Powdery mildew of grape

Characteristics of the disease: 1) It can infect all grape varieties where hot temperatures & low relative humidities are prevailing. Grape varieties grown in the mediterranean region (hot & dry conditions during summer & fall) are severely attacked by the disease,

2) It may cause great losses in grape production at favorable conditions so that it should be controlled by regular spraying of specific fungicides in a well-defined program,

3) The disease may attack all the vegetative organs of grapevine (leaves, shoots, tendrils & clusters of grape berries). Infection with the disease on fruits leads to their cracking then rotting.

Symptoms of the disease: 1) on leaves: affected portions of the leaves become shrinking or curling especially in young leaves then infected areas become covered with white-grayish powdery dust with velvety appearance (mycelium of the fungus bearing conidiophores & chains of conidia). Epidermal cells of affected leaves die causing necrotic areas on these leaves that may enlarge then cause defoliation.

Continued (Powdery mildew of grape)

2) on shoots & twigs: Round to elongate spots with white-grayish powdery appearance that could be observed on young shoots. This infection may stop or slow the growth of these shoots. Spots turn then into necrosis killing the growing points of these shoots.

3) on blossoms & clusters of berries: infection with the disease may appear on fruits, stalks & other parts of clusters in form of whitish-gray powdery fungus growths (mycelium, conidiophores & conidia) then the cortical epidermis of infected fruits become cracked in the area of infection then rotting by other agents may occur. Infected flowers & blossomes die & may drop.

Economic damage caused by the disease: Infection with the disease on fruits may cause great losses reaching at 90% of the yield. Also, wine produced from infected berries has a low content of alcohol to uninfected fruits and a high content of acidity due to a rapid maturity of infected berries.

Causal agent of the disease and biology: 1) *Uncinula necator* is the causal agent of the disease (has the same classification as P.M of cucumber). Its cleistothecia have several asci & coiled tip

Continued (Powdery mildew of grape)

appendages.

2) Cleistothecia of the fungus are usually formed by fertilization of ascogonia by anthridia during the sexual cycle. They become mature at late February or early March then germinate by giving asci and ascospores inside. Ascospores will dessiminate by wind to reach the susceptible organs for inducing infection.

3) Asexual reproduction occurs by producing conidia that are easily dessiminate by wind, insects and workers from infected plants to healthy plants.

Disease development: 1) conidia germinate at optimum temperatures ranging from 10 to 35 deg. C but temperatures from 25 to 28 deg. C & low but not high atmospheric R.H. are necessary for mycelium growth & conidial production.

Control of the disease: 1) dusting grapevines thoroughly with sulfure dust or spraying them with a previously boiled mixture of lime sulfure (sulfure +lime or calcium hydroxide). This spraying or dusting should be complete & cover the entire vines.

Continued (Powdery mildew of grape)

2) Spraying grapevines with wettable sulfure or with dithiocarbamate fungicides such as Afugan, Robigan, Lablite, Topsin-m and Offir. Thses fungicides as specific for control of powdery mildews on many plants. Spraying with these fungicides should be continued when temperatures & R.H are favorable for disease development.

3) Finally, it is possible to mix copper fungicides with sulfure compounds (e.g. dithiocarbamates) to control downy mildews & powdery mildews at the same time on many host plants.

Rust diseases

 # General characteristics: 1) they are considered one of the most destructive diseases of plants especially on grain crops (wheat, oat, barley etc.) but they may attack other types of plants such as onion, garlic, bean, broadbean, ornamentals, forest trees, fruit trees (pome & stone fruits),

2) Characteristic symptoms of these diseases appear as numerous rusty orange-yellow pustules resulting from rupturing of epidermis ,

3) The most important rust fungi & diseases caused by these fungi are: are:

*** *Puccinia* as *P. graminis* (stem rust of cereals: wheat, barley & oat); *P. steriiformis* (yellow or stripe rust of wheat, barley & rye); *P. recondita* (leaf rust of wheat & rye); *P. coronata* (crown rust of oat; *P. sorghi* (corn rust).**

*** *Uromyces* as *U. fabae* (rust of broadbean); *U. phaseoli* (rust of bean).**

*** *Cronartium* as *C. ribicola* (white pine blister rust).**

Continued (Rust diseases)

* *Gymnosporangium* as *G. juniper-virginianae* (cedar rust).

* *Hemileia* as *H. vastatrix* (coffee leaf rust).

* *Phragmidium* as *Phragmidium* sp. (rust of roses).

* *Melampsora* as *M. lini* (rust of flax).

* *Tranzshelia* as *Tranzshelia* sp. (rust of peaches & other stone fruits).

Stem rust of cereals

1) It is world-wide distributed & it affects wheat wherever is grown. It may affect other cereals as barley, oat, rye etc.

2) It can infect all above ground parts of wheat plant causing losses by reducing the foliage and hence reducing quality & quantity of the yield.

Symptoms of the disease: 1) first appear as long, narrow & elliptical blisters or pustules parallel with long axis of stem or

Continued (Rust diseases)

leaf sheath,

2) Within few days, the epidermis covering the pustule is ruptured revealing a powdery mass of red-colored spores called uredo-spores & the pustule in this stage is called uredium,

3) As the plant approaches maturity later in the season, the rusty-colored pustules turn into black color because the fungus produces teliospores instead of urediospores so black-colored telia are produced,

4) On barbery bushes (alternate host of the fungus), symptoms appear as yellowish-orange colored pustules on leaves & young twigs. These pustules are called pycnia, they are seen on upper side of infected leaves, but aecia (orange-yellow pustules with cup-like shape) are seen on the lower side of infected leaves.

Causal agent & disease cycle: *Puccinia graminis* that causes the disease. It belongs to order Uredinales, subclass Heterobasidio-mycetes, class Basidiomycetes, division Higher fungi.

