Diseases of Wheat

Fungal diseases	
Alternaria leaf blight	*Alternaria triticina*
Black point	*Alternaria tenuis/ Bipolaris sorokiniana*
Ergot	*Claviceps purpurea*
Foot and root rot	*Sclerotium rolfsii*
Leaf spot/ bight	*Bipolaris sorokiniana*
Loose smut	*Ustilago tritici*
Flag smut	*Urocystis agropyri*
Kernel bunt	*Tilletia indica/ Neovossia indica*
Leaf rust/ brown/ orange rust	*Puccinia recondita* f.sp. *tritici*
Stem rust/ black rust	*Puccinia graminis* f.sp. *tritici*
Stripe rust/ yellow rust	*Puccinia striiformis* f. sp. *tritici*
Septoria blotch	*Septoria tritici*
Take all	*Ophiobolus graminis*
Wheat Blast	*Magnaporthe oryzae* pathotype *triticum*
Bacterial diseases	
Bacterial leaf blight	*Pseudomonas syringae* subsp. *syringae*
Black chaff/ bacterial streak	*Xanthomonas campestris* pv. *translucens*
Nemic diseases	
Wheat gall/ Seed gall	*Anguina tritici*
Root-knot	*Meloidogyne spp.*
Viral diseases	
Wheat dwarf	*Wheat dwarf virus* (WDV)
Wheat yellow mosaic	*Wheat yellow mosaic virus /* *Wheat spindle streak mosaic virus*

Stem/ black rust

Causal organism: *Puccinia graminis* f. sp. *tritici*

Symptoms

The first symptom of rust infection is flecking of leaves, leaf sheaths, culms and floral structures. These flecks are the forerunners of uredo-sori, which soon develop as oblong, reddish-brown pustules, frequently merging into one another, finally bursting to expose a mass of brown uredospores. When large number of uredosori burst and release their spores, the entire leaf blade and other affected parts will give a brownish appearance even from a distance. Later in the season, teleutosori are produced. They are conspicuous, linear or oblong, dark-brown to black, and often merging with one another, to cause linear patches of black lesions, which account for the name black rust. On maturity the teleutosori burst open, exposing masses of dark-brown teleutospores. In the transitional stage, therefore, there is a mosaic of brown and black masses of spores on the affected tissues, which dry up prematurely. Moreover, in the case of severe infections the diseased plants are stunted, and can be identified from a distance; they produce small spikes and shrivelled grains, or no grain at all.


Leaf/ brown or orange rust

Causal organism: *Puccinia recondita* f. sp. *tritici*

Symptom

The first symptom of the disease is the appearance of minute round, orange sori, irregularly distributed on the leaves, rarely on the leaf sheath or stem. The sori turn brown with maturity, and as the disease advances, the telial stage may be formed in the same pustule. The telia are small, oval to linear, black, two celled and covered by the epidermis. The telia are formed on the leaf sheath also.


Yellow or stripe rust
Causal organism: *Puccinia striiformis* f. sp. *tritici*

Symptom
The uredosori appear as bright yellow pustules chiefly on the leaves, but in severe infections they may be found on the leaf sheaths, stem, spikelets, glumes and also on grains. The sori are elongated and are arranged in linear rows between the veins of the leaf, and hence the name 'stripe rust.' The sori are mostly sub-epidermal and remain covered by the epidermal layer and break through only at the time of crop maturity. The teleutosori appear late in the season, also arranged in linear rows. They, are more abundant on the leaf sheaths than on the leaf blade. Often the teleutospores may be formed in the uredosori. They are compact, elongated and black and remain sub-epidermal. The pycnial and aecial stages of the fungus are unknown.

