

**Course – M. Sc. Botany Part 1 Paper III**

**Topic – Stem/Black Rust of wheat**

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### Rust disease of plants:

- ❖ These are fungal diseases of grasses and other plants which appear on the host surface as small, coloured pustules- red, brown, yellow, orange, or black in colour.

### Types of Rust:

Three forms rusts can affect wheat (all fungal forms)

- (1) Stem/Black rust: *Puccinia graminis tritici*.
- (2) Leaf / Brown rust: *Puccinia rodentia*.
- (3) Stripe/Yellow rust: *Puccinia striiformis*.



**Stripe rust**

**Stem rust**

**Leaf rust**

### Stem/Black Rust of wheat:

- ❖ Most destructive wheat disease
- ❖ Severe grain shriveling.
- ❖ Masses of pustules on leaves & stems containing brick red spores.
- ❖ Rust infested plants transpire much more water than normal.
- ❖ Most important disease of wheat, globally.
- ❖ Drastically reduces growth and yield, up to 70%.
- ❖ Brittle stems can fall over or "lodge" hampering mechanical harvest.



#### Significance:

- ❖ Wheat is the sixth most important crop.
- ❖ Grown yearly on 220.4 million hectares.
- ❖ Possess net worth more than 22 billion dollars.
- ❖ World trade in wheat is greater than for all other crops combined.
- ❖ Major disease of wheat and, therefore a potential threat to the world food supply.
- ❖ More than 5 billion dollars are lost due to cereal rust each year.

#### Distribution:

- ❖ Disease is present almost everywhere wherever wheat crop is grown.
- ❖ Epidemics of stem rust of wheat often occur in different parts of the world.
- ❖ More prevalent in North America, Ethiopia, India, China and Australia.

#### Symptoms:

- ❖ Do not produce symptoms until 7-15 days from infection.
- ❖ the oval pustules (uredinia) of powdery, brick-red urediniospores break through the epidermis. Microscopically, these red spores are covered with fine spines.
- ❖ The pustules become abundant and are produced on both leaf surfaces and stems of wheat hosts.
- ❖ Later in the season, pustules (telia) of black teliospores begin to appear in infected grass species.
- ❖ Microscopically, teliospores are two celled and thick walled.
- ❖ The stem become dry and cracked and most severely attacked.
- ❖ The plant produces less or no grains.
- ❖ A number of physiological changes occur by rust infection.

- ❖ Pycnia appear on barberry plants in the spring, usually in the upper leaf surfaces. They are often in small clusters and exude pycniospores in a sticky honeydew.
- ❖ Five to 10 days later, cup-shaped structures filled with orange-yellow, powdery aeciospores break through the lower leaf surface.
- ❖ The aecial cups are yellow and sometimes elongate to extend up to 5 mm from the leaf surface. Microscopically, aeciospores have a slightly warty surface.

**Causal agent / Etiology:**

- ❖ Black or Stem rust of wheat is caused by *Puccinia graminis tritici*.
- ❖ Infects: Wheat, Barley and barberry.

