Albugo or Cystopus

Albugo name proposed by - De berry

SYSTEMATIC POSITION

Division	Eumycophyta
Class	Phycomycetes
Order	Peronosporales
Family	Alguginaceae
Genus	Albugo or cytopus

Note : Albuginacease is a **monotypic** family. It includes only single genera **Albugo.**

- The most common species of ***Albugo*** is ***Albugo candida/Cystopus candidus.*** This species grows in **intercellular** spaces of host tissue as an obligate parasite.
- It can not be grown culture medium. It causes **"White-rust disease** in the plants of family **cruciferae** or **brassicaceae.**
- It shows specificity towards the **host.**

Etiology : Study of causes of disease in body is called etiology.

Characteristics of White-rust disease:

- **White pustules/white blisters** $\rightarrow$ They are usually present on **lower surface** of leaves which many also spread on the supper surface of the leaves & stems.

The infected parte of the host become abnormal & the host become abnormal & the abnormality may be in the form of hypertrophy, fleshyness or distortion.

Note : (1) The main reason of hypertrophy is formation of sex organs in intercellular spaces.

(2) Infected flowers are unable to develop in normal seeds.

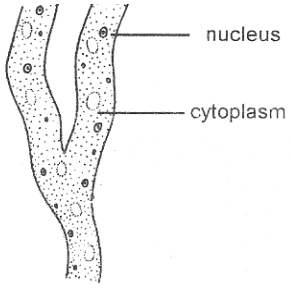
Note

- Albugo never infects the underground part of the plant such as roots Example - **Radish.** It is never infected but only influenced.
- In infect only aerial parts of the plants.
- An excessive enlargement of diseased organ to an excessive elargement cell, called **hypertrophy.**
- **Albugo** is **autoecisou** fungus. It means it whole life cycle complete in a single host.
- **Heteroecious** - Such type of fungus which complete their life cycle in two different hosts.
  Example - **Puccinia, Primary hsot -** Wheat, **Secondary host** - Berberis

STRUCTURE

- The albugo mycelium is branched **aseptate, coenocytic. (Septa** are only formed in mycelium **during reproduction).** The hyphal wall is made up of **cellulose.**
- Reserve food material is present in the form of **glyocogen and oil glubules.**

  Hphyal network is found in the **inter cellular** spaces of the **host.**
- Round, **button** shaped or **knob** like and stalked **haustoria** are found in Albugo. These haustoria enter into the host cells. With the help of these haustoria, it absorbs nutrients from the host cells.



STRUCTURE OF HYPHAE

- In the apical region of haustoria dense cytoplasm mitochondira and ribosomes etc. are found but **nuclei** are absent.
- The shape of haustoria have taxonomic importance.