- Disease cycle is summerized as follows:

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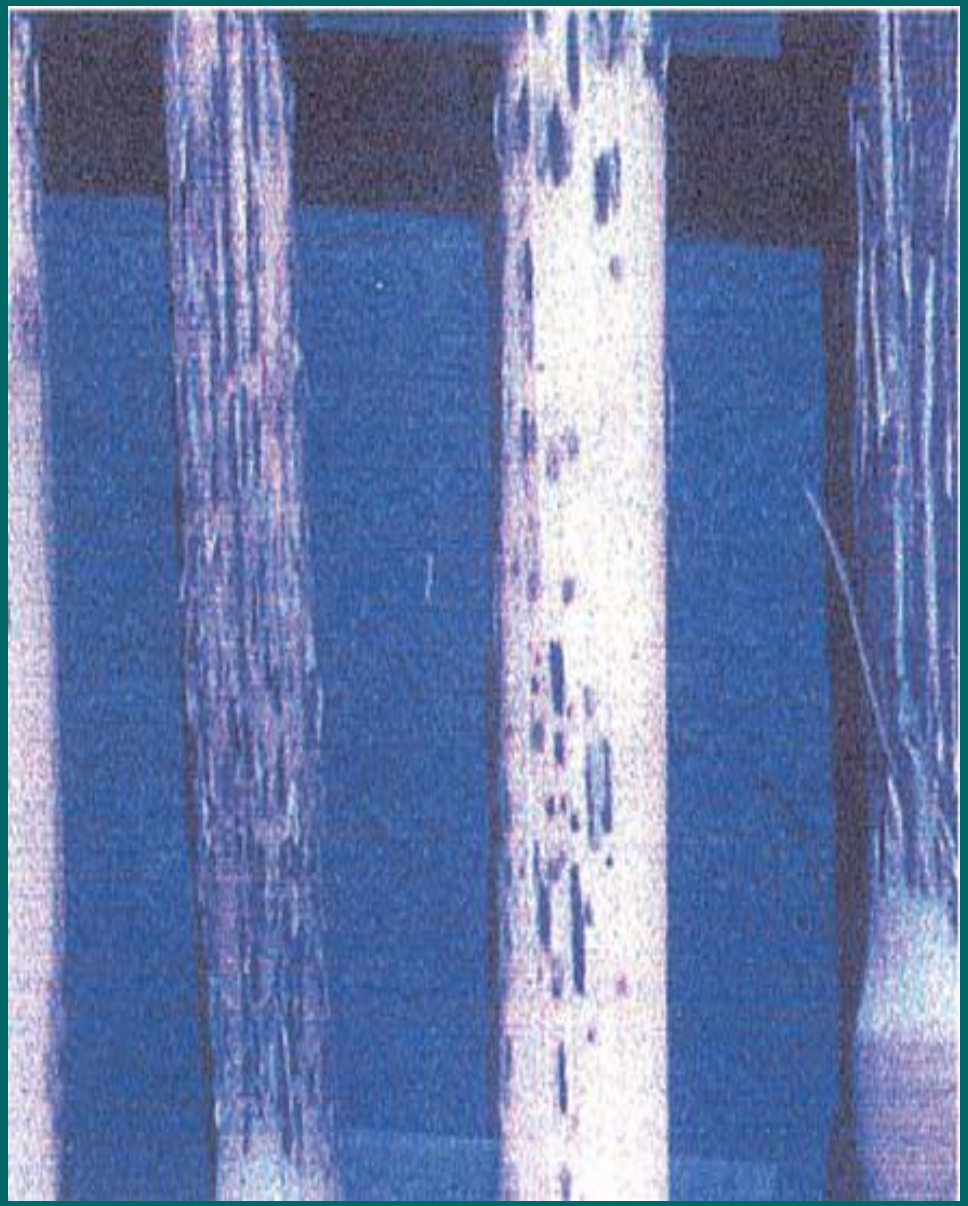

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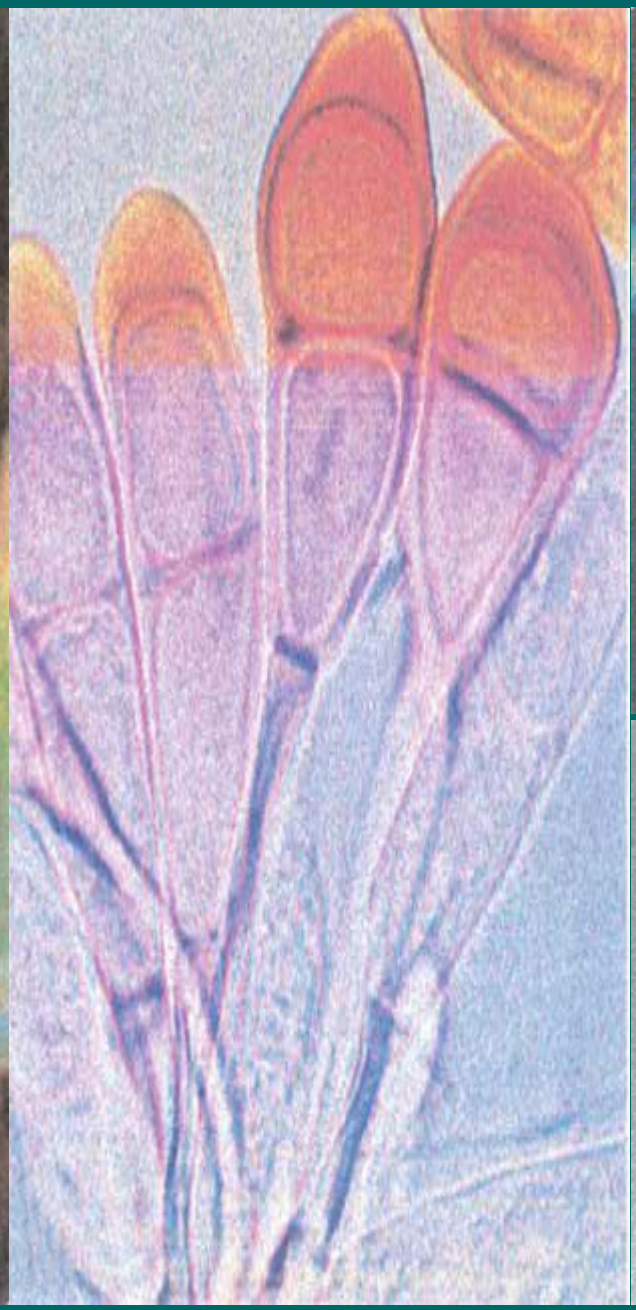

