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Albugo or Cystopus

White rust of crucifers

- **Content-**
- Classification
- Introduction
- Symptoms
- Mycelium
- Reproduction
- Life- cycle

Albugo or Cystopus

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- **Classification-**
- Division- Mycota
- Sub- division- Eumycotina
- Class- Oomycetes
- Order- Peronosporales
- Family- Albuginaceae
- Genus- Albugo
- Species- candida
- **Introduction** - **Albugo candida** commonly known as **white rust**, *A. candida* is an obligate plant pathogen that infects Brassicaceae species and causes the disease known as **white rust** or **white blister rust**.
- **Distribution-** *A. candida* has a cosmopolitan distribution and is known from many countries where cruciferous crops are grown in Europe, Asia, Africa, Australasia, North, Central, and South America. †

Albugo or Cystopus

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- **Symptoms** - 1.The fungus attacks all the above ground parts of plant as leaves, stems, inflorescence. The root is not attacked.
- 2.White rust can infect plants both **locally and systemically**.
- **3.On stems, leaves, and inflorescences it appears as a mass of white or cream-coloured pustules, each about 2 mm (0.08 in) in diameter, packed with sporangia.**
- 4.New pustules are borne in radial fashion (swelling, irregular blisters or patches), while older pustules coalesce to form a bigger pustules in the center. The patches gradually turn powdery.
- 5.The systemic version causes distortion, abnormal growth forms, and sterile inflorescences. The abnormal growth forms are sometimes known as "stagheads" (topmost branches become dead and bare).
- **Mycelium**- It is well developed and consists of branched, aseptate, coenocytic, intercellular hyphae. The hyphal wall contains cellulose not chitin. The hyphal protoplasm is granular and vacuolate in older parts. It contains numerous nuclei, oil globules and glycogen.

White rust of crucifers

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Albugo or Cystopus on Amaranthus 4



White rust of crucifers

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Section cuttings in Lab.

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Albugo

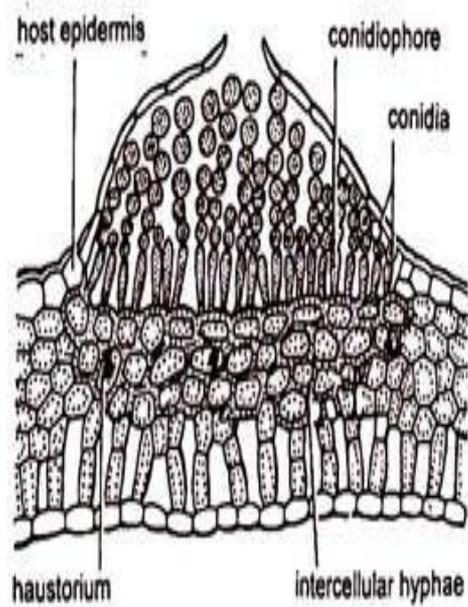


Fig. 3. *Albugo*: Asexual reproduction V.S. of *Brassica* leaf passing through infected portion