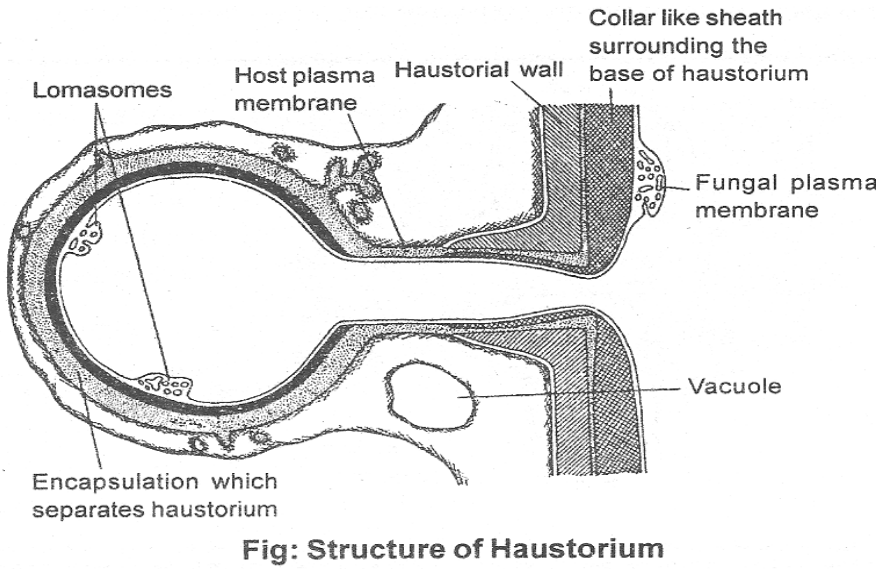


Fig: Structure of Haustorium

SPECIAL POINT

- It's mycelium is stained by **cotton blue** and mounted by **lactophenon.**

REPRODUCTION

- **Holocarpic fungus :** These re such type fungus in which their whole mycelium is utilized in the formation of reproductive structurese.g. ***Chytrid.***
- **Eucarpic fungus :** These are such type of fungus in which the whole mycelium is not utilized in the formation of reproductive structures. Only few part of mycelium used for the formation of reproductive structures. Ex-ample - ***Albugo, Rhizopus, Mucor***

  Reproduction takes place by two ***methods*** described as below -

  (1) Asexual reproduction

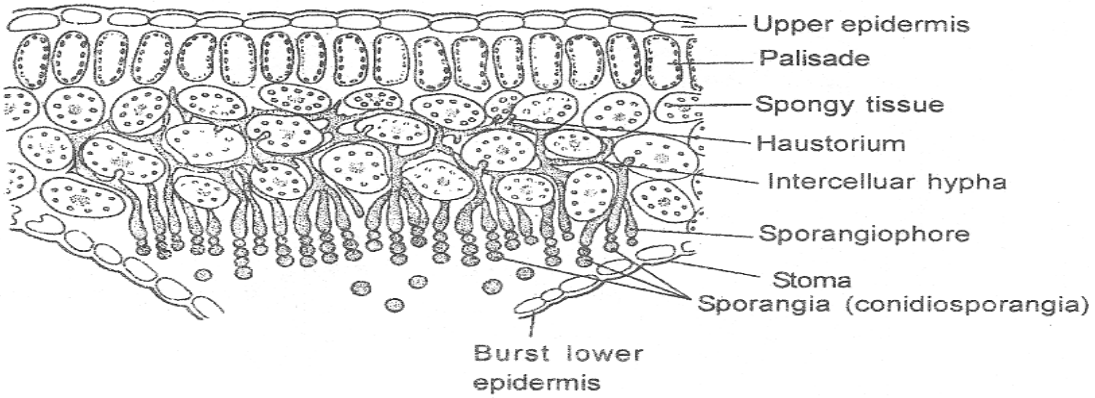
  (2) Sexual reproduction

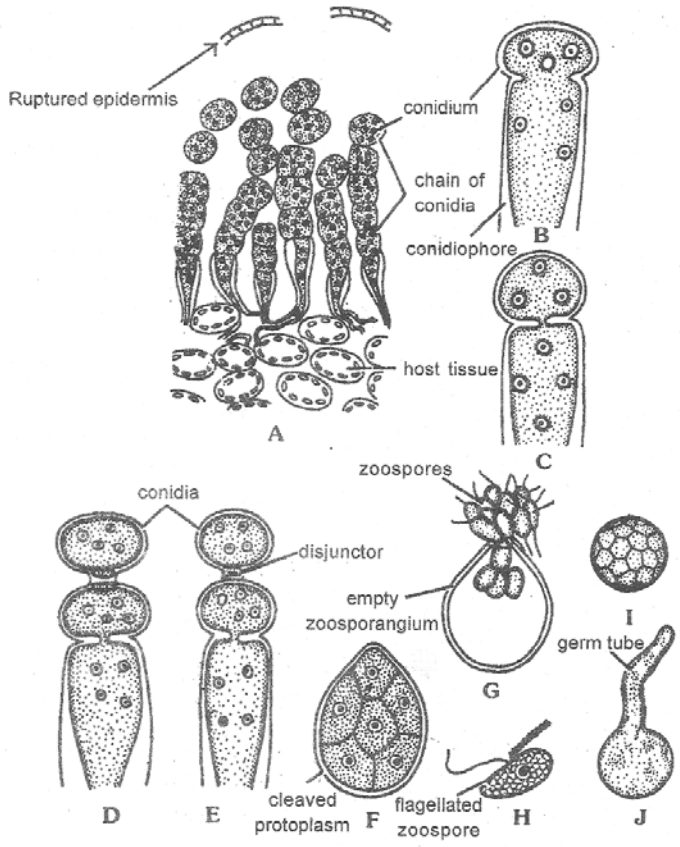
(1) Asexual reproduction : It takes place by ***Cnidia*** formation. It is a type of sporangium or zoosporangium. Conidium is a smooth colourless, spherical thin walled and multinucleated structure, in which **3-8,** nuclei are present. It diameter is 13-18 μ.