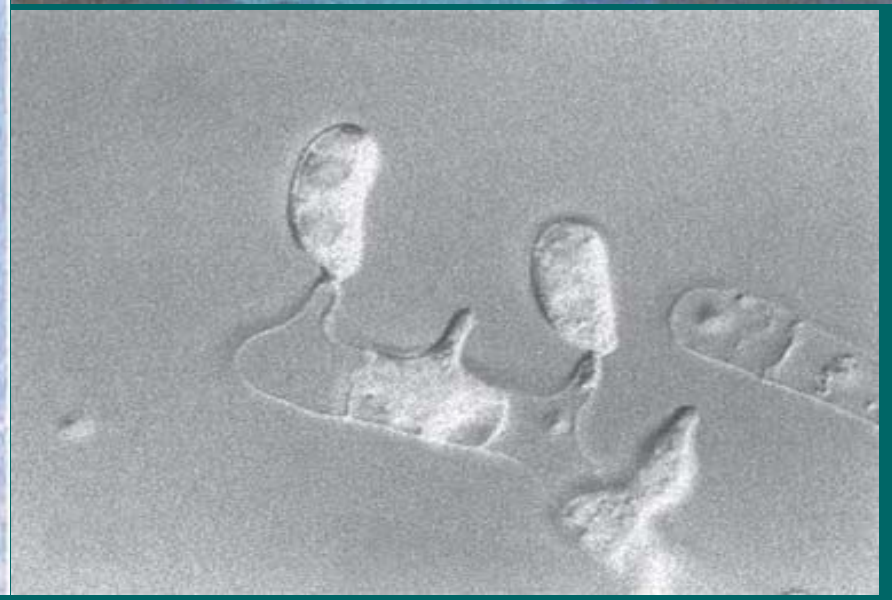

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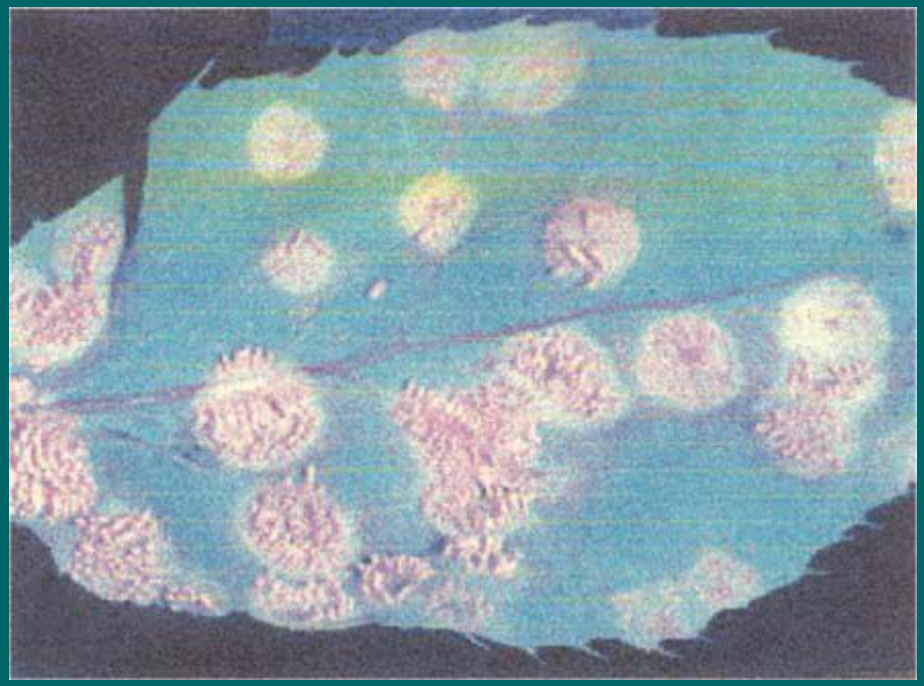

