

DISEASES OF WHEAT CROP

Session-1

M.S.Swaminathan School of Agriculture,CUTM



MAJOR DISEASES OF WHEAT

FUNGAL DISEASE

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BLACK OR STEM RUST

Puccinia graminis tritici

LEAF, BROWN OR ORANGE RUST

Puccinia recondita

YELLOW OR STRIPE RUST

Puccinia striiformis

LOOSE SMUT

Ustilago nuda tritici

KARNAL BUNT

Neovossia indica
(formerly *Tilletia indica*)

LEAF BLIGHT

Alternaria triticina

POWDERY MILDEW

Erysiphe graminis var. tritici

EAR COCKLE OF WHEAT

Anguina tritici (Nematode)



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BLACK OR STEM RUST OF WHEAT

Economic importance

- The most important and destructive disease throughout the world where ever wheat is grown.
- The rust epidemics of 1946-47 in M.P, Maharashtra, Rajasthan and U.P destroyed over two million tonnes of grain.
- In India though black stem rust is prevalent in all parts of the country.
- It normally appears in epidemic form only in central, southern and eastern parts of the country where high temperatures prevailed during crop season.



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SYMPTOMS

- The initial symptom of rust infection appear as flecking on leaves, leaf sheaths, culms and floral structures and soon develop as oblong, reddish brown uredo-pustules, frequently merging into one another, finally bursting to expose a mass of brown uredospores.
- When large number of uredosori burst affected parts will have a brownish appearance even from a distance.
- Later in the season, teleutosori are produced. Teleutosori 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.
- The affected part of plant dry up prematurely and in sever infection plant produce small spikes and shrivelled grains, or no grain at all.



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BLACK OR STEM RUST OF WHEAT



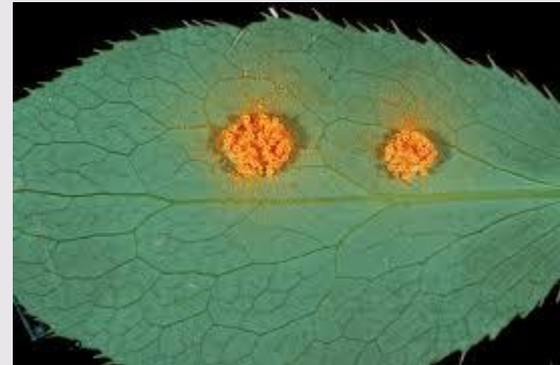


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PYCINIA IN UPPER SURFACE(2) AND AECIA LOWER SURFACE(1)



1



2



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ETIOLOGY

Causal organism- *Puccinia graminis tritici*

[subdivision-Basidiomycotina

The pathogen is a

- Biotrophic (obligate) parasite(only grow upon living host)
- Heteroecious(required two host for complet life cycle)
- Macrocylic(5-type of rust spore present)
- Polymorphic species



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ETIOLOGY

The pathogen has the following stages-

- Stage 0 : Pycnia(spermagonia) and pycniospores(spermatia).
- Stage I : Aecia and aeciospores.
- Stage II : Uredia and uredospores.
- Stage III : Telia and teleutospores.
- Stage IV : Basidia and basidiospores.
- Black stem rust is **heteroecious full cycle rust**. It requires more than one host species to complete its life cycle.
- The uredial and telial stages occur on wheat, barley and some grasses and the pycnial and aecial stages on the species of *Berberis* (*Barbery*) and *Mahonia*, the alternate hosts.

