

3. Diseases of Wheat

Black or stem rust - *Puccinia graminis tritici*

Symptoms

Symptoms are produced on almost all aerial parts of the wheat plant but are most common on stem, leaf sheaths and upper and lower leaf surfaces. Uredial [pustules](#) (or sori) are oval to spindle shaped and dark reddish brown (rust) in color. They erupt through the epidermis of the host and are surrounded by tattered host tissue. The pustules are dusty in appearance due to the vast number of spores produced. Spores are readily released when touched.



Symptoms

As the infection advances teliospores are produced in the same pustule. The color of the pustule changes from rust color to black as [teliospore](#) production progresses. If a large number of pustules are produced, stems become weakened and lodge. The pathogen attacks other host ([barberry](#)) to complete its life cycle. Symptoms are very different on this woody host. Other spores are [Pycnia \(spermagonia\)](#) produced on the upper leaf surface of barberry which appears as raised orange spots. Small amounts of honeydew that attracts insects are produced in this structure. [Aecia](#), produced on the lower leaf surface, are yellow. They are bell-shaped and extend as far as 5 mm from the leaf surface.

Brown or leaf rust - *Puccinia triticina* (*P. recondita*)

Symptom

The most common site for symptoms is on leaf blades, however, sheaths, glumes and awns may occasionally become infected and exhibit symptoms. [Uredia](#) are seen as small, circular orange blisters or pustules on the upper surface of leaves.



Symptoms

Orange spores are easily dislodged and may cover clothing, hands or implements. When the infection is severe leaves dry out and die. Since inoculum is blown into a given area, symptoms are often seen on upper leaves first. As plants mature, the orange [urediospores](#) are replaced by black [teliospores](#). Pustules containing these spores are black and shiny since the epidermis does not rupture. Yield loss often occurs as a result of infection by *Puccinia recondita* f. sp. *tritici*. Heavy infection which extends to the flag leaf results in a shorter period of grain fill and small kernels.

Yellow or stripe rust - [Puccinia striiformis](#)

[Symptom](#)

Mainly occur on leaves than the leaf sheaths and stem. Bright yellow pustules (Uredia) appear on leaves at early stage of crop and pustules are arranged in linear rows as stripes. The stripes are yellow to orange yellow. The teliospores are also arranged in long stripes and are dull black in colour.