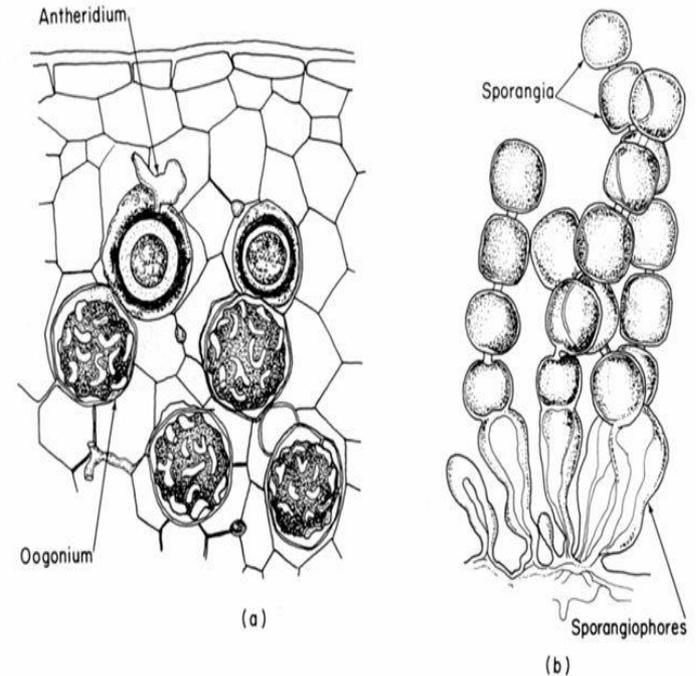


Figure 3-38 White-rust fungus, *Albugo candidus*: (a) sexual reproductive structures within the host tissue; an antheridium, oospores, and oogonia are visible; (b) chains of sporangia on surface of the host. [A. N. Berlese, 1898, *Icones Fungorum*, Phycmycetes, published by author.]

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- **Reproduction**- Two types-
- 1. Asexual Reproduction &
- 2. Sexual Reproduction.
- **1. Asexual reproduction:**
- The asexual reproduction takes place **by means of biflagellate zoospores** formed inside the sporangia. In the very beginning the hyphae accumulate