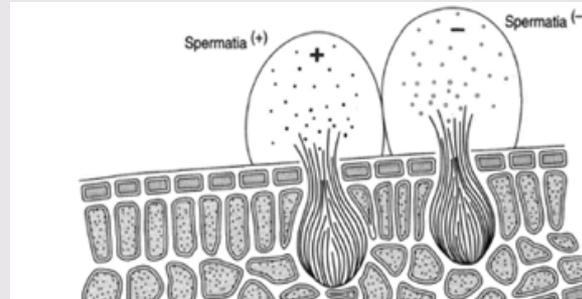


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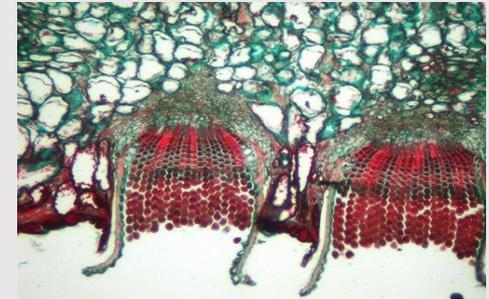
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SPORE PRODUCED BY WHEAT RUST

PYCNIOspore OR SPERMATIA AND AECIOSPORE PRODUCED IN BARBERY



Spermatia



Aeciospores

UREDOSPore , TELIOSPORE AND PROMYCELLIUM CONTAIN BASIDIOSPore PRODUCED IN WHEAT



Uredospores



Teliospores



Basidiospore



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DISEASE CYCLE

In USA, Europe and Australia Primary infection is mainly through **barberry, i.e., *Berberis vulgaris*** which act as the alternate host in which aeciospore produced which infect wheat and disease cycle continue.

INDIAN CONDITION

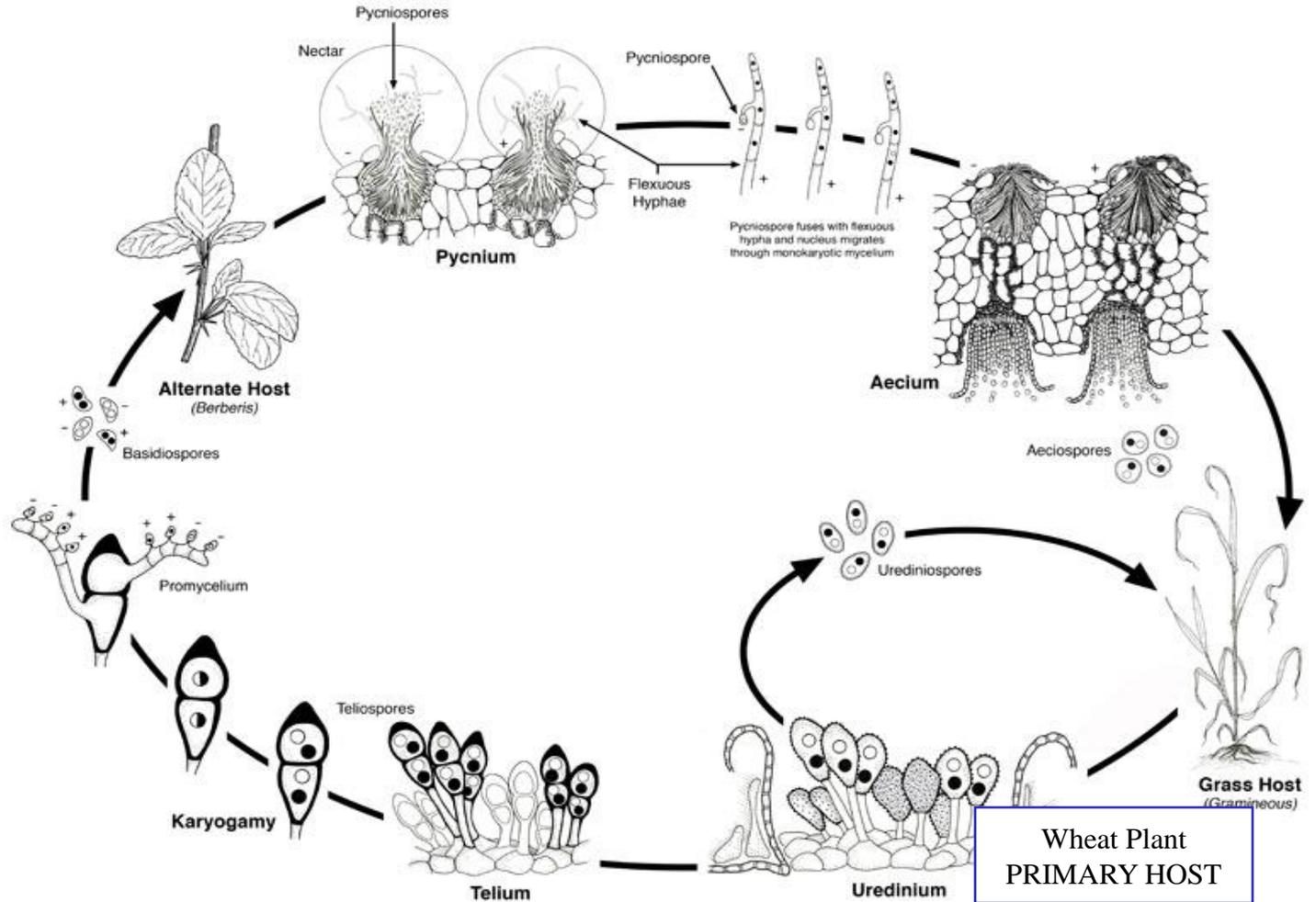
- ***The barbery*** plants in India are not known to play any role in the perpetuation of the fungus.
- It stuided that source of inoculum for black rust comes from **wheat crops and certain grasses growing in cool areas particularly in the foot hills** Of Himalayas in the North, the Nilgiris and Pulney hills in the South appear to be great.
- ***It is believed that the fungus over summers on*** the wheat plants and grasses in the hilly areas and spreads to the plains in the main wheat crop season.
- In the central Nepal, the wheat crop sown in August and harvested in December, January becomes infected by *P. graminis tritici* from October. This may be a source of inoculum for the main crop sown in the plains, which becomes infected from February each year.



