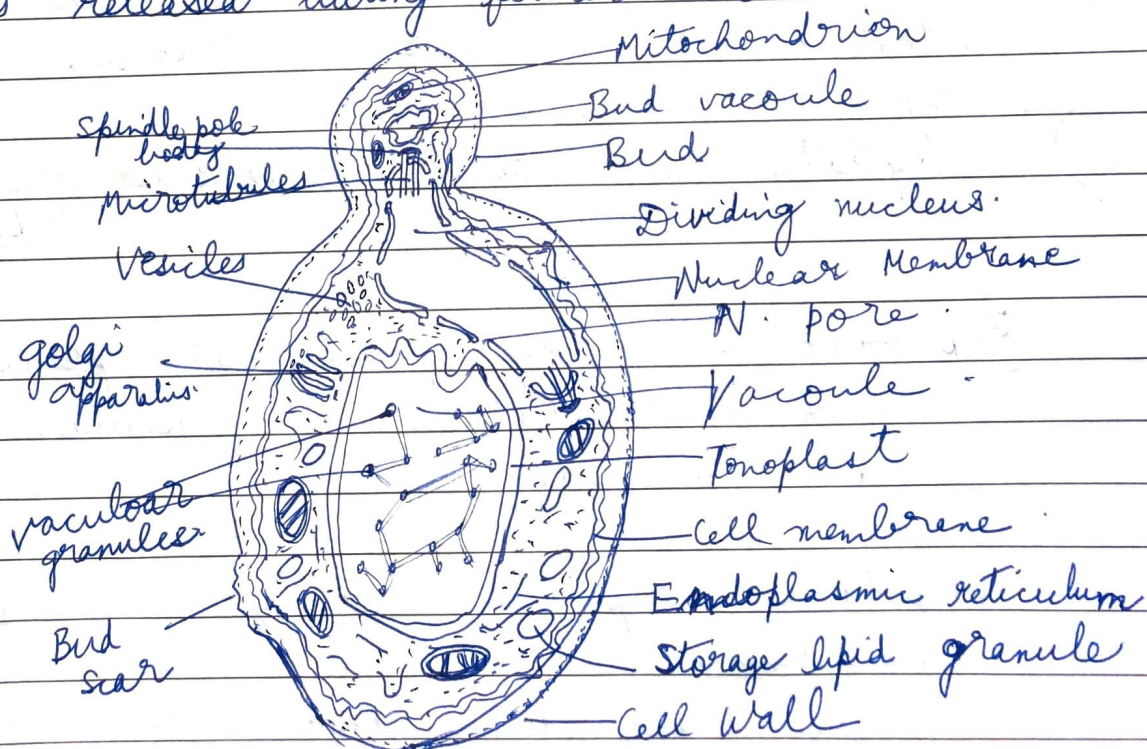
G. C. Ainsworth (1971)

Kingdom: Fungi
Div: Eumycota
Sub-div: Ascomycotina
class: Hemiascomycetes
Sub-class: _____ Series: Hemiascomycetidae
Order: Endomycetales
Family: Saccharomycetaceae
Genus: Saccharomyces

Ecology - 1) Yeast grow in organic material where sugar is found in abundance. They grow in toddy juice, grape juice & sugarcane juice.

2) Yeast convert sugar into alcohol by alcoholic fermentation. It is an anaerobic process. So they are used to make wines, alcohols & beer etc.

3) Used in bakeries to make bread & loafs. Spongy nature of loaf is because of CO_2 which is released during fermentation.