just beneath the epidermis of the infected leaf. From these hyphae, certain thick-walled, clavate aerial sporangiophores come out.
- In each such sporangiophore there are about a dozen nuclei and sufficient cytoplasm. The terminal end of the sporangiophore becomes constricted and sporangium contains **5-8 nuclei** and cytoplasm. Successively the sporangia develop by constriction method, **in basigenous chains**. In between each two sporangia a gelatinous pad develops acting as a separator of two sporangia from each other.

Asexual Reproduction

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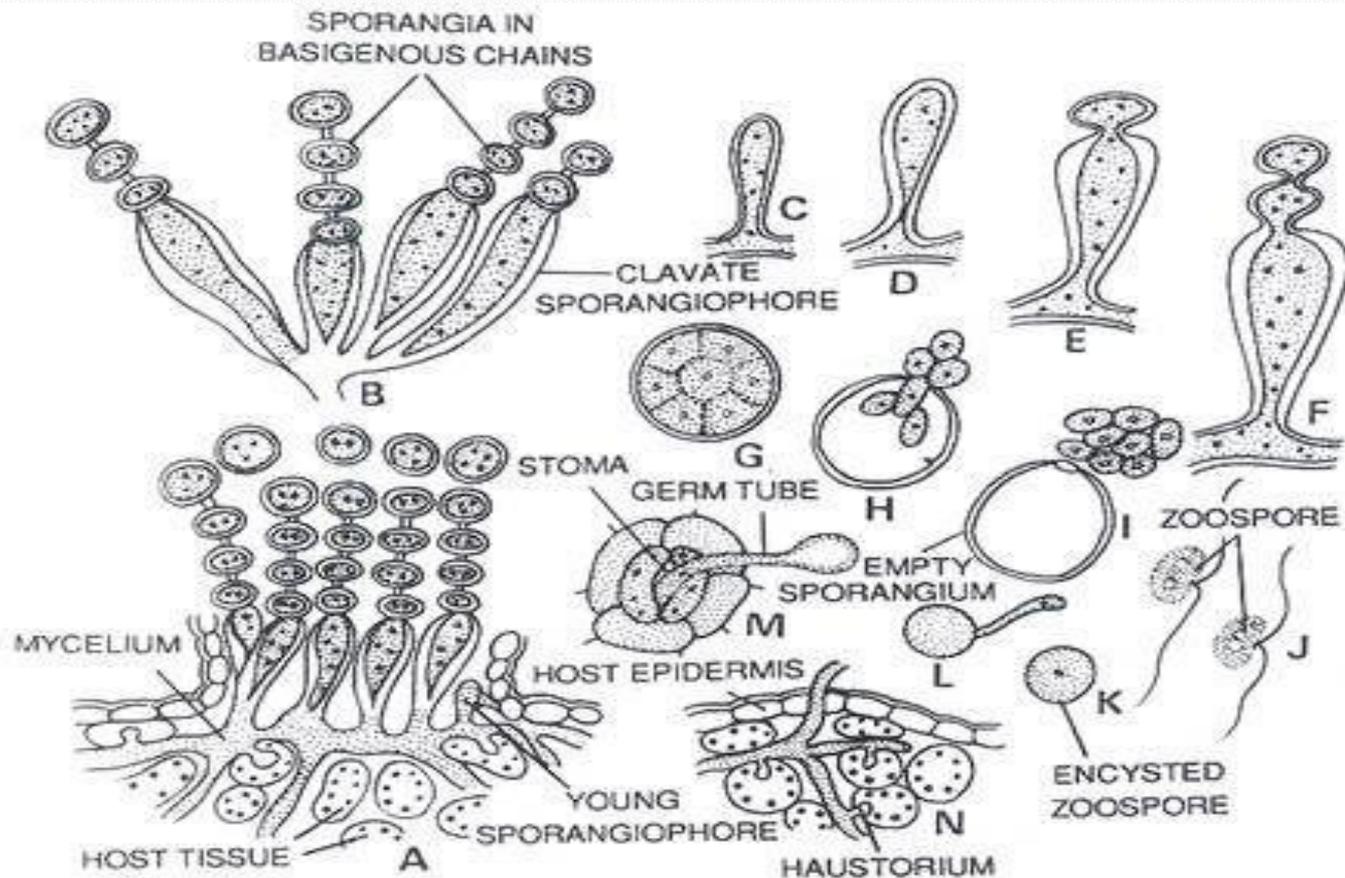