Life cycle of *Puccinia graminis*:
Puccinia graminis is macrocycli (**Macrocyclic** rusts are those which produce all the below mentioned five spore stages. These rusts are also known as long-cycled rusts. These spore stages may be produced in the same host as in case of autoecious rusts or on two different unrelated hosts as in heteroecious rusts. **Demicyclic** rusts are those which lack the uredinial stage and may be autoecious or heteroecious. **Microcyclic** rusts are those which produce only the telial stage), heteroecious rust, of which wheat is the primary host and the barberry bush is the secondary host. Out of the five stages of the life cycle three (urediniospores, teliospores and basidiospores) are produced on wheat plant, whereas the remaining two (pycniospores and aeciospores) are produced on barberry plant. The life cycle is therefore completed only when both the hosts are present.

At the time of reproduction *Puccinia graminis* produces five distinct stages in a regular sequence. These are as follows:
Stage 0: Spermogonia bearing spermatia and receptive hyphae.
Stage I: Aecia bearing aeciospores.
Stage II: Uredia bearing uredospores.
Stage III: Telia bearing teleutospores.
Stage IV: Promycelia bearing basidiospores.

Stage 0 Pycnium or Spermatium

A Pycnium or Spermatium bearing pycniospores or spermatiophores, pycnia are haploid structures, often flash-shaped. The pycniospores are haploid, uninucleate structures, which function as spermatia when transferred to antoher pycnium.

Stage I Aecium or Aecidium

An aecium or aecidium bearing aeciospores or aecidiospores. Aecia are frequently open, copulate sori which bear dikaryotic aeciospores in chains. The aeciospores are the first dikaryotic spores. In the Aecidium type the aeciospores are produced in a structure shaped like a cup with a short straight lip. It is generally white and appears as a thin structure.

Stage II Uredium or Uredinium

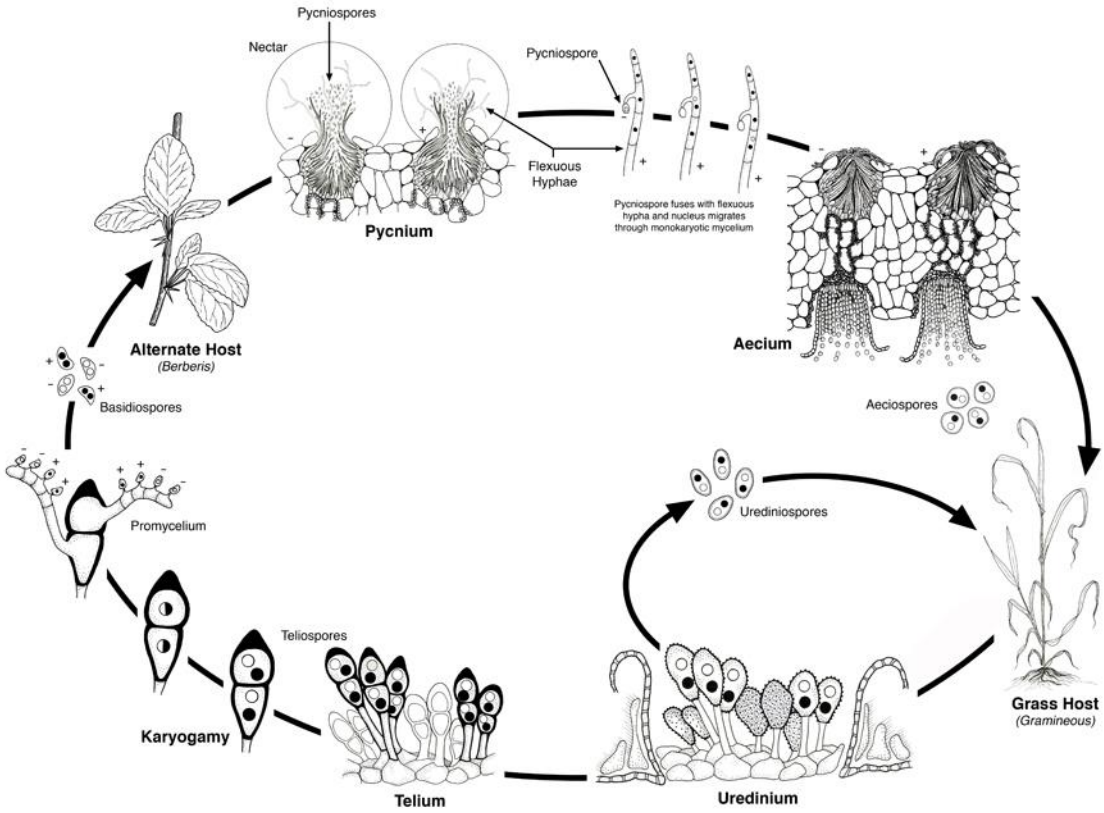
A Uredium or Uredinium bears urediospores or urediniospore. The uredium is usually a sorus and the urediospores are dikaryotic. This stage is repetitive as a urediospore may germinate, forming a mycelium, which again gives rise to uredia. That's why this cycle is known as repeating cycle and the spores are known as repeating spore.