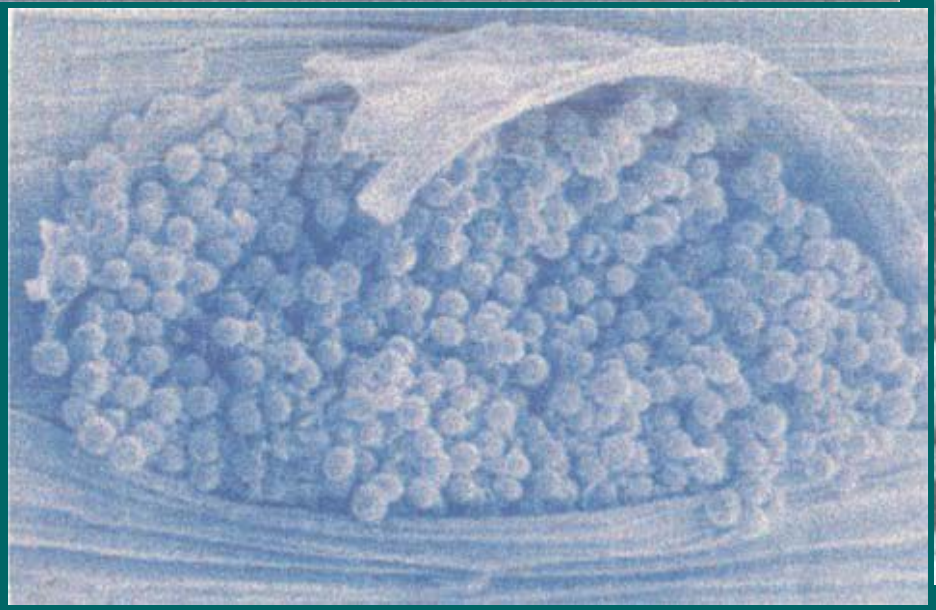

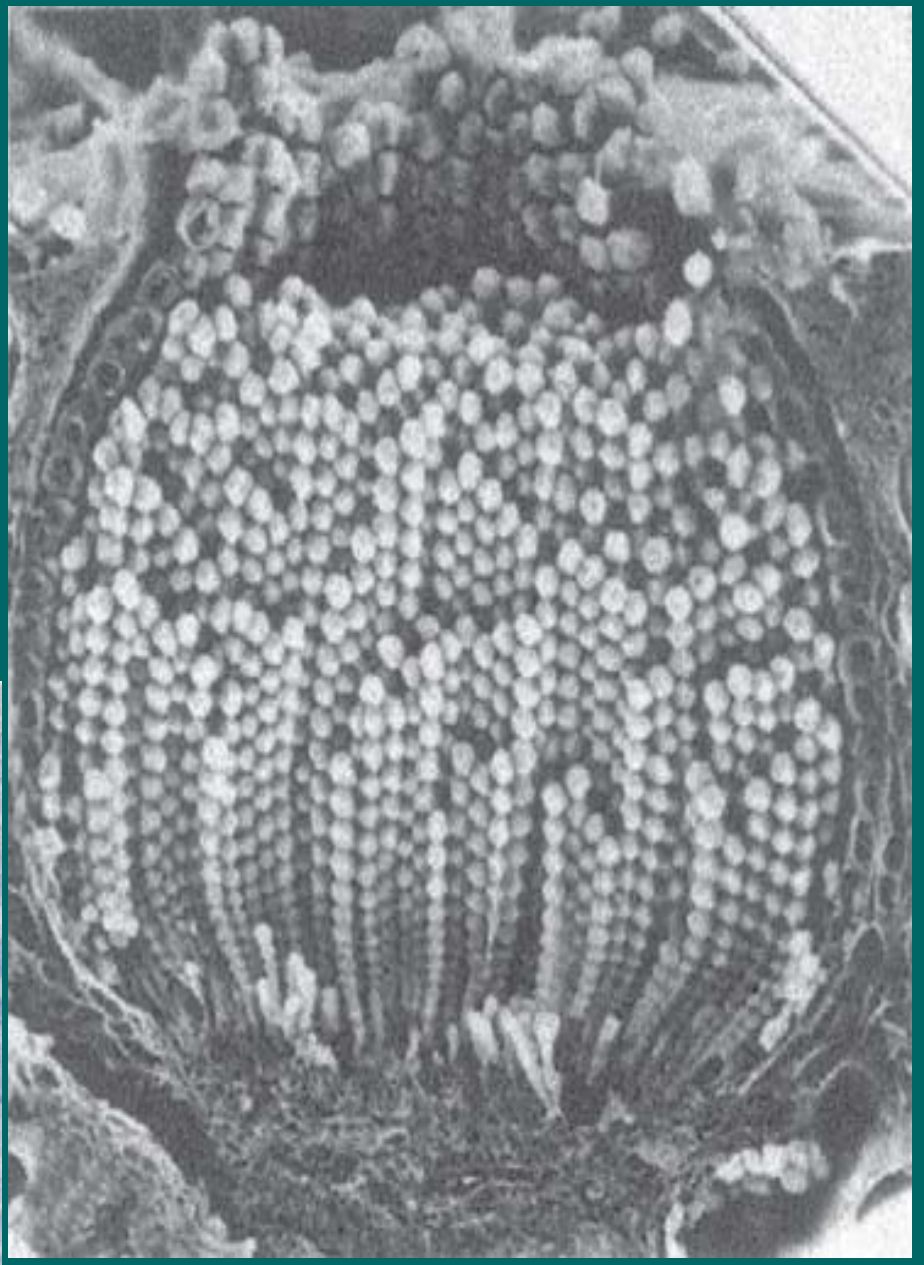

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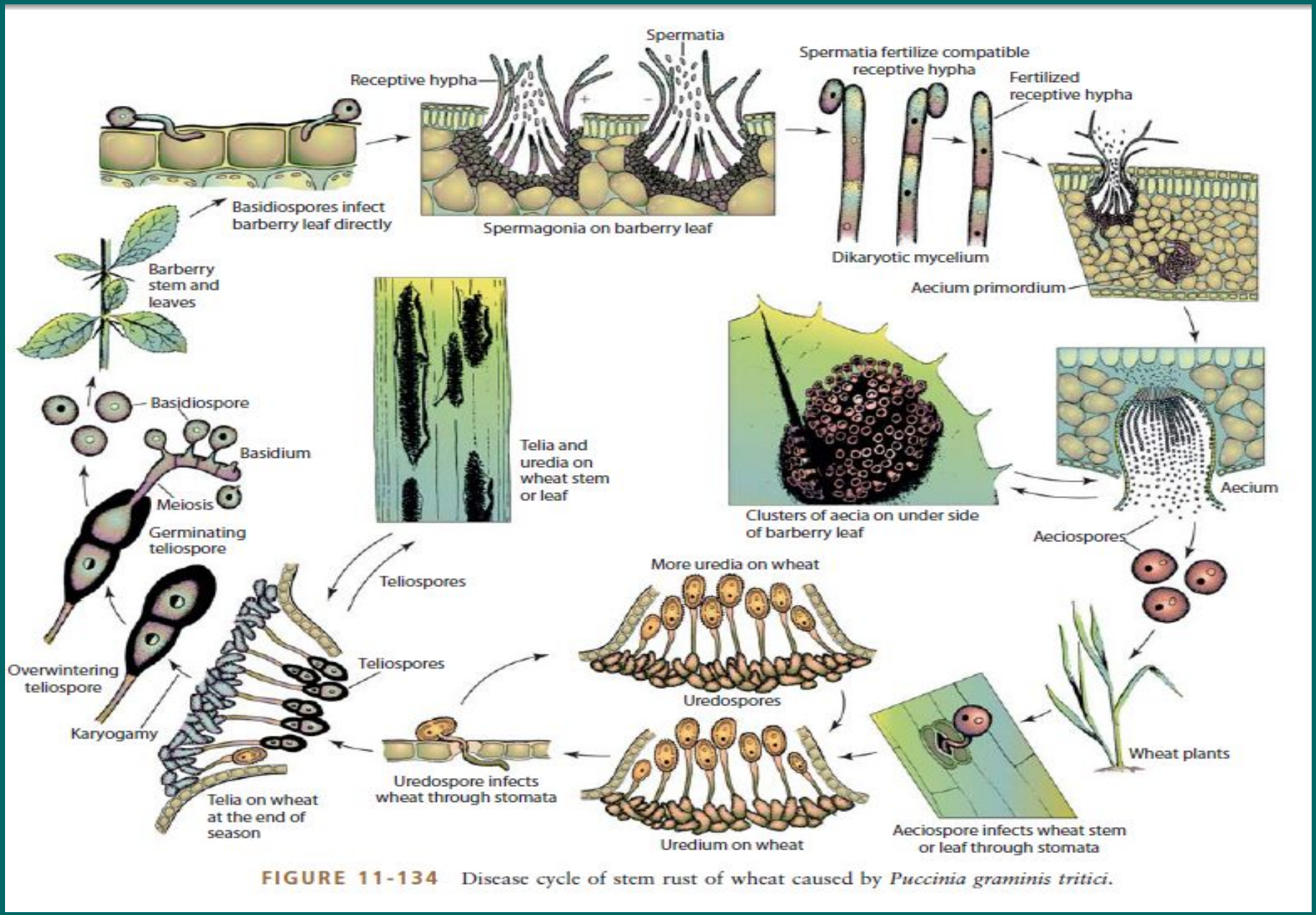


FIGURE 11-134 Disease cycle of stem rust of wheat caused by *Puccinia graminis tritici*.

