

Smut of Cereals

- There are approximately 1,200 species of smut fungi.
- In addition to the various cereals, smuts also affect other crops.
- Until the 20th century, smuts were the causes of serious grain losses that were equal to, or second only to, losses caused by the rusts.
- Smut fungi seldom kill their hosts, but in some cases infected plants may be severely stunted.
- Most smut fungi produce only two kinds of spores, teliospores and basidiospores.

Control:

- 1- Use smut-free seed of a resistant variety.
- 2- Seed treatments are extremely effective in controlling bunt.
- 3- Application of a systemic fungicide.
- 4- Remove plant debris on the soil surface.
- 5- All machinery that handled infected grain should be thoroughly cleaned.
- 6- Wheat should not be sown back into an infected field for at least two years / several years.

BUNT OF WHEAT

There are *three kinds* of bunt caused by related but different fungi:

A. *common bunt;*

Covered smut, or common bunt, or stinking smut of wheat occurs in all wheat-growing areas of the world.

Now is controlled easily by treating the seed with fungicides and therefore causes few losses in most developed countries.

B. *dwarf bunt;*

Still cannot be controlled and therefore continues to cause severe losses in many parts of the world.

This is a disease exclusively of winter crops since the teliospores only germinate when the **soil temperature hovers around freezing for long periods of time, usually 90 days or longer.**

This condition is usually found under snow cover so dwarf bunt is restricted to areas where winter wheat is grown and that have long periods of snow.

C. *Karnal bunt;*

So far, occurs only in India and some other Asian countries, Mexico, and a few locations in the southwestern United States.

A. common bunt (stinking smut)

Pathogen:

Tilletia caries (= *T. tritici*) and *T. laevis* (= *T. foetida*)

Hosts: specific to wheat



Wheat kernels filled with black spores (arrows)
of the common bunt fungus

Symptoms:

- No symptoms can be observed prior to ear emergence.
- Flag leaves show yellow streaks and plants can be stunted, with dark grey-green ears and slightly gaping glumes.
- In infected ears the grain is replaced by seed like 'bunt balls' each containing millions of greasy, black, foul-smelling spores.
- In severe cases, the whole field may smell of rotting fish.

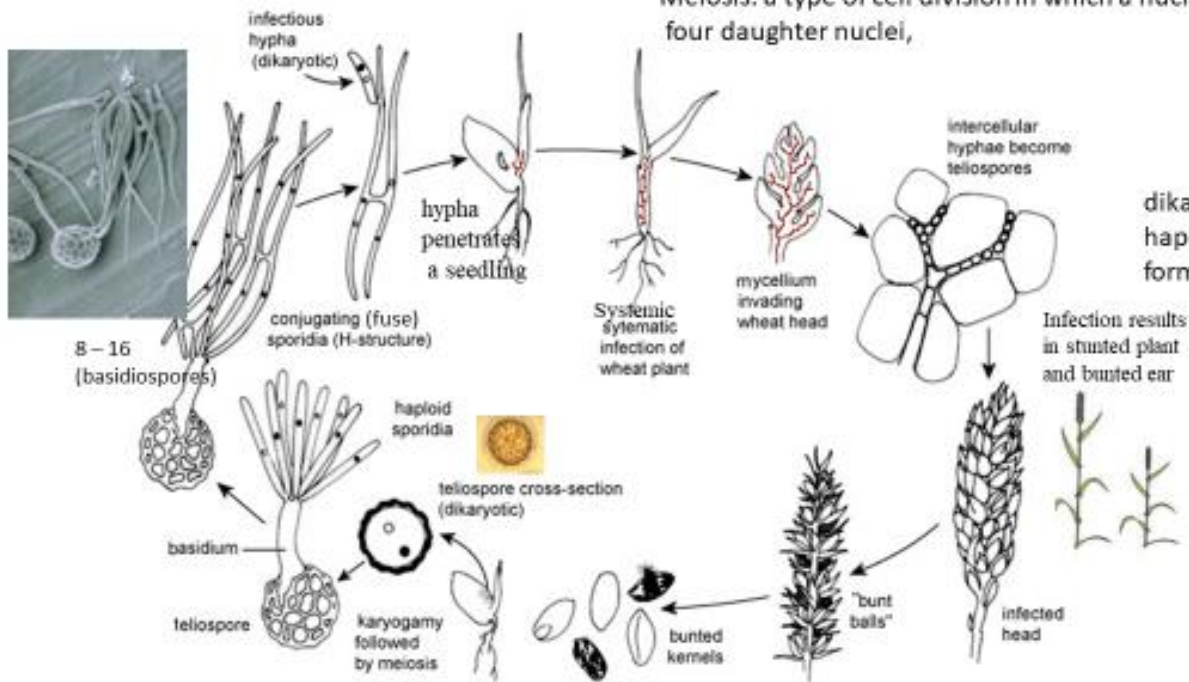


Bunt balls (left) and
Healthy grain (right)