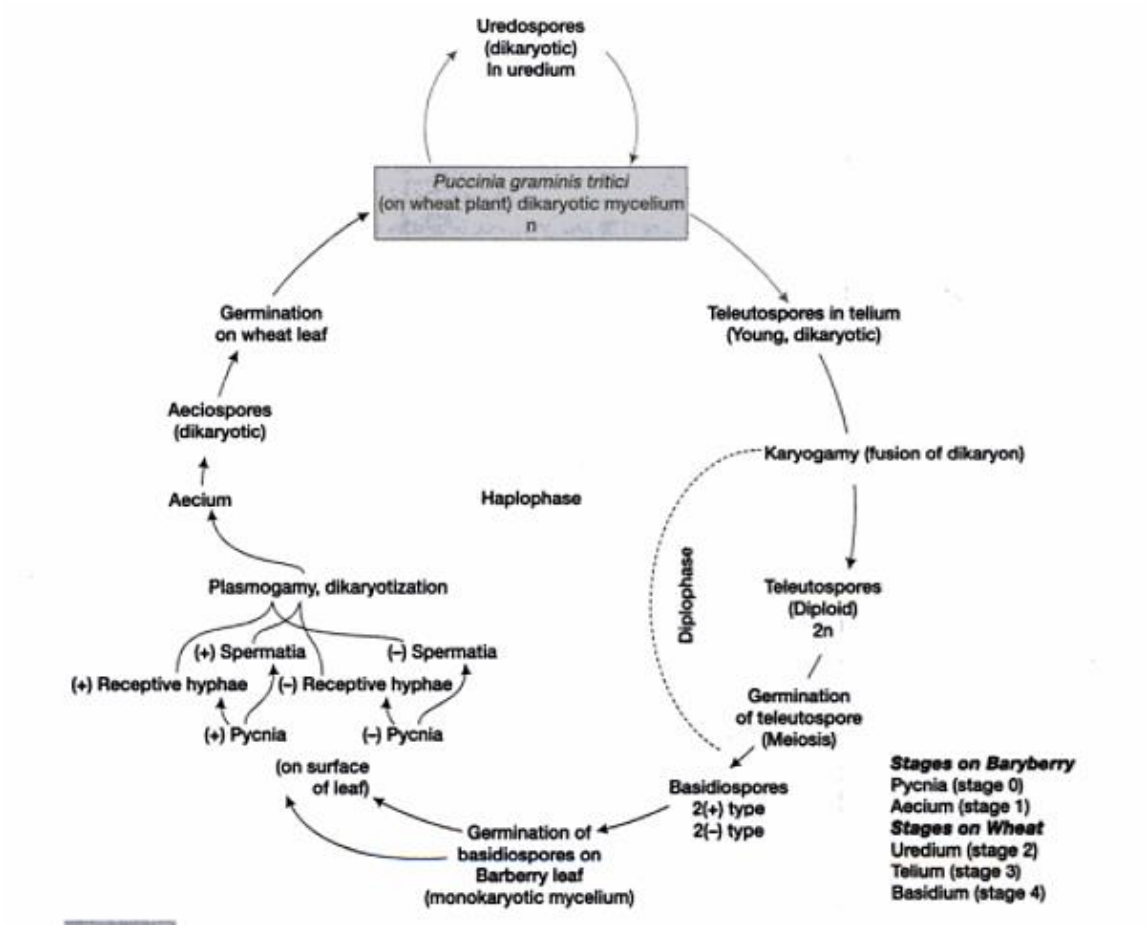
Stages III Telium

A telium is containing teliospores or teleutospores. A telium is usually a sorus. The teliospores function as probasidia and are the site of karyogamy and meiosis.

Stage IV Basidiospore

The haploid basidiospores produced from the teliospores are capable of reinfection the host and initiating the life cycle again.





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 < 10º 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 Propioconazole @ 0.1 %.
- Grow resistant varieties

Leaf spot or blight

Causal organism: *Alternaria triticina* / *Bipolaris sorokiniana*

Symptoms:

It is a complex disease, having association of *A. triticina, B. sorokiniana* and *A. alternate.* The symptoms first appear as small, elongated to oval, brown to almost black discolored lesions, which are irregularly scattered on the leaves. As lesions mature, the centers often turn a light brown to tan color, surrounded by an irregular dark brown margin. A well-developed lesion is typically elliptical with abundant sporulation and can cover large area of leaves. Consequently the whole leaves become blighted. Stem and node infection results in lodging.