Continued (Rust diseases)

- The fungus overwinters as teliospores on Infected plant wheat debris. These spores germinate in spring by giving basidium with basidiospores which are carried by wind to barberry plants. On these plants, pycnia or spermagonia are produced after the development of mycelium intercellularly.

- Spermagonia on barberry leaves are formed from receptive hyphae (+ & - types) which give upon fertilization the aecial stage on the under surfaces of infected leaves.

- Aeciospores are released in late spring & carried by wind to nearby wheat plants then mycelium grows below epidermis after penetration & forms uredia with urediospores inside (red or rusty colored spores).

- Urediospores are easily blown by wind when epidermis is ruptured, so re-infection of wheat plants or nearby fields may occur & many successive infections occur until maturity.

- Uredia produce teliospores instead of urediospores at the end of growing season. The black or dark-brown bi-celled teliospores do not infect wheat plants but used for overwintering of the fungus.

Continued (Rust diseases)

- Disease development: high humidity is necessary for the development of the disease + presence of temperatures ranging from 20 to 25 deg. C.

- Control measures: 1) The most effective & practical control measure is to use resistant varieties to rust infection.

2) Eradication of the alternate host (barberry plants) in order to decrease the disease intensity & primary infection at the beginning of wheat growing season.

3) Seed treatment using the systemic fungicide Oxycarboxin when planting the seeds or adding the fungicide to the soil just before sowing.

4) Spraying fungicides in case of occurrence of infection during the growing season as Zineb, Dichlone etc. directly on infected plants.

Smut diseases

General characteristics: 1) Smut diseases occur throughout the world & losses due to these diseases are equivalent to those caused by rust diseases but smut diseases always attack the kernels & replace their content with black dusty spore masses,

2) Most of the smut fungi produce only 2 kinds of spores: teliospores & basidiospores instead of 5 kinds in rust fungi.

3) The most common smut fungi & diseases caused by them are:

* Ustilago as U. tritici (loose smut of wheat); U. nuda (loose smut of barley); U. avenae (loose smut of oat) and U. maydis or U. zea (corn rust).

* Tilletia as T. caries & T. foetidae (covered smut of wheat).

* Sphacelotheca as S. sorghi (covered smut of sorghum)

* Urocystis as U. cepulae (onion smut).

* Neovossia as N. brachayana (kernel smut of rice)

Continued (Smut diseases)

Loose smut of wheat & barley

1) It is world-wide distributed all over the world in the areas of wheat & barley production. It is serious in humid & subhumid regions,

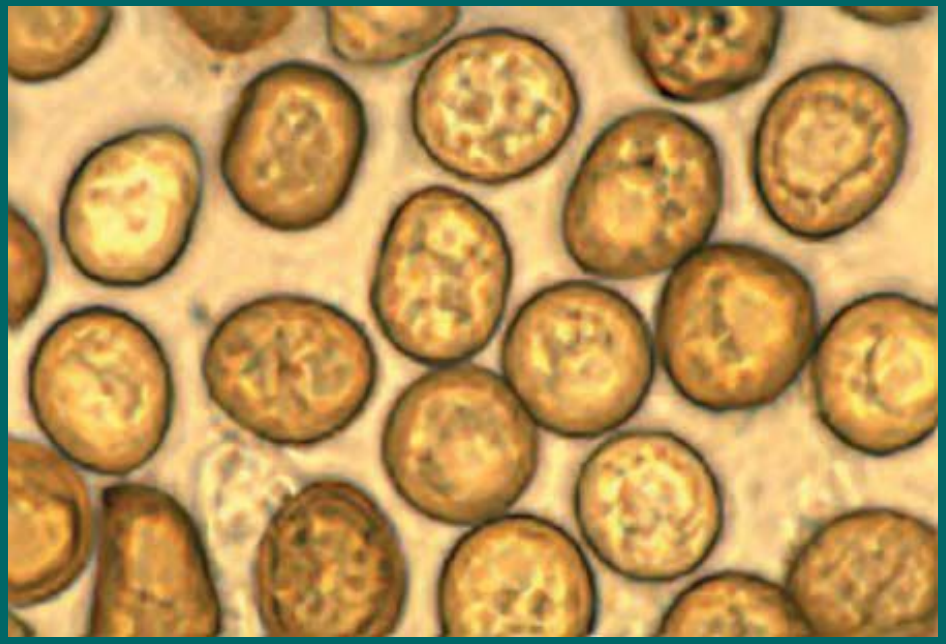
2) Losses caused by this disease may be ranged from 10 to 40% in a given locality per year.

Symptoms of the disease: 1) Symptoms only appear at the stage of heading in wheat & barley , so infected heads bear spikelets which has kernels entirely transformed into a black smut mass consisting of smut teliospores,

2) These smutted kernels are at first covered with a delicate grayish membrane which soon bursts or ruptures & sets the powdery smut mass of black teliospores which become free &naked,

3) these spores are then blown off by wind & leave the rachis as a naked stalk, so it is easy to see infected plants in the field with naked rachis.

Continued (Smut diseases)



Continued (Smut diseases)

 # Disease causal agent : 1) *Ustilago tritici* (on wheat) and *U. nuda* (on barley). These fungi are belonging to order Ustilaginales, subclass Heterobasidiomycetes, class Basidiomycetes, Division Higher fungi. The important points in the disease cycle are:

1)The mycelium cells in infected kernels transformes into brown spherical teliospores, so they become filled with teliospores,

2) The outer membrane of infected kernels breaks & teliospores inside are carried by wind to other healthy plants,

3) Teliospores landing on flowers of healthy spikletes germinate by formation of basidium which penetrates them then becomes inactive & dormant inside.

4) The pathogen overwinters as dormant mycelium in the cotyledons of infected kernels. These kernels germinate after planting & dormant mycelium resumes its activity & grows in the tissues of young seedlings until reaching its growing point.

5) The mycelium then invades the young spikelets & destroys most of its tissues except the rachis then transformes into teliospores.