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DISEASE CYCLE





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FAVOURABLE CONDITIONS

- Hot days (25-30°C), mild nights (15-20°C) and wet leaves from rain or dew. In this condition large number of teliospores are produced.

DISEASE MANAGEMENT

- Eradication of self sown wheat plants and weed hosts.
- Adjust time of sowing.
- Grow resistant varieties like Kalyanasona, Sonalika, Choti Lerma, Lerma Rojo, Safed lerma, NP 700 & 800.
- Avoid late sowing
- Balanced application of nitrogenous fertilizers
- Application of sulphure 15 kg/ha in 15 days interval.
- Seed dressing with Plantavax@0.1% followed by two sprays with the same chemical.
- Spray twice or thrice with Zineb@0.25% or Mancozeb@0.25% or Plantavax@0.1% , at 15 days interval.



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LEAF, BROWN OR ORANGE RUST

SYMPTOMS

- The first symptom of the disease is the appearance of minute, round, **orange sori**, irregularly distributed on the leaves, **rarely on the leaf sheath and stem.**
- **The sori turn brown** with maturity.
- As the disease advances, the telial stage may be found in the same pustule.
- The telia are small, oval to linear, black and covered by the epidermis.
- The telia are also found on the leaf sheath.
- Severe rusting of leaves causes reduction in yield.



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Causal organism: *Puccinia recondita*, is heteroecious
rust

Subdivision-Basidiomycotina

- *Primary host:Wheat*
- *Secondary host:Thalictrum*

FAVOURABLE CONDITIONS

- Free moisture
- Temperature between 20-30°C.

DISEASE CYCLE

Primary infection :Uredospore

Alternate host, species of *Thalictrum*



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ORANGE RUST





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MANAGEMENT

- Grow resistant varieties like Sonalika, NP 700 & 800, Lerma Rojo and Safed Lerma.
- RH-124, an Indofil product is very specific to brown rust (or) spray dithiocarbamates like zineb@0.25% or Mancozeb@0.25%
- Seed dressing with Plantavax@0.1% followed by two sprays with the same chemical



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YELLOW OR STRIPE RUST

SYMPTOMS

- The uredosori appear as bright yellow pustules mainly on the leaves, in severe infections they may be seen on leaf sheaths, stem also.
- The sori are elongated and are arranged in linear rows between the veins of the leaf and hence it is referred as stripe rust.
- The sori are mostly sub-epidermal and are remained covered by the epidermal layer and break only at the time of crop maturity.
- The teleutosori appear late in the season and are also arranged in linear rows, sori are compact, elongated, and black which remain subepidermal.