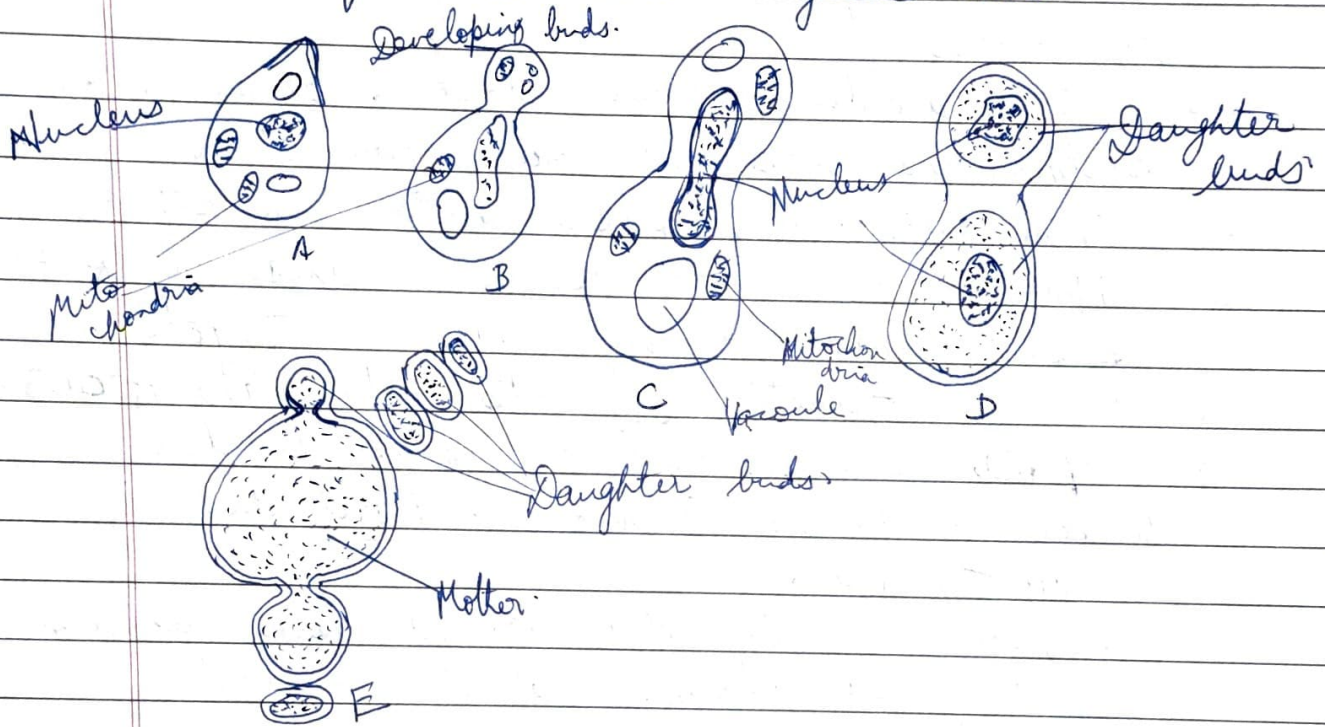
ultra str. of Budding Yeast.

- 1.) Thallus is unicellular. Sometimes may form pseudomycelial str.
- (2.) Cells are elliptical & measure about 6-8 x 5-6 μ m.
- (3.) Cells with thicker walls have 3 layers:
Outer layer - made of manna-protein & Chitin.
Middle layer - " largely of glucan.
Innermost layer - " of protein glucan. Some lipids & phosphate is also present.
- 4.) Cell membrane (plasmalemma) has stange invaginations.
- 5.) Cell organelles like E.R, ribosomes, mitochondria, golgi bodies & nucleus are present. Lipid granules are present in Cytoplasm.
- 6.) Centre of the cell is occupied by a large vacoule limited by membrane called Tonoplast.
Vacoule contains watery substance & granules of polymetaphosphate & lipid.
- 7.) During Mitotic div., the nuclear membrane remains intact. Nucleus has nuclear pore & cup shaped nucleolus.
- 8.) Vegetative cell of S. cerevisiae are mostly Diploid.

Reproduction - of yeasts takes place by means of 1.) Vegetative - (2.) Asexual & 3.) Sexual methods.

1.) Vegetative repⁿ : is by means of budding.
It takes place during favourable condition.

- From each yeast cell, one or more small outgrowths are given out. These enlarge in size, detach from mother cell & act as independent individuals
- Nucleus of mother cells divide amitotically & transfers to the daughter cell.



2) Asexual repⁿ

- During unfavourable conditions when there is scarcity of nutrients & abundance of O_2
- Yeast cells enlarge & become "Ascus".
- (see) Ascus is naked. Nucleus of Ascus divide twice producing 4 nuclei.
- Around each nuclei deposits cytoplasm. Now it becomes Ascospores (in Ascus)
- Sometimes 8 ascospores are produced.
- Each ascospore surround itself by thick wall. These are perennating bodies
- During favourable conditions they germinate.
- Ascus wall bursts to liberate ascospores.