Symptoms

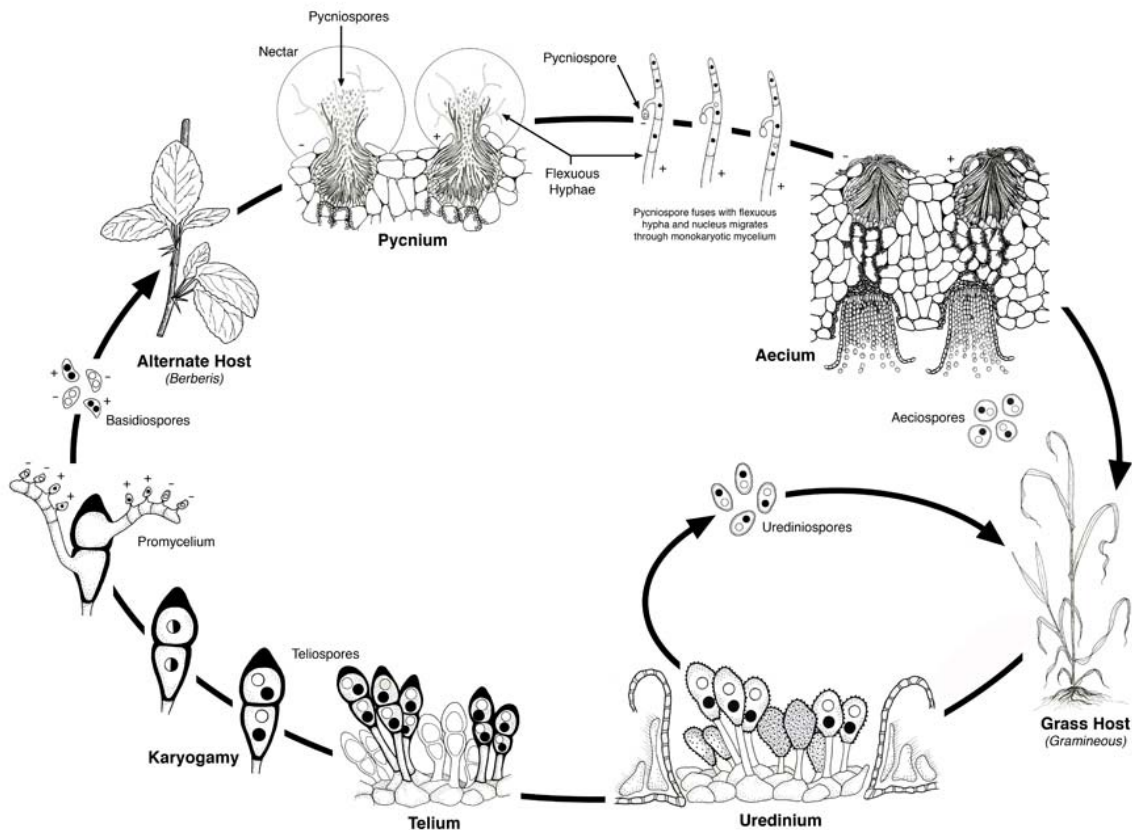
Pathogen

The uredospores of rust pathogen are almost round or oval in shape and bright orange in colour. The teliospores are bright orange to dark brown, two celled and flattened at the top. Sterile [paraphyses](#) are also present at the end of sorus.

Disease Cycle

In India, all these rusts appear in wheat growing belt during Rabi crop season. Uredosori turn into teliosori as summer approaches. The [inoculum](#) survives in the form of uredospores / teliospores in the hills during off season on self sown crop or volunteer hosts, which provide an excellent source of inoculum. In India, role of [alternate host](#) ([Barberis](#)) is not there in completing the life cycle.

The fungus is inhibited by temperatures over 20°C although strains tolerant of high temperatures do exist. The complete cycle from infection to the production of new spores can take as little as 7 days during ideal conditions. The disease cycle may therefore be repeated many times in one season. During late summer, the dark teliospores may be produced. These can germinate to produce yet another spore type, the [basidiospore](#), but no alternate host has been found. Although the teliospores seem to have no function in the disease cycle they may contribute to the development of new races through sexual recombination.



Life cycle of *Puccinia graminis*

Favourable Conditions

- Low temperature (15-20°C) and high humidity during November – December favour black and brown rusts.
- Temperature less < 10° favours yellow rusts.

Disease cycle

Uredospores and [dormant mycelium](#) survive on stubbles and straws and also on weed hosts and self sown wheat crops. Wind borne uredospores from hills are lifted due to cyclonic winds and infect the crop in the plains during crop season.

Management

- Mixed cropping with suitable crops.
- Avoid excess dose of nitrogenous fertilizers.
- Spray [Zineb](#) at 2.5 kg/ha or [Propiconazole](#) @ 0.1 %.

- Grow resistant varieties like PBW 343, PBW 550, PBW 17

Loose smut - *Ustilago nuda tritici* (*Ustilago tritici*)

Symptoms

It is very difficult to detect infected plants in the field until heading. At this time, infected heads emerge earlier than normal heads. The entire inflorescence is commonly affected and appears as a mass of olive-black spores, initially covered by a thin gray membrane. Once the membrane ruptures, the head appears powdery.