Wheat flag leaf showing typical
yellow streak symptoms

Life cycle of *Tilletia tritici*



Karyogamy: The fusion of two gametic nuclei during fertilization

Meiosis: a type of cell division in which a nucleus divides into four daughter nuclei,

Haploid: having a single set of unpaired chromosomes

dikaryotic hyphae (two haploid cells fuse to form a dikaryon).

Basidiospores, usually called primary sporidia

Importance:

- The disease is potentially very damaging and can lead to complete crop loss due to the grain being unsalable because of discoloration and smell.

Survival:

- The fungus survives between growing seasons as teliospores on the surface of seeds or in the soil.
- can remain viable in either location for a number of years.



teliospores

Spread:

- During harvest, spores are released from infected heads as the heads pass through the combine.
- They contaminate other seed being harvested or are spread by the wind to the soil surface.
- As each bunt ball contains millions of spores, the capacity for contamination of healthy grain in the same field is enormous.
- If seeds is continually saved and re-sown without treatment, the disease can build up very rapidly.



Environmental conditions:

- Cool temperatures (5-15°C) favor the germination of the teliospores.
- Planting winter wheat early when the soil temperature is above 20°C results in very low infection.
- In contrast, early seeding of spring wheat when soil temperatures are cool favors infection.

Loose Smut

Pathogen: *Ustilago nuda* f.sp. *tritici* (*U. tritici*) - Wheat
Ustilago nuda f.sp. *hordei* - Barley
Ustilago avenae - Oats



Loose smut infected wheat ears



Close-up of infected wheat ears

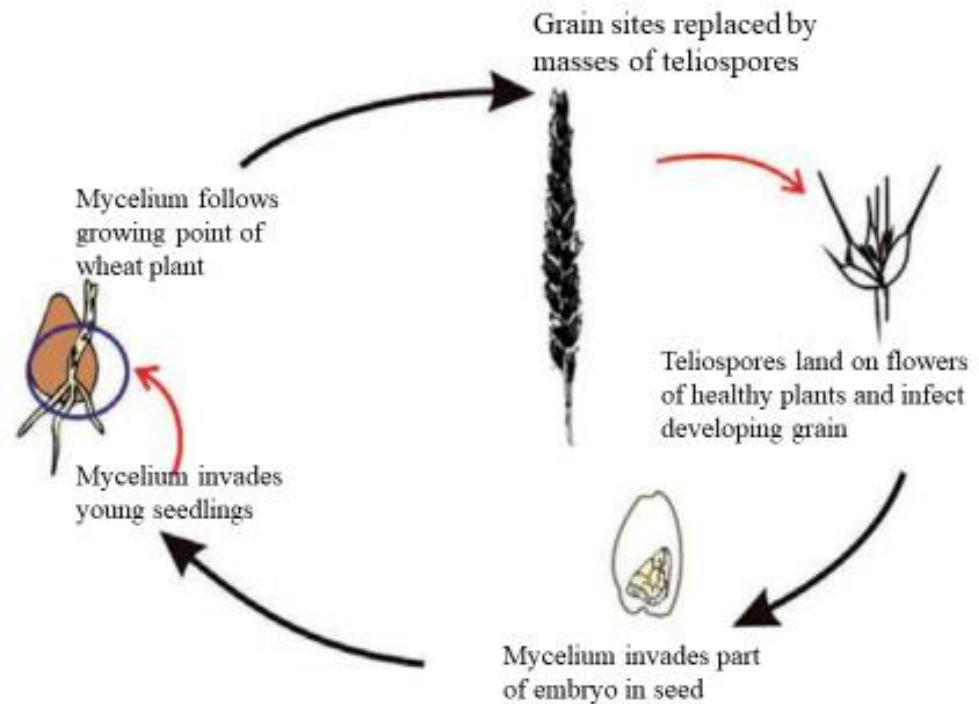
Symptoms

- Loose smut is easily recognized at ear emergence as individual grains are completely replaced by a mass of black fungal spores.
- Partly affected ears are sometimes seen.
- The spores are released as soon as the ear emerges, eventually all that remains of the head is the bare stalk.