→ On suitable media, ascospores germinate and new individuals are formed by budding.

3. Sexual reproduction :-

- takes place by conjugation but is rare.
- 2 individuals come close. Beak like outgrowths are given out from them.
- These outgrowths fuse with each other.
- Nuclei of both come in these beaks & fuse together giving rise to zygote.
- The zygote converts into an Ascus.
- Diploid nucleus ($2n$) of ascus divides thrice producing 8 nuclei. First div. is reductional.
- Cytoplasm is deposited around each nucleus & they now become walled & called ascospores.
- Ascus wall bursts, ascospores are liberated.
- In suitable conditions they germinate & new individuals are produced by budding.

Life Cycle :-

1) Haplobiontic Type —

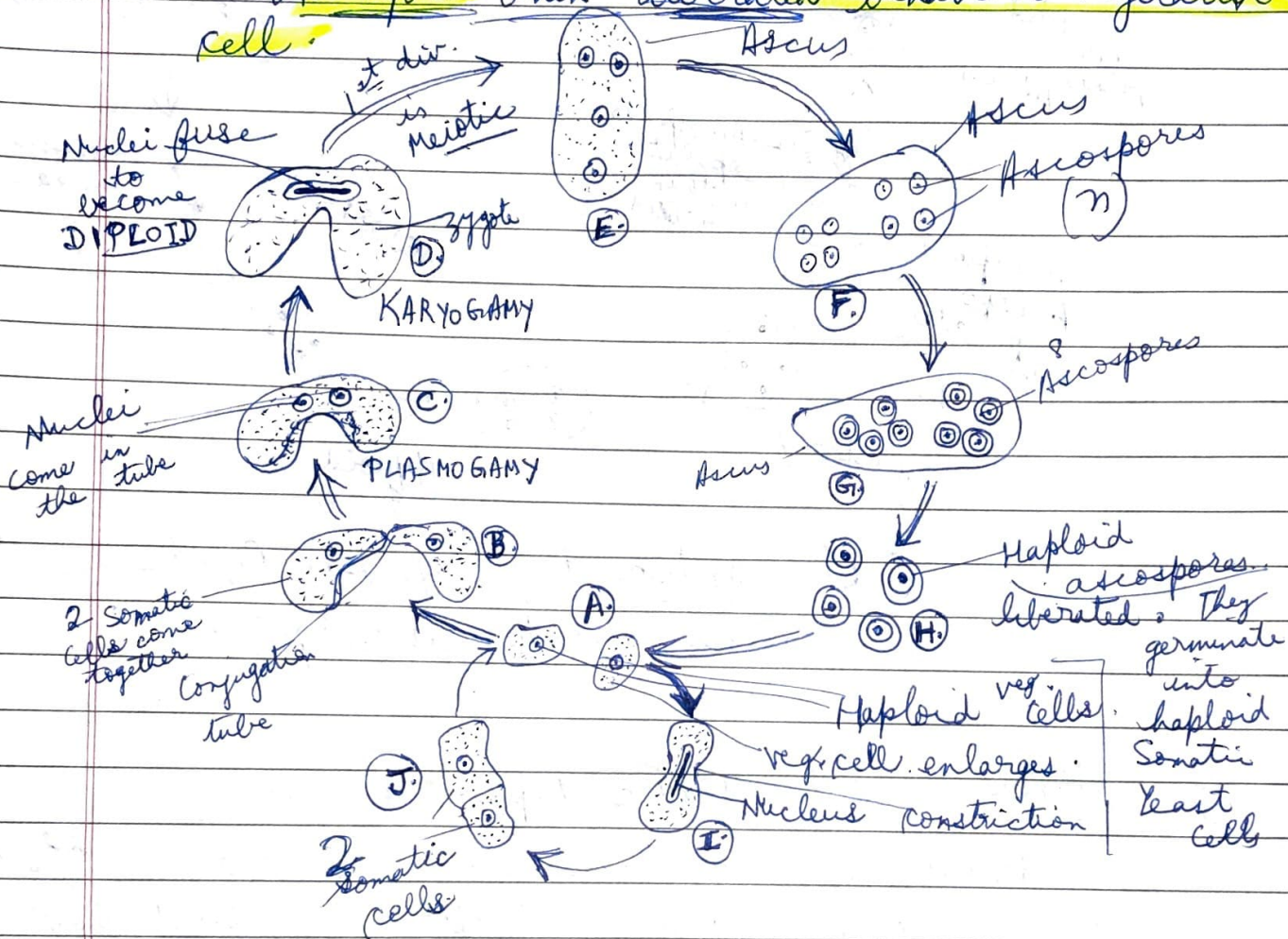
- Found in *Schizosaccharomyces octosporus*.
- Vegetative stage is predominantly haploid.
- Diploid stage is very short & represented by zygote which undergoes meiosis.
- Each somatic cell acts as potential gametangium.