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YELLOW OR STRIPE RUST



**STRIPE RUST SYMPTOM ON LEAF SURFACE OF
WHEAT**



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Causal organism: *Puccinia striformis*

Disease cycle

- Some weeds like *Agropyron semicostatum*, *Bromus catharaticus*, *Bromus japonicus* and *Hordeum murinum* also serve as primary source of inoculum.
- Secondary infection is by wind borne uredospores.

Favourable conditions

- Optimum temperature ideal for the disease development is 8 - 130C.
- No infection occurs above 230C and below 20C and Heavy Rainfall

Management

- Grow resistant varieties like Lerma Rojo, Safed Lerma, Sonalika and Choti Lerma.
- Spray plantavax @0.1%.
- Removal and destruction of weed hosts.



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LOOSE SMUT

SYMPTOMS

- The symptoms are evident only at the time of emergence of the ears from boot leaf.
- All the spikelets in a ears transform into a mass of **black powdery spores**.
- **The infected ears** emerges earlier than healthy ones.
- Usually all spikelets are affected, having been transformed into a mass of black powdery spores.
- The spores are easily blown by wind leaving the bare rachis.



LOOSE SMUT SYMPTOM





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Causal organism: *Ustilago nuda tritici*

[subdivision-Basidiomycotina

- Chlamydospores (**TELIOspores**) of the fungus are pale, olive brown, spherical to oval in shape, about 5-9 μ in diameter and echinulate on the surface.

DISEASE CYCLE

- It is **internally and externally seed borne and is systemic.**
- **The fungus is carried over in the seed as dormant mycelium.**
- Secondary spread occurs through wind borne smut spores.

FAVOURABLE CONDITIONS:

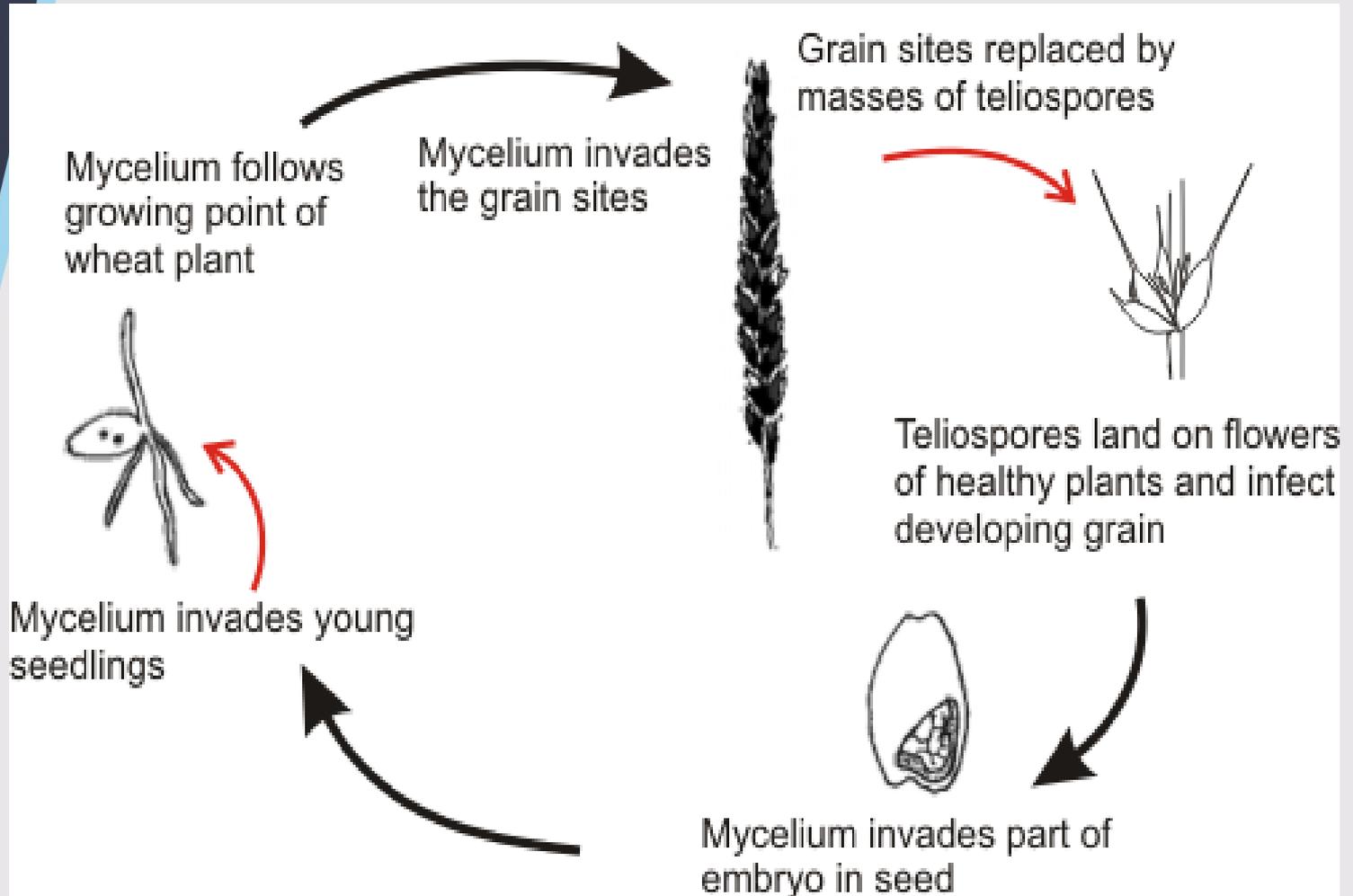
- 20-21°C temperature and high RH (60-80%) during flowering stage favour the disease development.
- Flowers of cultivars with loose spikelets are more susceptible than those with compact spikelets.