***Wheat ears infected with loose smut.
The right ear is all that remains after the
loose smut has blown free.***

Life cycle of *Ustilago tritici*



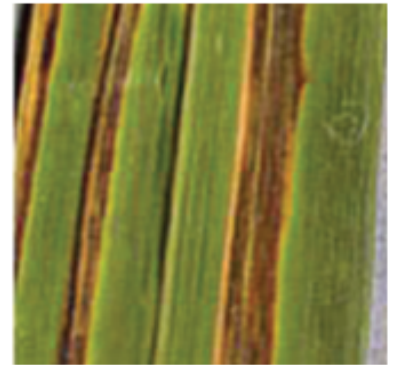
Occurrence & environmental conditions:

- Occurs wherever cultivated wheat is grown.
- It is more common in regions with a cool, moist climate during flowering of the host.
- Infection during flowering is favored by frequent rain showers, high humidity and temperatures of 16 -22°C.
- The optimum temperature for teliospore germination and further growth is 20° - 25°C and 95% relative humidity.
- The disease is not devastating, but causes low to moderate losses, however, even in dry, warm climates economic losses occur.
- Since the pathogen is seed-borne, humans are the principal means of dissemination.

Flag smut: *Urocystis agropyri*

Hosts

The disease infects wheat
and many grass species



Streak symptoms of flag smut on a wheat leaf

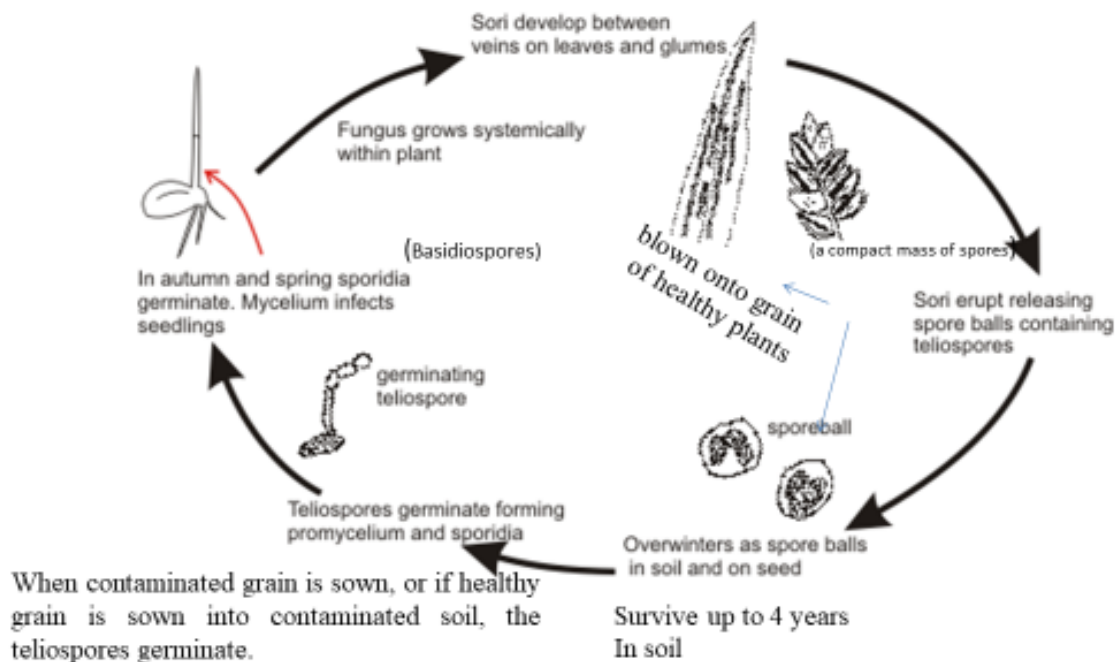
Symptoms:

- Affected plants are often severely stunted and affected leaves may be curled and distorted.
- Excessive tillering is common and often the ears fail to emerge, remaining within the boot.
- Plants show long dark grey to black streaks (spore masses) on the leaf blades and leaf sheaths.
- Initially the spore masses (teliospores) are under the surface of the leaf, but break through the surface revealing distinct streaks of sooty spores on the leaves



Black teliospores on a wheat leaf

Life cycle of Flag smut *Urocystis agropyri*



Importance:

- The disease is not particularly damaging unless present at high levels but it can have serious consequences with regard to exporting grain or wheat products.
- Many countries have *quarantine* restrictions which prohibit the import of wheat products from countries where the disease is established.

Environmental Conditions:

As a general rule, flag smut occurs more frequently in light, relatively dry soils in the 18° to 24°C temperature range.

Inoculum (Infection):

Teliospores on the seed or in soil provide the inoculum.

T.A.