Fig. 10.18. *Albugo candida*. White rust of crucifers—asexual reproduction of *Albugo*—A, section of infected host leaf showing mycelium, haustoria, sporangiophores and sporangia; B, branching of sporangiophores with basigenous chains of sporangia; C-F, development of sporangiophore and sporangia; G-I, germination of sporangium and formation of zoospores; J, biflagellate zoospores; K, encysted zoospores; L, germinating encysted zoospores; M, infection; N, intercellular mycelium and rounded haustoria within host tissue.

Albugo- Asexual Repdn

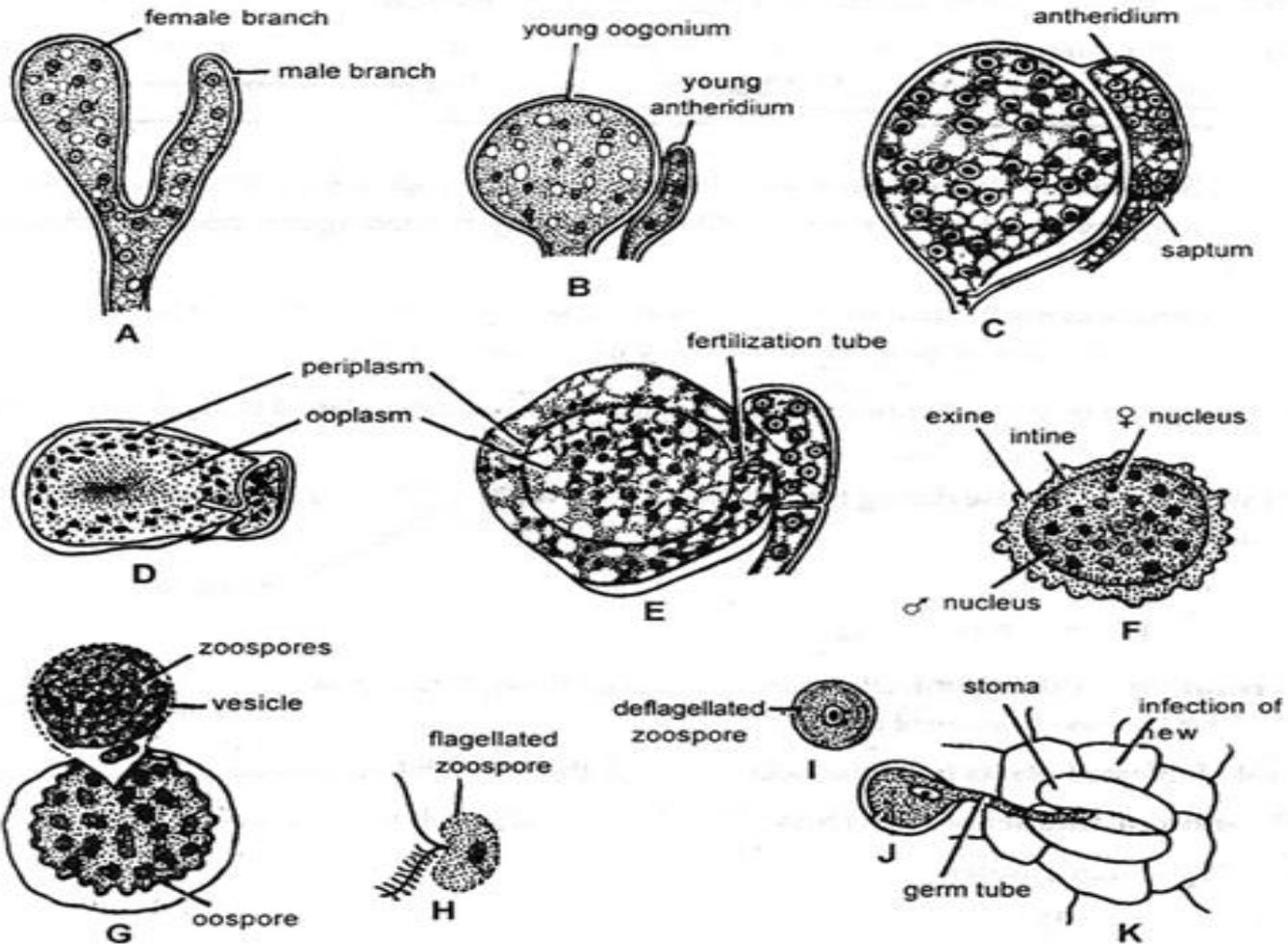
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- The **sporangium is smooth, double-walled and rounded**. When the sporangia are formed in abundance on innumerable sporangiophores, the pressure is caused; the host epidermis ruptures and hundreds of sporangia are seen on the surface of the host in the form of white creamy powder forming pustules. The sporangia are transferred from one place to another by various agencies such as wind, insects, water, etc.
- **On the maturation of the sporangium the protoplast is cleaved into uninucleate protoplasts. Each protoplast metamorphoses into a naked, biflagellate, uninucleate, reniform and vacuolate zoospore.** The sporangium bursts anteriorly and the zoospores liberate in the film of water.
- The flagella are withdrawn and the zoospore becomes encysted. Each encysted protoplast germinates, producing a germ tube on the surface of the suitable host. The germ tube enters through stoma, develops into new mycelium and ramifies in the intercellular spaces of the host tissue.
- Sometimes the sporangia behave as conidia and germinate directly producing germ tubes. The conidia may germinate from 3°C to 25°C temperature, but the optimum temperature is **10°C**.

Albugo Sexual Repdn.

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- The **sexual reproduction is oogamous**. The sex organs develop on the hyphal ends in the intercellular spaces of the deeper tissues of petioles and stems. **The female sex organs are oogonia and the male sex organs are antheridia**. The oogonium is rounded and the antheridium club-shaped. The developing oogonia and antheridia are separated from rest of the mycelium by septa.
- The cytoplasm, vacuoles and nuclei are uniformly distributed in the young oogonium. On the maturation of the **oogonium** the protoplasm of the oogonium differentiates into two regions. The outer region is called the periplasm containing thin cytoplasm, many nuclei and many vacuoles.
- The **central protoplasm with denser consistency surrounded by periplasm is called the oosphere or the egg**. The dense cytoplasm within the **oosphere contains one female nucleus in it and called the ooplasm**. In the beginning of the development of the oogonium there are many nuclei, which degenerate soon leaving **one functional female nucleus**.