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DISEASE CYCLE OF LOOSE SMUT OF WHEAT





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MANAGEMENT

- Grow resistant varieties kalyanasona, PV 18, WG 307 and HD 450.
- ***Hot water treatment (Jensen, 1908): Soak the seed in cold water for 4 hours and then*** immerse the seed in hot water at a temperature of 52°C for about 10 minutes.
- Dry the seed in shade before sowing.
- ***Solar seed treatment (Luthra and Sattar, 1934): Soak the seed in water for 4 hours (8 AM to 12 Noon) and expose the seed to the hot sun for 4 to 5 hours (from 12 Noon to 5 PM) on cement or rocky surface.***
- Seed treatment with systemic chemicals like vitavax@0.2% or Benlate@0.2% .
- Use certified seed.



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KARNAL BUNT

The disease was first reported in India from Karnal (Haryana) by **Mitra in 1931.**

SYMPTOMS

- The infection is usually confined to a **few grains in the spike with irregular arrangement.**
- In some cases the infection may spread to only a part of the grains.
- In severe cases, the grain is reduced to black shiny sac of teliospores.
- As the grains mature the outer glumes spread and the inner glumes expand, exposing the bunted grains.
- The bunt balls are first enclosed by the pericarp but when it bursts the masses of bunt spores are exposed.
- The bunt affected plants emits a foul smell which is mainly due to the presence of **Trimethyl amine.**



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KARNAL BUNT SYMPTOM





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SYMPTOM AND PATHOGEN OF BUNT DISEASE



BUNTED GRAINS



TELIOSPORE



ALLANTOID SPORIDIA



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Causal Organism: *Neovossia indica*

subdivision-Basidiomycotina

- Teliospores are smooth walled measuring 22-49 μ in diameter and require a long resting period.
- Teliospores germinate and produce a large number (60-120) of needle shaped primary sporidia on a short stout basidium.
- Later, sickle shaped (allantoid) secondary sporidia are produced which help in the dispersal of karnal bunt.