- The mycelium gives rise to **erect brancihg.** They are usually formed towards lover epidermis. They are called **conidiophore.** Conifiophores are parallel to each other and at right angle to epidermis.
- Condiophore are **club shaped** strucutre. Their cell wall of the apical region is thin.

  These thin walled apical region forms the chains of conidia by **contriction techique.**
- Conidia are developed in the form of chain, in **basipetal** sequence. It means newly formed conidia are present at the base of chain and old large conidia are present at the end of the chain.
- A **gelatinous disc** is present in between the two conidia. It is called **disjuctor.**

- This disc helps, conidia to remain in a chain. The chain of conidia grows and press the lower **epidermis.**
- This causes epidemis to **bulge out** and appears in the form of **blister.** Due to more pressure, the epidermis burts, and these conidia are spread in the form of white powder on the surface of leaf. (Due to chage o auxin amount in infected diseased tissue, spots are converted into white powder form).





ASEXUAL REPRODUCTION

A. part of vertical section of infected leaf, B-E Stages in the formation of conidia, F. A conidium with cleaved protoplasm, G. Liberation of zoospores from sporangium, H. A zoospore, I- J Germination of zoospore.

DISPERSAL & GERMINATION :

- Conidia are dispersed by **air**
- Two different types of germination takes place in favourable conditions.

  (i) Direction germiantion :
- It takes place at **high** temperature and low **humidity** in environemnt eg. **Algubo bliti**
- Conidium absorbs some water which is present on the surface of the leaf. A **germ tube** comes out from the condidiu. This tube enters inside host tissues through stomata and form intercellular mycelium
- White rust disease spreads slowly in this condition. Spreading of disease is called **secondary infectiion.**

  Note : Secondary infection $\rightarrow$ **By wind**

  (ii) Indirect Germination : In the presence of **lee temperature** approximately **10-15^{0}C** and **high moisture** in atmosphere, conidium germinates by (After 2-3 hours of their dspiersal) **zoospores** formation.
- Conidium absorbs more water and swell up and form **3-8 zoospores.** These zoospores are envolded by **vesicle.**
- These envveloped zoospores are ooze out. Vesicle dissolves then and zoospores become free.
- Free zoospores smim in water for few minute and finally they reaches on the surface of host, then after withdraw their flagella and round off and secretes a wall around itself.
- Deflagellated zoospores with wall germinates through the germ tube. This germ tube enter into the host tissue through **stomata** or through the **treated epidermis** and form mycelium.

STRUCTURE OR ZOOSPORES :

- Zoospores of Albugo are **uninucleated, reniform** or **bean shaped** and **biflagelalted.**
- Flagella are located on the **lateral side** of zoospore which unequal in length. Out of them small and hairy flagellum is called **Tinsel or Pantonematic or Filimmergersal.** Another long and smooth flagellum is called **whiplash or Acronematic or peitgersal flagellum.**

  Note : In the presence of high availability of water secondary zoospores are also develop then many generation of zoospores are fomred such as -

  (i) Monoplanetic Gerneration : Only primary zoospores are formed.

  (ii) Polyplanetic Generation : In which many generation of zoospores are formed, like primary secondary and tertiary zoospores are formed.

> - In the presence of **less** temperature are **high moisture** while rust disease speads vigorously.
> - The study of spread of disease is called **Epidemiology.**

2. Sexual Reproduction :

- In **Albugo** sexual reproduction is **oogamous** type. Male and female sex organs are known as **antheridium** and **oogonium** respectively.
- In **A. candida** the sex organs are generally formed towards the end of the growing season of the host. Reproductive organs are **endogenous.** ?They develop in intercellular spaces, quite deep into the host tissues. Their presence is externally indicated by **hypertrophy** and **defromation** of the organ.