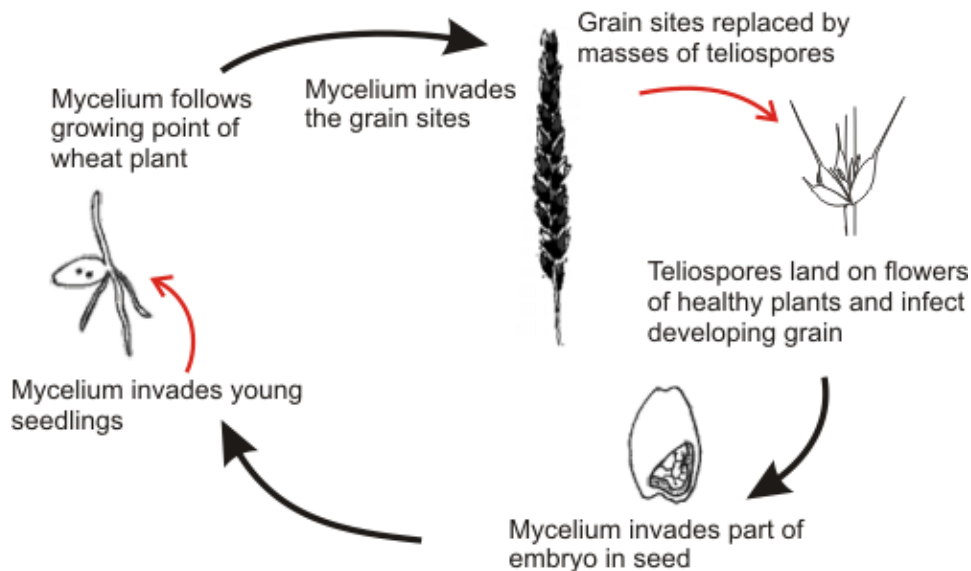
Symptoms

Spores are dislodged, leaving only the rachis intact. In some cases remnants of glumes and awns may be present on the exposed rachis. Smutted heads are shorter than healthy heads due to a reduction in the length of the rachis and peduncle. All or a portion of the heads on an infected plant may exhibit these symptoms. While infected heads are shorter, the rest of the plant is slightly taller than healthy plants. Prior to heading affected plants have dark green erect leaves. Chlorotic streaks may also be visible on the leaves.

Disease Cycle

Ears of infected plants emerge early. The spores released from the infected heads land on the later emerging florets and infect the developing seed. Infection during flowering is favored

by frequent rain showers, high humidity and temperature. The disease is internally seed borne, where pathogen infects the embryo in the seed.



Management

Treat the seed with [Vitavax](#) @ 2g/kg seed before sowing. Burry the infected ear heads in the soil, so that secondary spread is avoided.

Flag smut - [Urocystis tritici](#)

[Symptoms](#)

The symptoms can be seen on stem, culm and leaves from late seedling stage to maturity. The seedling infection leads to twisting and drooping of leaves followed by withering. Grey to grayish black [sori](#) occurs on leaf blade and sheath. The sorus contains black powdery mass of spores.



Symptoms

Pathogen

Aggregated spore balls, consisting 1-6 bright globose, brown smooth walled spores surrounded by a layer of flat sterile cells.



Spore balls

Favourable Conditions

- Temperature of 18-24°C.
- Relative humidity 65% and above.

Disease cycle

Seed and soil borne. Smut spores are viable for more than 10 years.

Management

- Treat the seeds with carboxin at 2g /kg.
- Grow resistant varieties like Pusa 44 and WG 377.

Hill bunt or Stinking smut - *Tilletia caries* / *T.foetida*

Symptoms

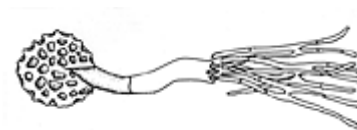
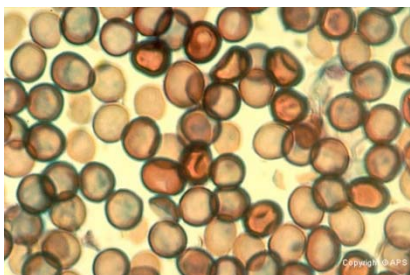
The fungus attacks seedling of 8-10 days old and become systemic and grows along the tip of shoot. At the time of flowering hyphae concentrate in the inflorescence and spikelets and transforming the ovary into smut sorus of dark green color with masses of [chlamydospores](#). The diseased plants mature earlier and all the spikelets are affected.