→ During sexual union, plasmogamy is soon followed by karyogamy.

→ Zygote nucleus divides thrice: 1st div. is reductional (meiotic)

→ zygote becomes ascus containing 8 ascospores

→ Ascospores when liberated behave as vegetative cell.



2.) Diplobiontic type:

→ Found in Saccharomyces ludwigi & other yeasts

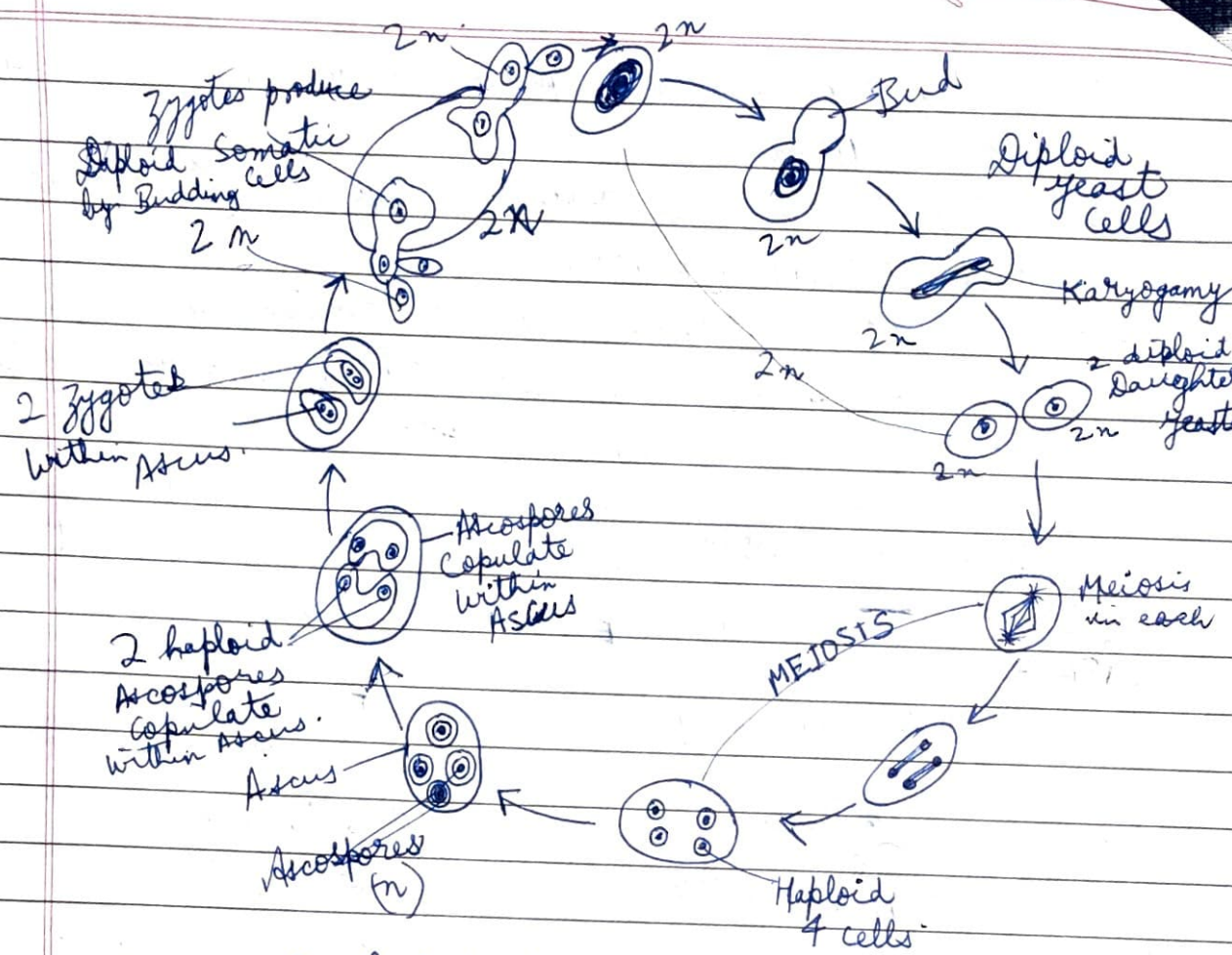
→ Veg. stage is DIPLOID

→ Haploid stage is very short.

→ Ascospores are not liberated from Ascus.

→ Ascospores copulate within the Ascus.

→ Zygotes within the Ascus bud out into diplobiontic vegetative cells.