  (i) Anteridium : The antheridium is an elongated, **club shaped** and multinucleated structure. A transverse septum is present in its basal region. It develop on male hypha which is paced very close to the oogoniuom.

  There are many **(6-12)** nuclei present in a young antheridium but mature antheriudium has only one **functional nucleus.**

(ii) Oogonium :

- Oogonium is **globular** is shape. The cytoplasm of oogonium differented into two distinct regions

(i) Peripheral cytoplasm or Outer cytoplasm :

- It is vacuolated, spongy and diffused. It is called **periplasm.**

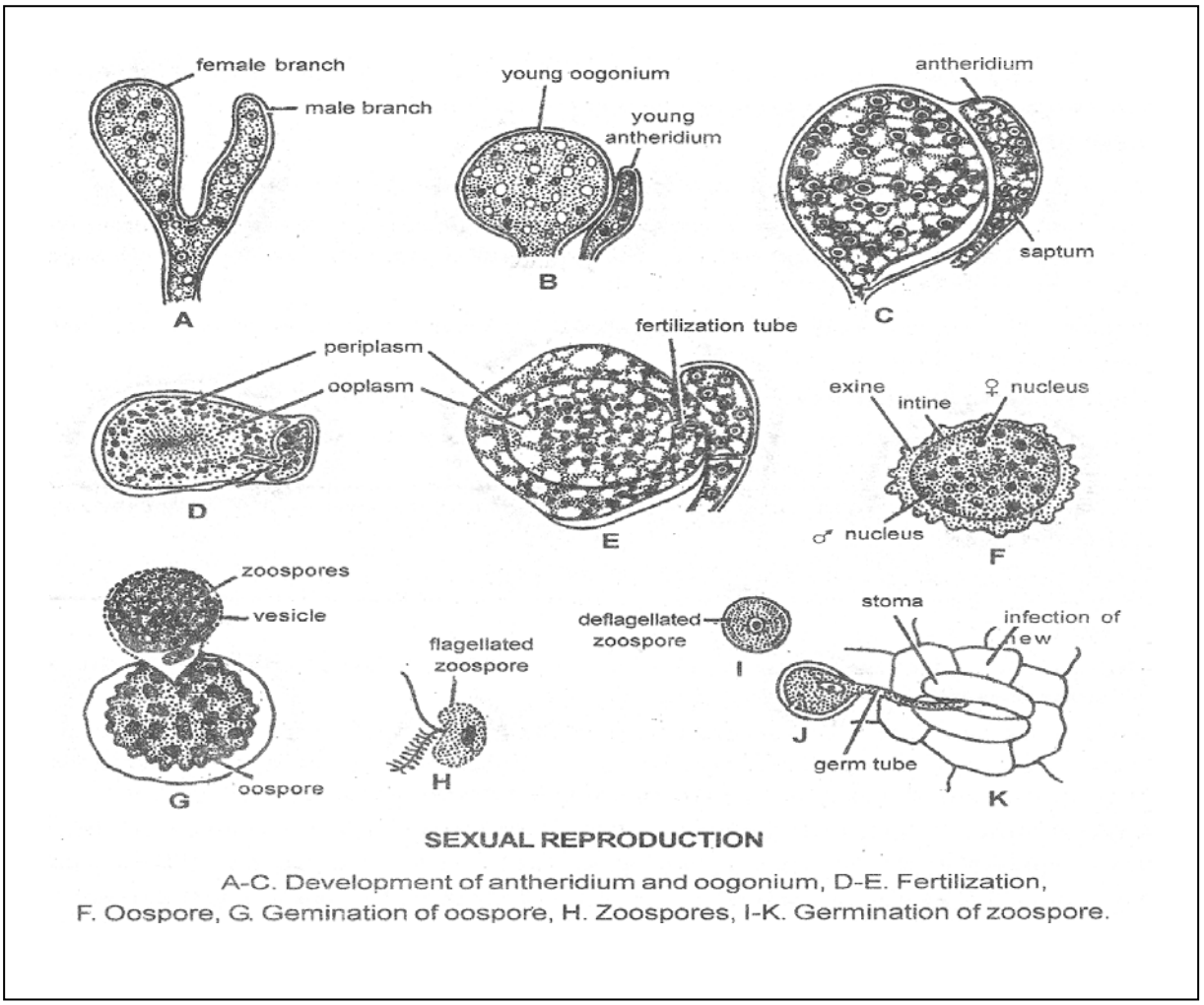
(ii) Centrral cytoplasm :