Symptoms on earhead and grains

Pathogen

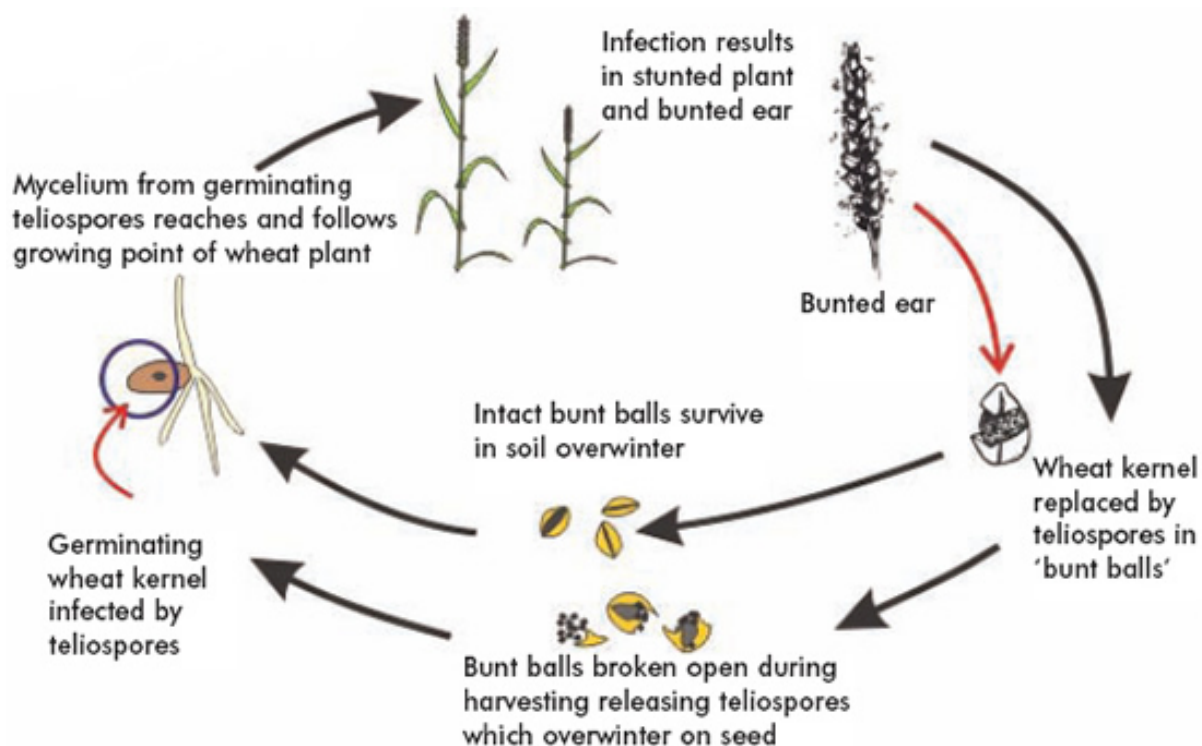
[Reticulate](#), [globose](#) and rough walled. No resting period. Germinate to produce primary [sporidia](#) which unite to form 'H' shaped structure.



Spores and its germination

Life cycle

The spores on the seed surface germinate along with the seed. Each produces a short fungal thread terminating in a cluster of elongated cells. These then produce secondary spores which infect the [coleoptiles](#) of the young seedlings before the emergence of the first true leaves. The [mycelium](#) grows internally within the shoot infecting the developing ear. Affected plants develop apparently normally until the ear emerges when it can be seen that grain sites have been replaced by [bunt balls](#). In India disease occurs only in Northern hills, where wheat is grown.



Favourable Conditions

- Temperature of 18-20°C.
- High soil moisture.

Disease cycle

Externally seed borne

Management

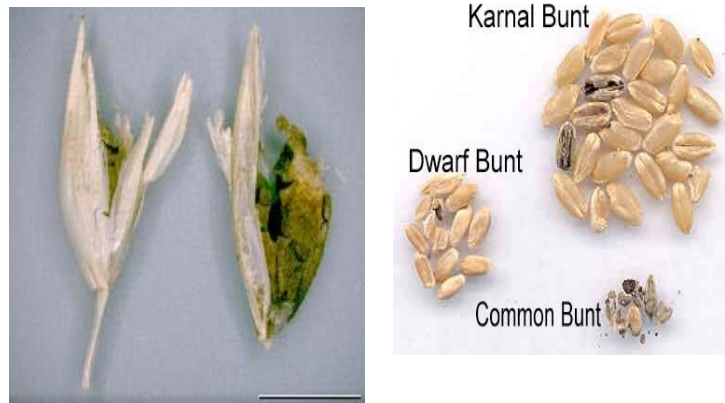
- Treat the seeds with carboxin or carbendazim at 2g/kg.
- Grow the crop during high temperature period.
- Adopt shallow sowing.
- Grow resistant varieties like Kalyan sona, S227, PV18, HD2021, HD4513 and HD4519.

Karnal bunt - *Neovassia indica*

Symptoms

Symptoms of Karnal bunt are often difficult to distinguish in the field due to the fact that incidence of infected kernels on a given head is low. There may be some spreading of the glumes

due to sorus production but it is not as extensive as that observed with common [bunt](#). Symptoms are most readily detected on seed after harvest.



Symptoms

The black [sorus](#), containing dusty spores is evident on part of the seed, commonly occurring along the groove. Heavily infected seed is fragile and the pericarp ruptures easily. The foul, fishy odor associated with common bunt is also found with karnal bunt. The odor is caused by the production of trimethylamine by the fungus. Seed that is not extensively infected may germinate and produce healthy plants.