Diplobiontic type of life cycle in *Saccharomyces ludwigii*.

3: Haplo - Diplobiontic type (Life cycle)

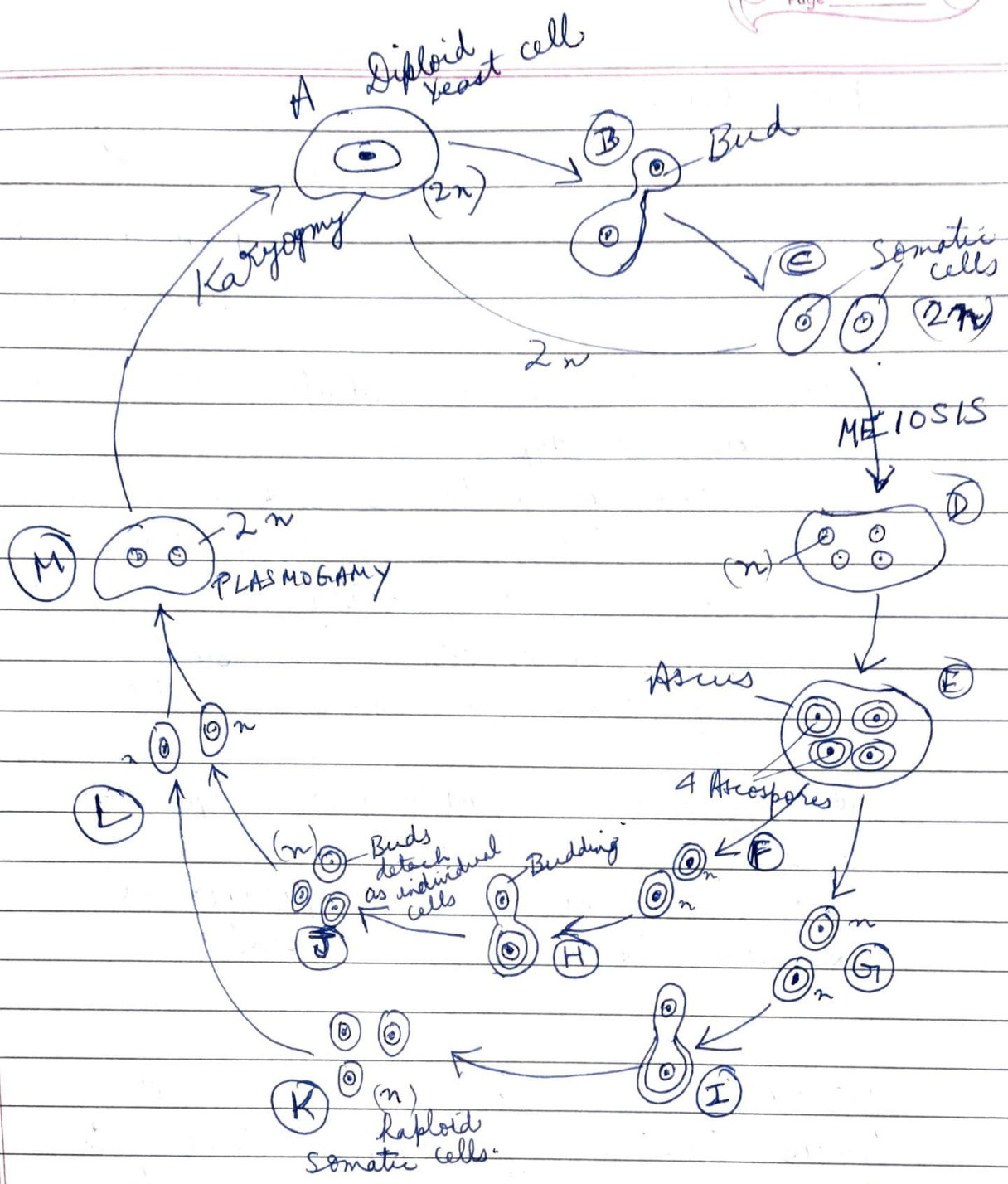
- Found in *Saccharomyces cerevisiae* & other yeasts.
- Veg. cells have both haploid & diploid phases
- Haploid somatic cells copulate to form diploid zygote.
- Zygote nucleus divide thrice. 1st div. is meiotic.
- Finally 8 nuclei (n) are produced which metamorphose into 8 ascospores.
- Only diploid cells produce ascospores which give rise to haploid vegetative cells by budding.