DISEASE CYCLE

Primary infection: By teliospores

Secondary infection: By sporidia



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FAVOURABLE CONDITIONS

- Moderate temperatures (19-23°C), high humidity (>70%) and cloudiness or rainfall during anthesis favours disease development in susceptible host varieties.

MANAGEMENT

- Grow tolerant varieties, viz., WL 1562, HD 2281, etc.
- Use resistant sources like wild species of *Aegilops* and *Triticum*, HD 2329, HD 29 and HD 20 for breeding programme.
- Follow strict quarantine measures.
- Use disease free seed for sowing.
- Judicious application of nitrogenous fertilizers.
- Adjust date of sowing.
- Intercropping with Gram or Lentil.



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LEAF BLIGHT

SYMPTOMS

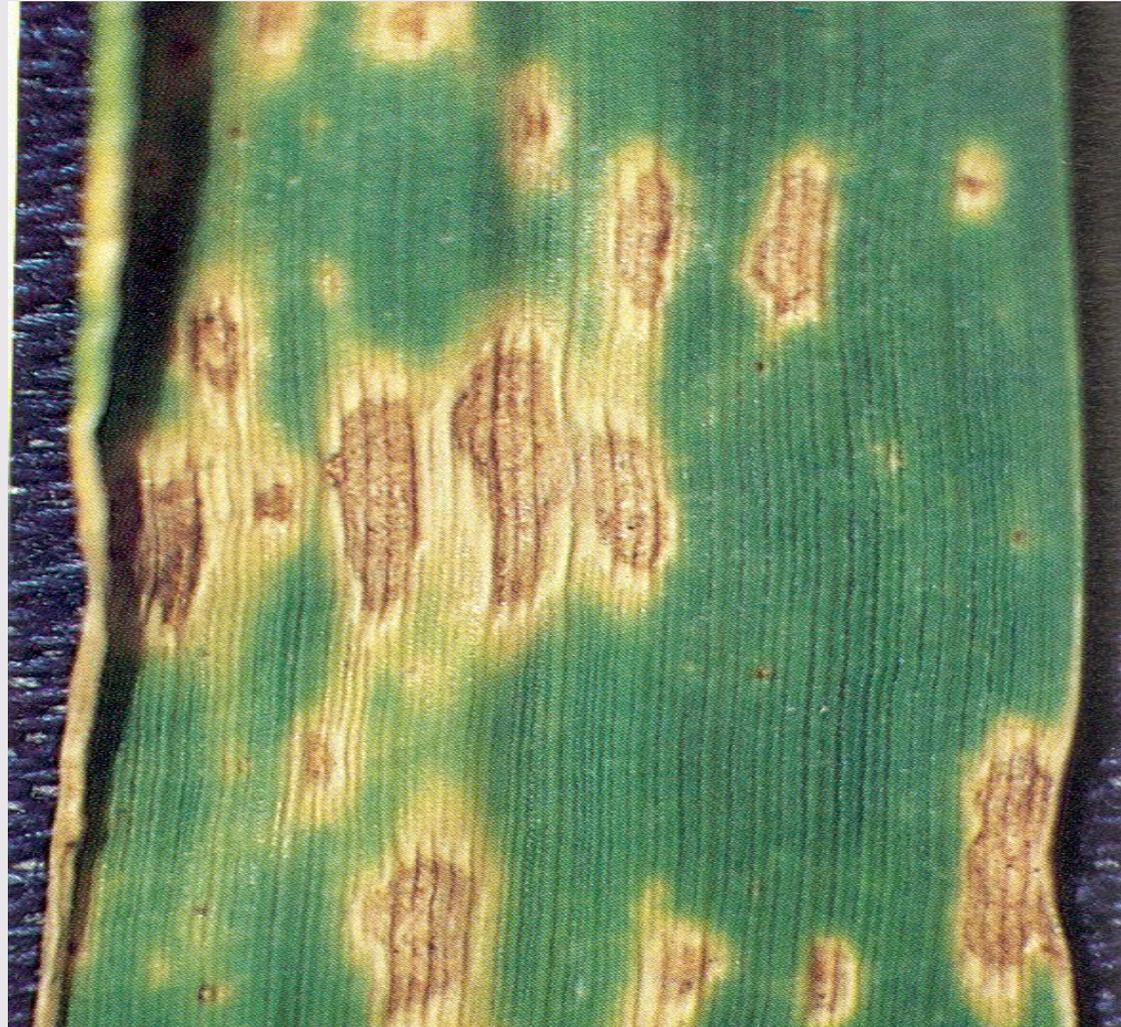
- Reddish brown oval spots appear on young seedlings with bright yellow margin.
- In severe cases, several spots coalesce to cause drying of leaves.
- The young leaves are not usually infected.
- Heavily infected fields display a burnt appearance even from a distance.
- In some varieties reduction in grain yield is as high as 90% if the infection takes place at or before the boot leaf stage.