Foot rot - [Pythium graminicolum](#) and [P. arrhenomanes](#)

Symptoms

The disease mainly occurs in seedlings and roots and rootlets become brown in colour. Seedlings become pale green and have stunted growth. Fungus produces sporangia and [zoospores](#) and [oospores](#).

Favourable Conditions

Wet weather and high rainfall.

Disease cycle

Through soil and irrigation water.

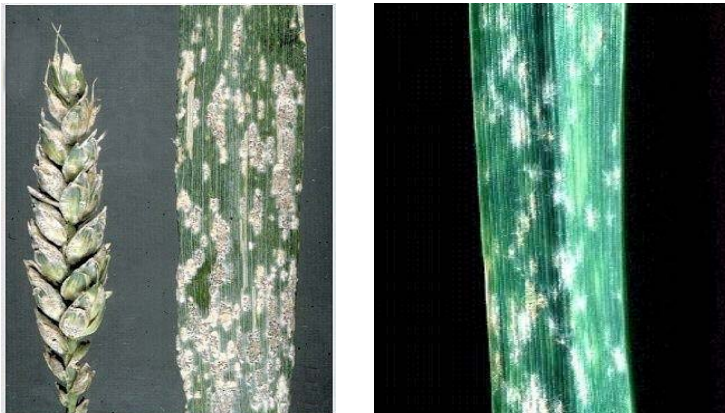
Management

- Follow crop rotation.
- Treat the seeds with [Carboxin](#) or Carbendazim at 2g/kg.

Powdery mildew - *Erysiphe graminis* var. *tritici*

Symptoms

Greyish white [powdery growth appears on the leaf](#), sheath, stem and floral parts. Powdery growth later become black [lesion](#) and cause drying of leaves and other parts.

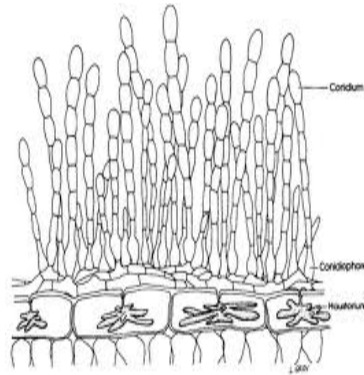


Symptoms

Pathogen

Fungus produces septate, superficial, hyaline mycelium on leaf surface with short [conidiophores](#). The [conidia](#) are elliptical, hyaline, single celled, thin walled and produced in

chains. Dark globose [cleistothecia](#) containing 9-30 [asci](#) develop with oblong, hyaline and thinwalled [ascospores](#).



Conidia and conidiophores

Disease cycle

Fungus remains in infected plant debris as dormant mycelium and asci. Primary spread is by the ascospores and secondary spread through airborne conidia.

Favourable Conditions

- Temperature of 20-21°C.

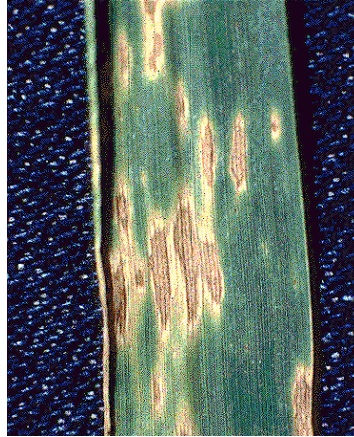
Management

- Spray [Wettable Sulphur](#) 0.2% or Carbendazim @ 500 g/ha

Leaf blight - [Alternaria triticina](#) / [Bipolaris sorokiniana](#)

Symptoms

Reddish brown oval spots appear on young seedlings with bright yellow margin. In severe cases, several spots coalesce to cause drying of leaves. It is a complex disease, having association of [A.triticina](#), [B.sorokiniana](#) and [A. alternate](#).



Symptoms

Disease cycle

Primary spread is by externally seed-borne and soil borne conidia. Secondary spread by air-borne conidia.

Favourable Conditions

- Temperature of 25°C and high relative humidity.

Management

- Spray the crop with Mancozeb or Zineb at 2 kg/ha.

Other minor diseases

Helminthosporium leaf spot: [*Helminthosporium*](#) spp.

Tundu or yellow ear rot: [*Corynebacterium tritici*](#) + [*Anguina tritici*](#)

Seedling blight: [*Rhizoctonia solani*](#) and [*Fusarium*](#) sp

Sclerotinia rot: [*Sclerotinia sclerotiorum*](#)

Molya disease: [*Heterodera avenae*](#) (Nematode)