Start - Diploid somatic cell

classmate

Date _____

Page _____



Haplo-diplontic type of life cycle in *Saccharomyces cerevisiae*.

No. of ascospores per ascus varies from genus to genus.

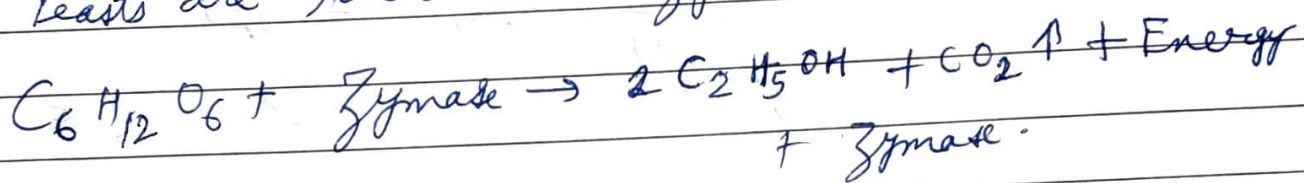
2-4 ascospores / ascus in Debaromyces

4 ascospores / ascus in Saccharomyces

8 " " " Schizosaccharomyces

Fermentation :-

Yeasts are rich in enzymes & vitamins



Most yeasts are intermediate between aerobic & anaerobic types.

→ During fermentation besides the production of alcohol & CO_2 other substances like glycerol, ethers, fatty acids, acetic acids & succinic acid are also produced in small quantities.

Wine yeast — *Saccharomyces ellipsoides*

Beer yeast — *S. cerevisiae*

ginger beer yeast — *S. piriformis*

Sake wine yeast of Japan — *S. sake*.

→ Leeuwenhoek in 1680 described yeast cells.

→ Louis Pasteur in 1859 established that fermentation was directly associated with life activities of yeasts.

40 spp. of *Saccharomyces* are known.

PARASEXUAL RECOMBINATION.

It is a process in which genetic recombination occurs in the vegetative thallus in the absence of a sexual stage.

This process has been investigated chiefly in species of *Aspergillus* & *Penicillium*.

Pontecorvo & his co-workers have worked on this.

Sequence of events in complete parasexual cycle:

- 1.) Formation of heterokaryotic mycelium.
- 2.) Fusion between two nuclei:
 - a.) Fusion between like nuclei
 - ✓ b.) Fusion between unlike nuclei (dissimilar) ^{genetically}
- 3.) Multiplication of diploid nuclei alongside rest of the haploid nuclei.
- 4.) Occasional mitotic crossing over during the multiplication of diploid nuclei.
- 5.) Sorting out of diploid nuclei.
- 6.) Occasional haploidization of the diploid nuclei.
- 7.) Sorting out of the new haploid strains.

Results are similar to those in meiosis.

Frequency of this process is low & significance of ~~the~~ somatic recombination is little known.

Parasexuality produced new races of *F. oxysporum* during experiments.

Parasexuality is ~~for~~ exhibited in Deuteromycetes, & Ascomycetes (*Aspergillus*, *Penicillium*), & *Puccinia graminis tritici* (Basidiomycetes).