Continued (Smut diseases)

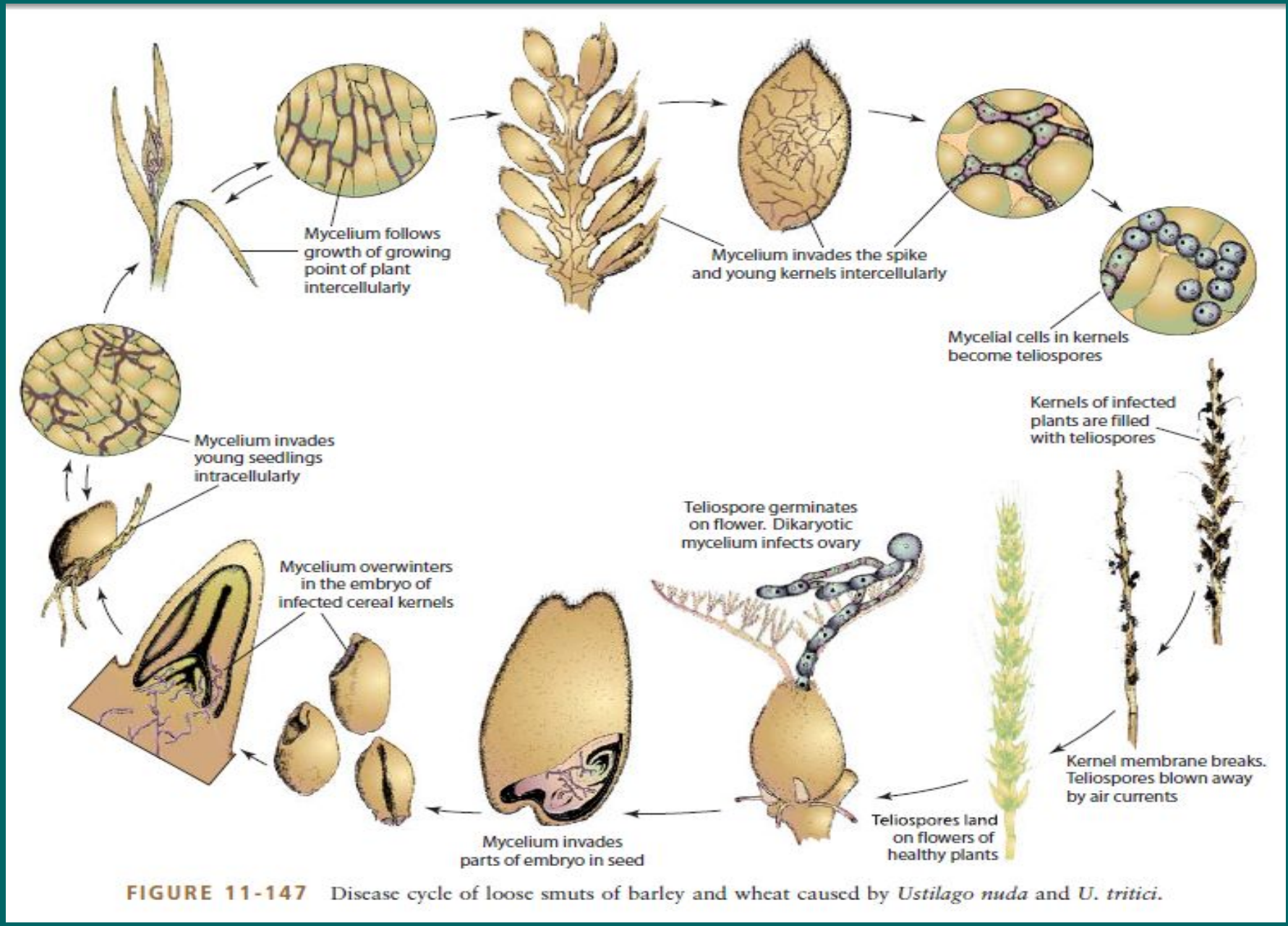


FIGURE 11-147 Disease cycle of loose smuts of barley and wheat caused by *Ustilago nuda* and *U. tritici*.

Continued (Smut diseases)

disease development: As in rust diseases, high humidity is necessary for the disease development + prevailing temperatures varying from 20 to 25 deg. C.

Control measures: 1) Treating seeds with systemic fungicides like Carboxin before planting since these chemicals are absorbed during the seed germination & then act systemically in the germinated seedlings & then in the growing plants.

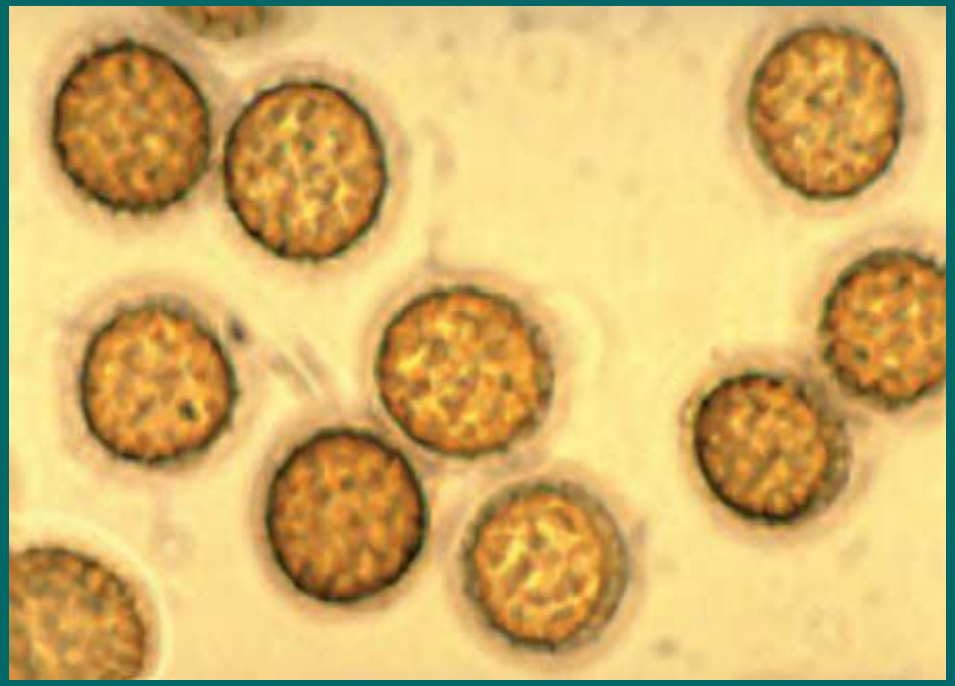
2) Previously & before discovery of systemic fungicides, certified smut-free seeds of wheat & barley were used. These seeds were obtained by treating seeds in hot water (52 deg. C for 11 minutes) then planted in isolated fields to produce smut-free seeds to be used during the next season.