Normally, individual spikelets are infected, but under favorable conditions the whole ear including the awns is severely diseased. The lesions on the glumes are sometimes oblong with dark brown margin. If in seed, seed may be discolored, shriveled and oblong.

Disease cycle

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

Favourable Conditions

- Temperature of 25˚C and high relative humidity.

Management

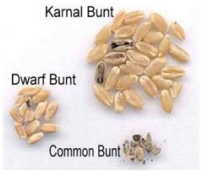
- Spray the crop with Mancozeb or Zineb at 2 kg/ha.

Kernel bunt

Causal organism: *Neovassia indica*

Symptoms

Symptoms of Kernel 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.



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 Kernel 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.

Loose smut

Causal organism: *Ustilago tritici*

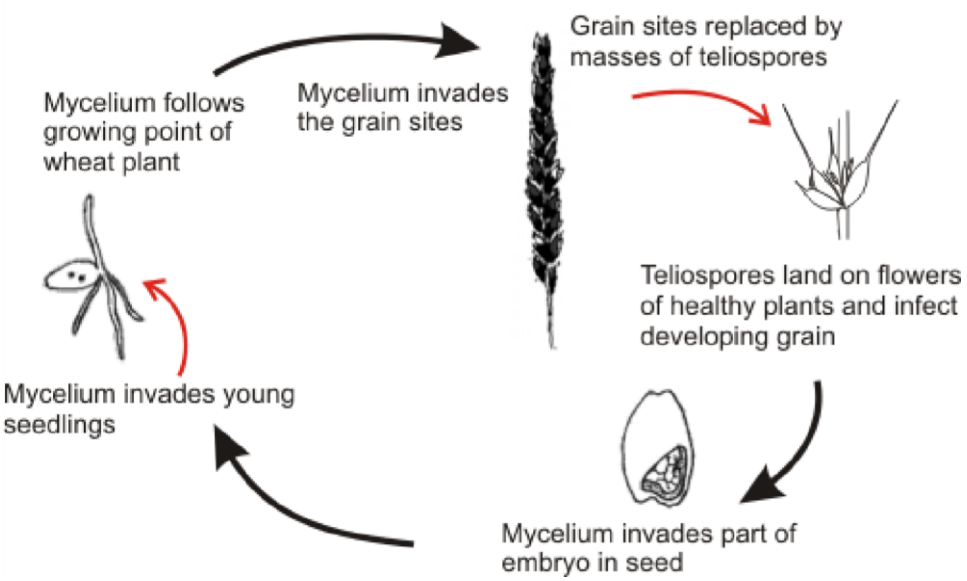
Symptoms

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.