- It is dense. It is known as **ooplasm.**
- Both Ooplasm and periplasm are multinucleated in the beginning but only a single nucleus remains in the ooplasm at maturity and rest of nuclei are transferred into the periplasm. However some workers believe that all nuclei in the oooplasm except on disintegrate.
- A single nucleus present in the ooplasm is called **female nucleus** or **oosphere.**

  The oogonium of ***A.blitti, A portulacae*** cotains many female nuclei or oospheres.

Note :

- Antheridium and oogonium develops very close in the mycelium. They are present on different hyphae lying close together.
- Albugo is **homothallic** because fusing gametes are genetically similar.



SEXUAL REPRODUCTION

A-C. Development of antheridium and oogonium, D-E. Fertilization, F. Oospore, G. Gemination of oospore, H. Zoospores, I-K. Germination of zoospore.

FERTILIZATION

- A small protuberance develops from oogonium towards the antheridium. The wall of the antheridium and oogoium becoem thin at the region of their contact.
- this out growth stimulate the antheridium for fertilization. The innver wall of stimulated antheridium produces fertilization end of fertiliztion tube must and introduces a single nulceus along with some cytoplasm.
- The nucles fuses with the female nulceus and results in the formation of **diploid nucleus**. Now it is known as **zygote**. Latter on antheridium **dry up** as well as the **nuclei of periplasm** are **also disorganised.** Priot to fertilization a mass of protpoast is found in oooplasm. It is called **concentrum.** Which is formed by granular cytoplasm. the single function **egg nucleus** of oogonium is **attached** with **coenocentrum.** After the fertilization it is also degenerate.
- After there fertilization, zygote secretes a thick **tri layered** wall around it self and now it is called **oospore** (2N). In oospore there orruce **free nucler divisions** and **32-nuclei** are formed in oospore. (According to modern mycologists) but according to **old mycologitsts,** the diploid nucleus of the oospore divide first by a **meiotic** division, followed by several **mitotic division** resulting in the formation of about **32 nuclei** in oospore.

SPECIAL POINT

- According to **Stevens** all the structuresof Albugo are diploid **except gamete.**
- According to **Sansome** and **Sansome** meiosis division takes place at the time of gamete formation i.e. gamentagial meiosis found in Albugo. In Albugo meiosis not takes place in **oospore.**

- Oospore with **32 nuclei** is the resting stage of **Albugo.** In this stage it lives on dry branches in the abssence of host. On returns of favourable conditions the 32 nuclei of oospore undergoes repeated divisions to from 100 or more nuclei.
- 100 or more zooposres are formed from these nuclie. The zoospores are releases/liberated with vesicle by the repturing of outer thick wall of oosore (formed by inner wall of oospore)
- These zoospores are coming in contact with a suitable host (seedling plants) settile down on the host and infect them.
- The initial stage o the disease during the growth period is called **primary infection.**
- **Primary infection** takes place through the **soil.**

CONTROL OF WHITE - RUST DISEASE

1. **By crop rotation :** Primary infection can be checked through the growing of crops one after another crops. This is the best method to control the white - rust.
2. By removal of infected plants from the field. Through this it can be eradicated.
3. **By application of fungicides -** Such as **- Bordeaux** mixture. It is composed of

   $CuSO_4$ + Lime water

   (1 : 1)

- Through the sulphur dust etc.