Continued (Smut diseases)

Covered smut or Bunt of wheat

As the loose smut, the causal agent of covered smut destroys the contents of infected kernels & replacing them with a mass of fungus spores (teliospores), but infected kernels with covered smut in the infected spike have intact membrane & when these kernels are broken by harvesting & threshing, they set the sooty, black fungus spores (teliospores) free.

Continued (Smut diseases)



<u>Causal agent of the disease</u>: Two species of *Tilletia* that cause the disease on wheat (*T. caries* & *T. foetida*). They have the same classification as the causal agent of loose smut.

These pathogens have also similar disease cycle as in loose smut but with the following differences: 1) covered smut pathogens overwinter as teliospores on contaminated wheat kernel surface whereas pathogen of loose smut overwinters as mycelium in the embryo.

Continued (Smut diseases)

2) Covered smut pathogens invade all parts of the kernel & consume their contents except the kernel pericarp which remains intact and contains teliospores inside whereas in loose smut, it is ruptured.

3) Odors-like decaying fish were given-off from smutted kernels with covered smut when pericarp is ruptured during harvesting & threshing, so it is called bunt of wheat or stinking smut (no odors were given-off by loose smut).

Control measures: as the loose smut by seed treatment before planting with systemic fungicides as carboxin or with thiabendazole (e.g. Benomyl) to kill & inhibit germination of teliospors on the surface of infected kernels. Also by treatment of contaminated kernels with hot water (52 deg. C for 11 minutes). Also cleaning & removing smutted unbroken kernels from biles of kernels is beneficial in decreasing the source of inoculum for the disease next season.

Continued (Smut diseases)

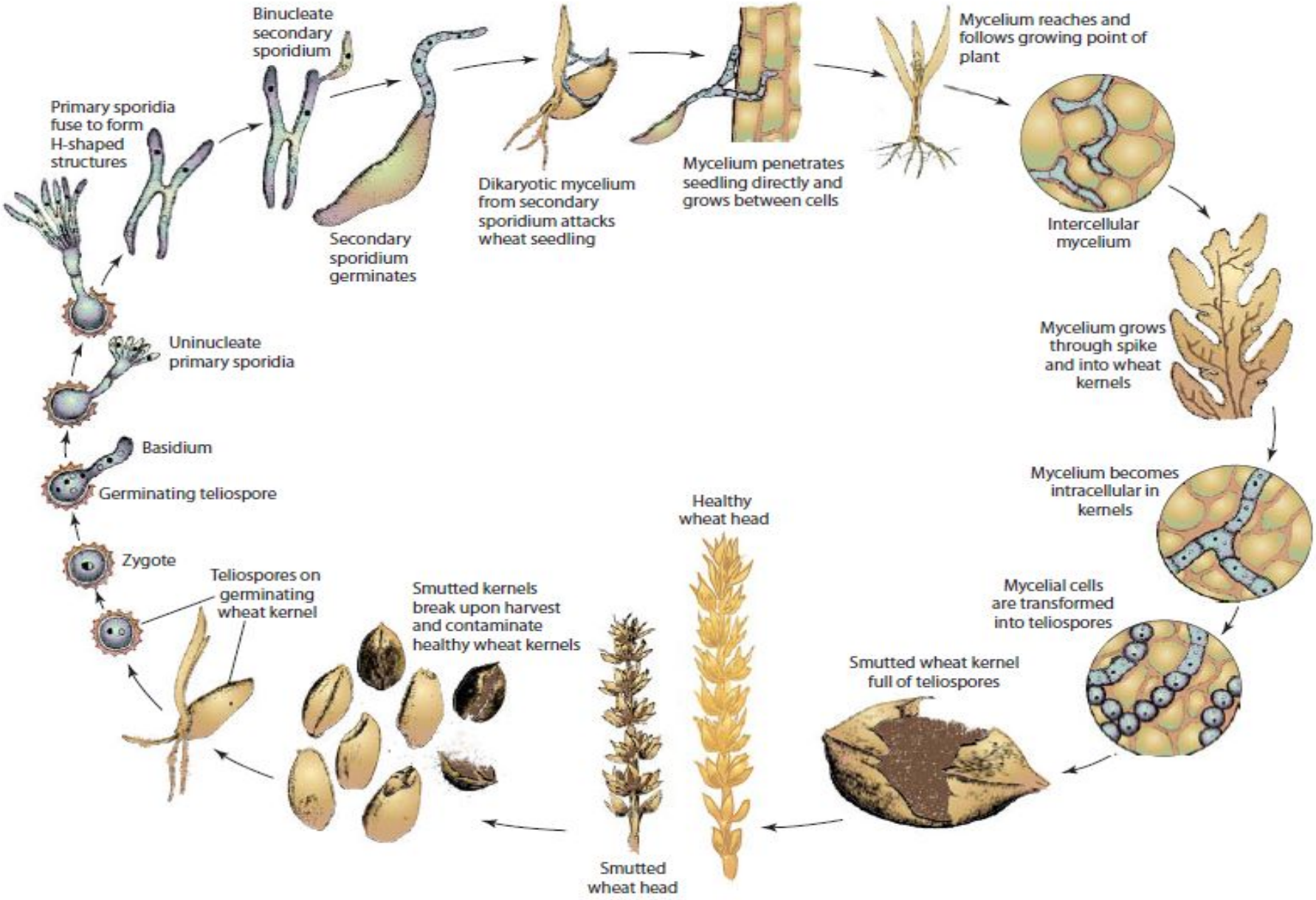


FIGURE 11-149 Disease cycle of covered smut or bunt of wheat caused by *Telletia* sp.

Apple scab

This disease exists in every country where apples are grown especially at cool, moist springs & summers.

It is the most important disease on apples & losses from this disease may reach 70% or more of total fruit production including malformation of infected fruits.