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.

Albugo Sexual Repdn

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- **The antheridium develops on the terminal end of another hypha lying very close to the oogonium. The hyphal end swells, becomes club-shaped and separates from rest of the mycelium by a septum. This swollen multinucleate club-shaped portion is called the antheridium.**
- **The antheridium attaches itself to the oogonial wall and at the point of contact a fertilization tube develops from the antheridium. The fertilization tube penetrates the oogonial wall and reaches the oosphere through the periplasm. One functional male nucleus transfers through the tube, reaches the egg, fuses with the female nucleus and the rest of the nuclei of the antheridium degenerate.**
- **The oospore is thick-walled and three-layered. The outermost thick layer of the wall is warty in Albugo candida. The oospore contains a large diploid (2n) nucleus. The reduction division (meiosis) is not yet seen in Albugo Candida but it has been observed in the other species of Albugo.**
- **Prior to germination the zygote nucleus divides repeatedly producing 32 nuclei. The first division is meiotic.**

- **Germination of oospore:**
- The oospores are perennating bodies and survive in adverse conditions. The **32 nucleate oospore** undergoes a period of rest and germinates on the approach of favourable conditions of moisture and temperature. The outer warty wall of oospore bursts and a thin membrane of sessile vesicle comes out of the oospore.
- Prior to extrusion of the contents in the vesicle the nuclei undergo the mitotic division repeatedly and a large number of **uninucleate bits of protoplast** are produced. **Each bit metamorphoses into a biflagellate, reniform, naked, uninucleate and single vacuolate zoospore.**
- Each oospore produces **forty to sixty zoospores**. After extrusion from the oospore, the vesicle bursts and the zoospores liberate in the film of water where they move about with the help of their flagella. They swim about, encyst and germinate producing the germ tubes on the

Albugo Sexual Repdn.

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suitable host. The germ tube enters through the stoma and develops into the new mycelium which ramifies in the intercellular spaces of the host tissue.

- The oospores remain dormant in the soil and infect the plants next year.

- The disease may be **controlled** by the following methods:
 - 1. By crop rotation.
 - 2. By eradicating infected plants.
 - 3. By spraying fungicides such as Bordeaux mixture.