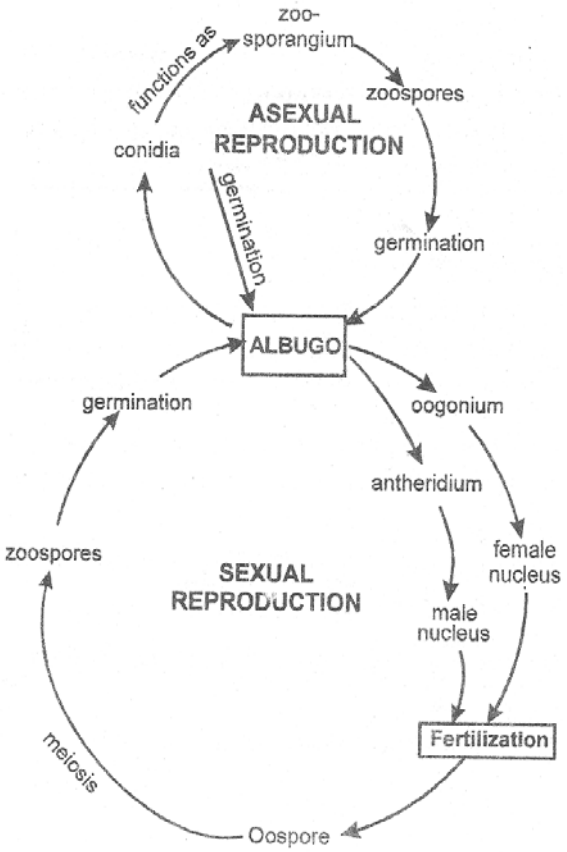
* In the absence of host **Albugo** grows on another plant **(Cleome Viscosa).** This plant grows as weeds.

Some Species of Albugo :

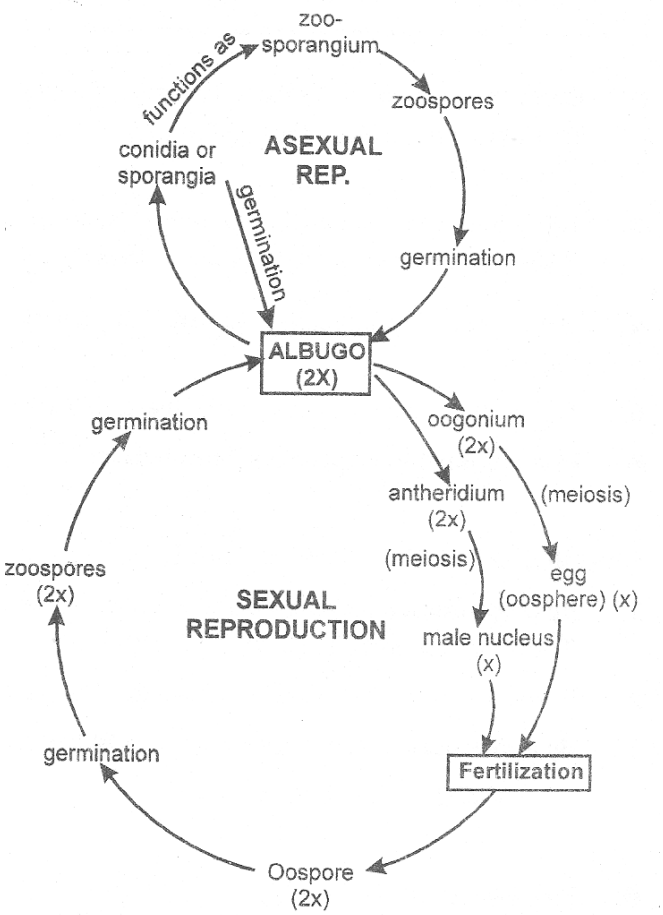
1. **Albugo oxidental -** Infects Spinach
2. **A. impomoeae -** Infects sweet potato
3. **A. bliti -** Infects Amaranthaceae family plants.
4. **A. protulacae -** Infects protulaca plant.
5. **A. tregopogosis -** Infects compositae family plants. eg. **Eclipta alba**

LIFE CYCLE -

Diplonitc type (accordind to **modern mycologists)**



LIFE CYCLE OF ALBUGO
(ACCORDING TO OLD MYCOLOGISTS)



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