Symptoms of the disease: 1) They appear at first on the lower surfaces of young leaves as light, olive-green colored & irregular spots or lesions, then these lesions have a velvety grayish-dark surface then become as metallic-black & called scabby lesions,

2) Lesions then coalesce & infected leaves become dwarfed & curled then fall off.

3) Infection on fruits appear as distinct, almost circular scabby lesions which first velvety & olive-green but later become metallic-dark and somewhat cracked. Sever early fruit infections result in misshapen, cracked fruit which frequently drop prematurely.

Continued (Apple scab)

<u>Causal agent & disease cycle</u>: *Venturia inaequalis* is the causal agent. It belongs to Order Pleoporales, Subclass Euascomycetes, Class: Ascomycetes, Division Higher fungi.

The most important points in the disease cycle are: 1) Mycelium of the fungus in the living tissues is located between the leaf cuticle & the epidermal cells (subcuticular mycelium) and after rupturing of cuticle, the fungus produces short erect brownish conidiophores which give rise to conidia (1- or 2-celled reddish-brown & fusicladium-type.

Continued (Apple scab)

Continued (Apple scab)

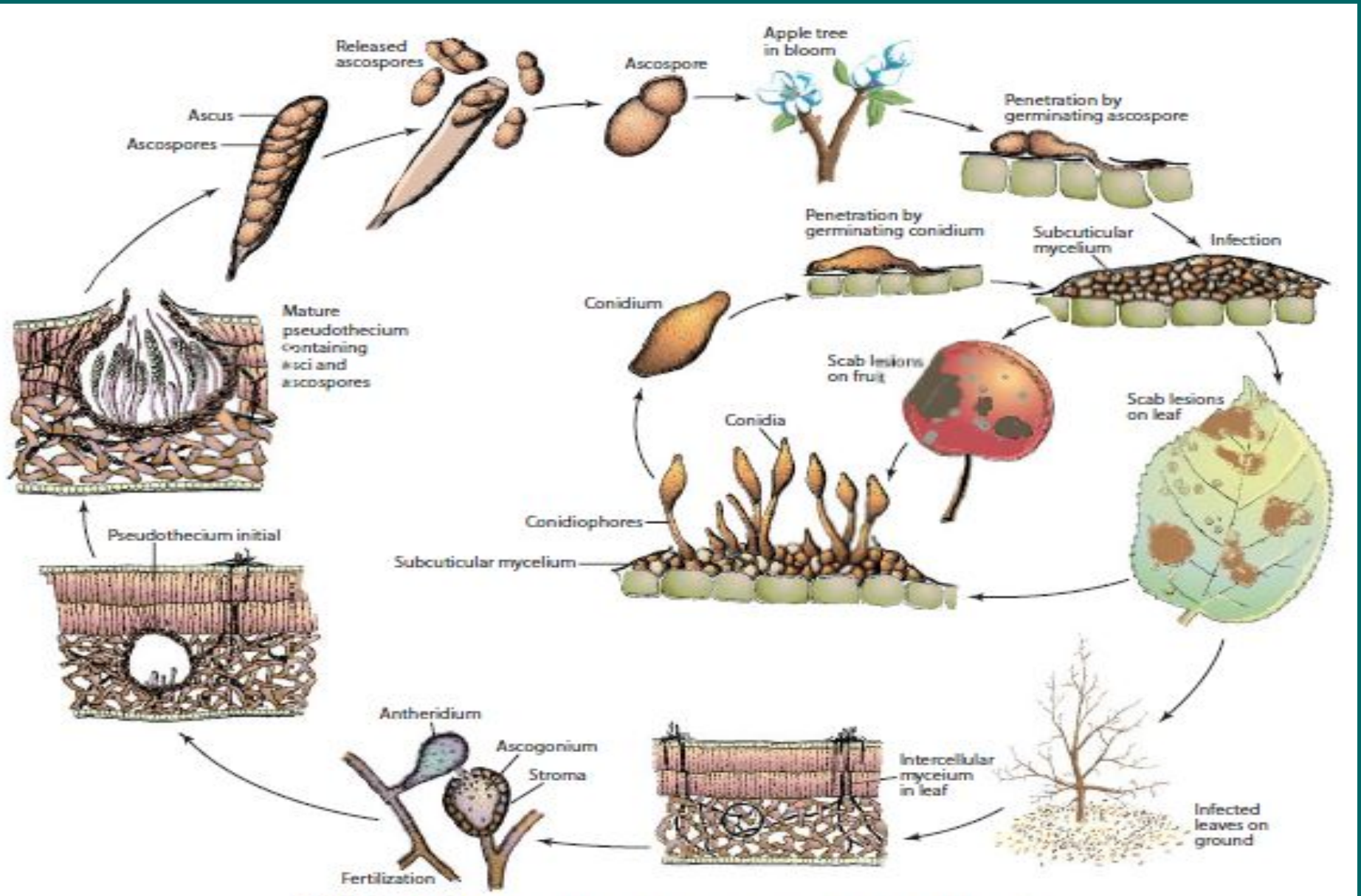


FIGURE 11-90 Disease cycle of apple scab caused by *Venturia inaequalis*.

Continued (Apple scab)

2) In dead fallen leaves, the mycelium grows through the leaf tissues. Fertilization takes place by means of ascogonia and anthridia to give perithecia (fruiting body of the fungus).

3) Perithecia are dark-brown to black to black with a slight beak & of a distinct opening (ostiate). Inside perithecium, there are 50-100 asci are formed & each one contains 8 ascospores. Each ascospore is consisting of 2 cells of un equal size, hyaline first then brown when become mature.

Disease development: 1) The pathogen overwinters in dead leaves on the ground as perithecia which become mature in spring. This maturity coincide with fruit bud opening or bud break & then the fruit set, so ascospores can germinate & cause infection.

2) For infection to occur, the ascospores must be continuously wet for 48 hours at 6 deg. C, 14 hours at 10 deg. C, 9 hours at 18-24 deg. C, and 12 hours at 26 deg. C.

Control measures: 1) By timely sprays with the proper fungicides before or during or immediately after the rain at the

Continued (Apple scab)

beginning of bud break. Sprays begin in the spring are repeated every 5-7 days or according to the rainfall frequency.

2) Several fungicides which may give excellent control of apple scab (as protectants) such as Dodine (Cyprex TR) by inhibiting ascospore germination. Other fungicides as Captan, Ferban, Benomyl, Thiram etc. give a good control of the scab.