Life-cycle of Albugo

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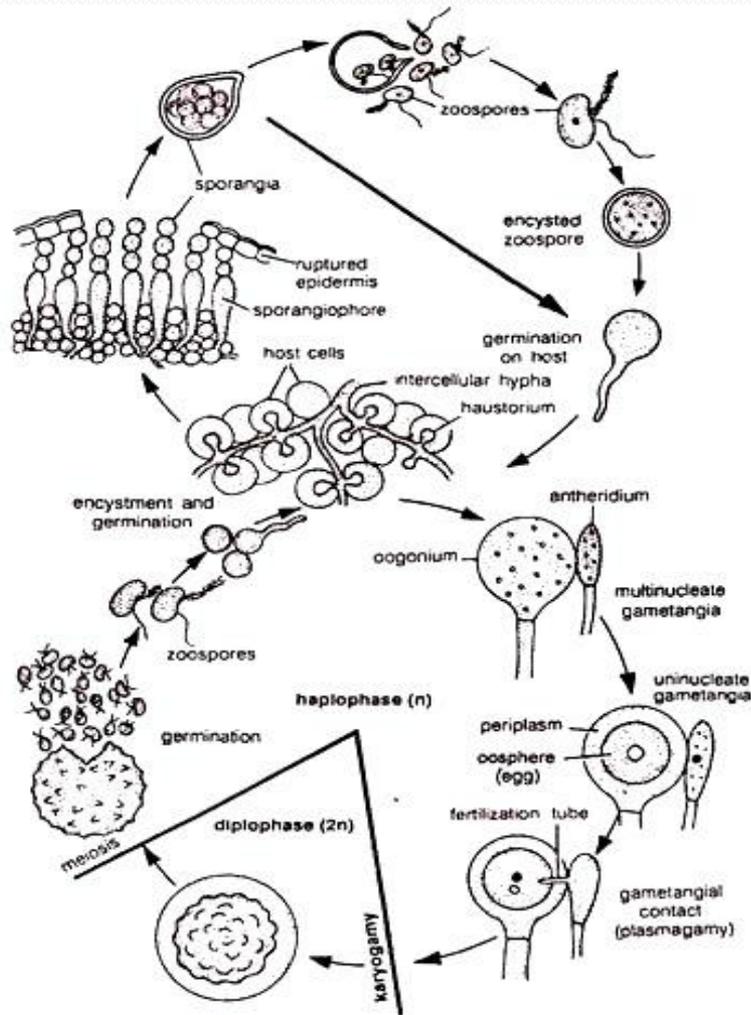
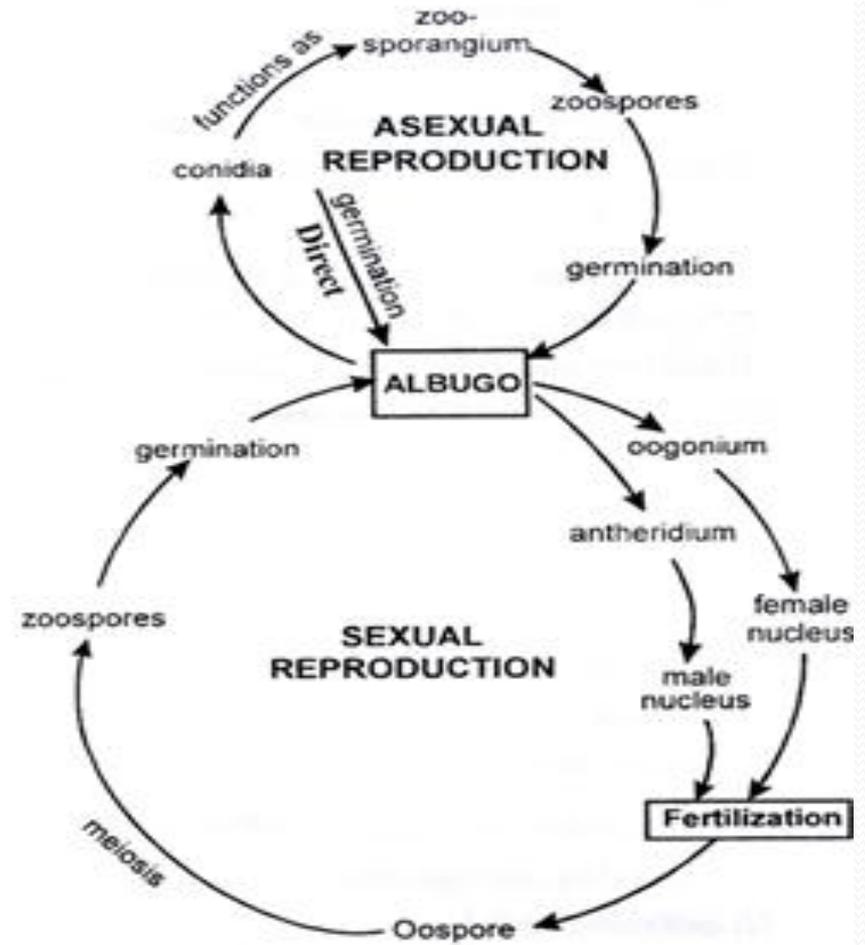


Fig. 5. *Albugo* : Diagrammatic life cycle



LIFE CYCLE OF ALBUGO
(ACCORDING TO OLD MYCOLOGISTS)