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LEAF BLIGHT SYMPTOM





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Causal organism: *Alternaria triticina*

Subdivision-Deuteromycotina

DISEASE CYCLE

- Primary spread is by externally and internally seed-borne conidia.
- Secondary infection is mainly through wind-borne conidia.

Favourable conditions

- Temperature of 25 0C and high relative humidity favours the disease.

Management

- Soak the seeds in water for 4 hrs followed by 10 min. dip in hot water at 520C.
- Grow resistant varieties like Co.25, Sonalika, Arnautka, E6160 and K7340.
- Spray the crop with Mancozeb@0.25% or Zineb@0.25%.



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POWDERY MILDEW OF WHEAT

SYMPTOMS

- Grayish white powdery growth appears on the leaf sheath, stem and floral part.
- Powdery growth later become black lesions and cause drying of leaves and other parts.
- The affected leaves die off prematurely.
- The cleistothecia remain on wheat debris.



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SYMPTOMS OF POWDERY MILDEW OF WHEAT





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CONIDIA AND CLEISTOTHECIA OF *ERYSIPHE GRAMINIS VAR. TRITICII*



CONIDIA IN
CHAINS

CLEISTOTHECIA



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Causal organism: *Erysiphe graminis var. tritici*..

Favourable condition

Temperature of 20-21 °C is ideal for the disease development.

Disease cycle

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



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DISEASE MANAGEMENT

- Spray dust sulphur @ 40Kg/ha.
- Seed dressing and soil drenching with 0.01% calexin was also found effective.
- One spray of propiconazol (Tilt) 25EC @1.5ml/lit. On disease appearance is highly effective.
- Grow resistant varieties like C591, E750, UP1109 and VL421 etc.



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EAR COCKLE OF WHEAT

The ear cockle disease of wheat occurs in most of the wheat-growing parts of the world. In India, the disease commonly occurs in U.P., Punjab and Western part of Bihar, and is popularly known as “sehun” disease

Symptoms

- Symptoms appear on leaves, stems, and heads (floral organs).
- The affected plants look dwarfed with twisted and crinkled leaves.
- Infected heads are shorter, broader, remain green for longer period, and contain hard, dark-brown or black cockles (also called galls) replacing grains in the ear partially or completely.
- The cockles remain filled with nematode larvae.
- When they are soaked in water and then macerated, one can see larvae coming out from them.



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EAR INFECTION



Fig :- Healthy v/s Diseased Earheads



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GRAIN INFECTION





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Causal Organism : *Anguina tritici*

- The second-stage larva infect host.
- Second-stage larvae, which remain inside the cockle (gall) to carry on the life-cycle.

Disease Cycle

Primary infection: By infected seed.

Secondary infection: By second stage larve.



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Management

- Affected plants should be uprooted and burnt.
- Healthy seeds should be selected and sown.
- Healthy seeds and cockles (galls) can be better separated by immersing in water or normal salt solution (brine). The cockles come up on the surface and can be collected and destroyed.
- Early sown crops usually escape infection hence early sowing should be preferred.
- Nematicides such as D-D Mixture (20-40 gallons/acre), Nemaphos proved to be most effective.
- Varieties like Sonara 63, NP 908, and 227 are preferable against this disease as they show certain degree of resistance.