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

Causal organism: *Urocystis tritici*

Symptoms

The symptoms can be seen on stem, clum 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.

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

Bunt or Stinking smut

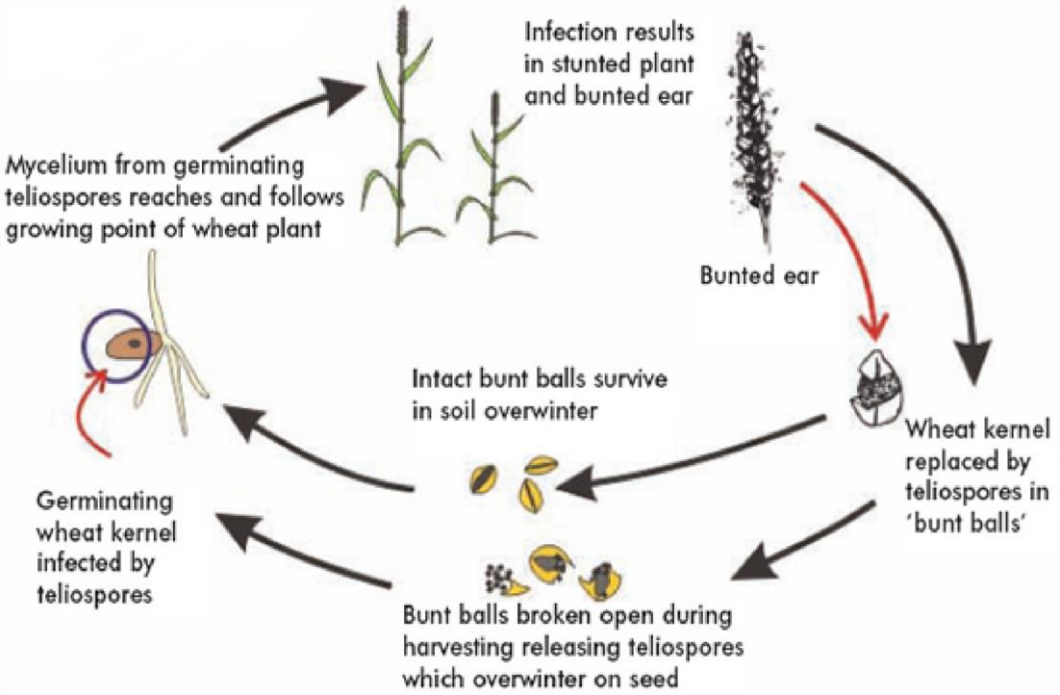
Causal organism: *Tilletia caries*

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.

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

Wheat Blast

Wheat blast is one of the most fearsome and intractable wheat diseases in recent decades. It is caused by the fungus *Magnaporthe oryzae*

- Blast directly strikes the wheat ear and can shrivel and deform the grain in less than a week from first symptoms, leaving farmers no time to act.
- Fungicides typically provide only a partial defense. They are also often hard to obtain or use in the regions where blast occurs, and must be applied well before any symptoms appear—a prohibitive expense for many farmers.
- Blast appears sporadically on wheat and grows well on numerous other plants and crops, so rotations do not control it. The irregular frequency of outbreaks also makes it hard to understand or predict the precise conditions for disease development, or to methodically select resistant wheat lines.
- The fungus is physiologically and genetically complex, so even after more than three decades, scientists do not fully understand how it interacts with wheat or which genes in wheat confer durable resistance.

Control measures:

Wheat blast disease can be controlled through a combination of the following measures:

- Improved wheat varieties that carry genetic resistance to *M. oryzae.*
- Global monitoring of disease appearances, movement, and evolution, in coordination with local governments and research agencies, as well as predictive models.
- Advanced studies on potentially effective, safe, and affordable chemical control measures.
- Genetic and epidemiological research to strengthen knowledge of the fungus and its interactions with wheat and other host plants.