**Systematic position:**

Kingdom: Fungi

Phylum: Basidiomycota

Subphylum: Pucciniomycotina

Class: Pucciniomycetes

Order: Pucciniales

Family: Pucciniaceae

Genus: *Puccinia*

Species: *P. graminis* f. sp. *Tritici*

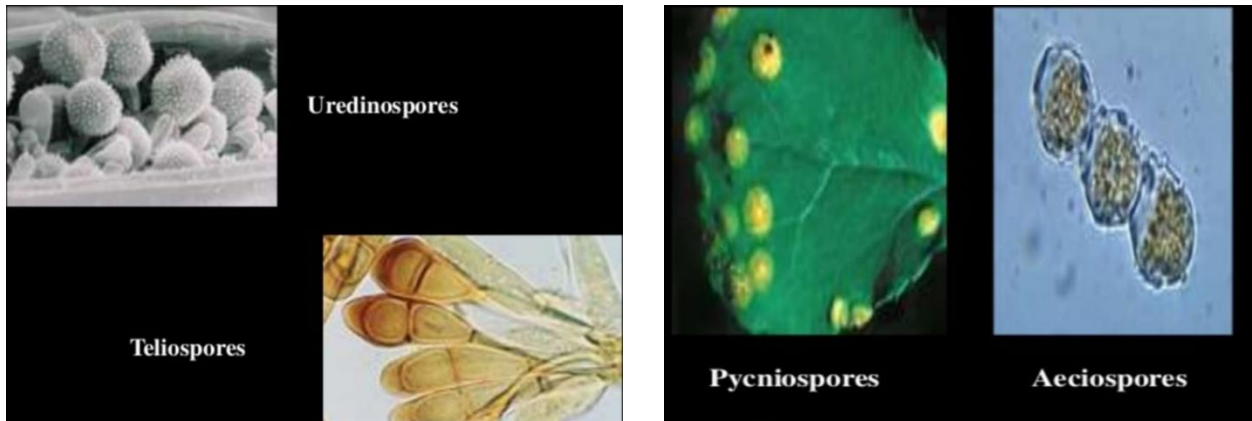
**Pathogen characters:**

- ❖ The pathogen is an obligate parasite.
- ❖ It cannot exist as a saprophyte.
- ❖ In most rust fungi, only the teliospores survive apart from a living host plant for more than a few months under field conditions.
- ❖ *Puccinia graminis* is heteroecious and polycyclic fungus which completes its disease cycle in two hosts.
- ❖ Wheat; Primary host, Barberry; alternate host.
- ❖ Accordingly, in wheat the mycelium is dikaryotic and in barberry monokaryotic.

**Stages in Pathogen:**

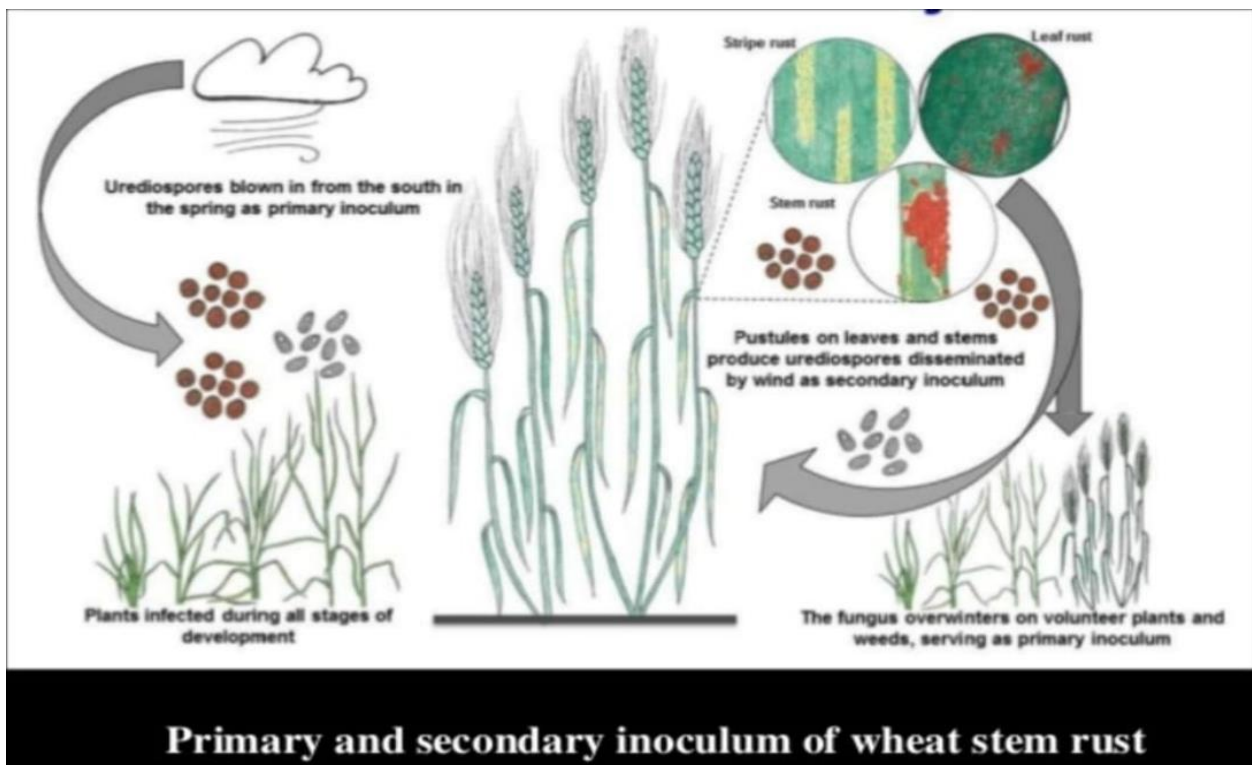
- ❖ Fungus gains entrance to host through stomata.
- ❖ Five spore stages of *Puccinia graminis*
  - Stage 0: Spermatogonium, produces spermatozoa and receptive hyphae.
  - Stage I: Aecium produces aeciospores.
  - Stage II: Uredium produces urediospores.
  - Stage III: Telium produces teliospores.

- Stage IV: Basidium produce basidiospores.



### Epidemiology: mode of spread.

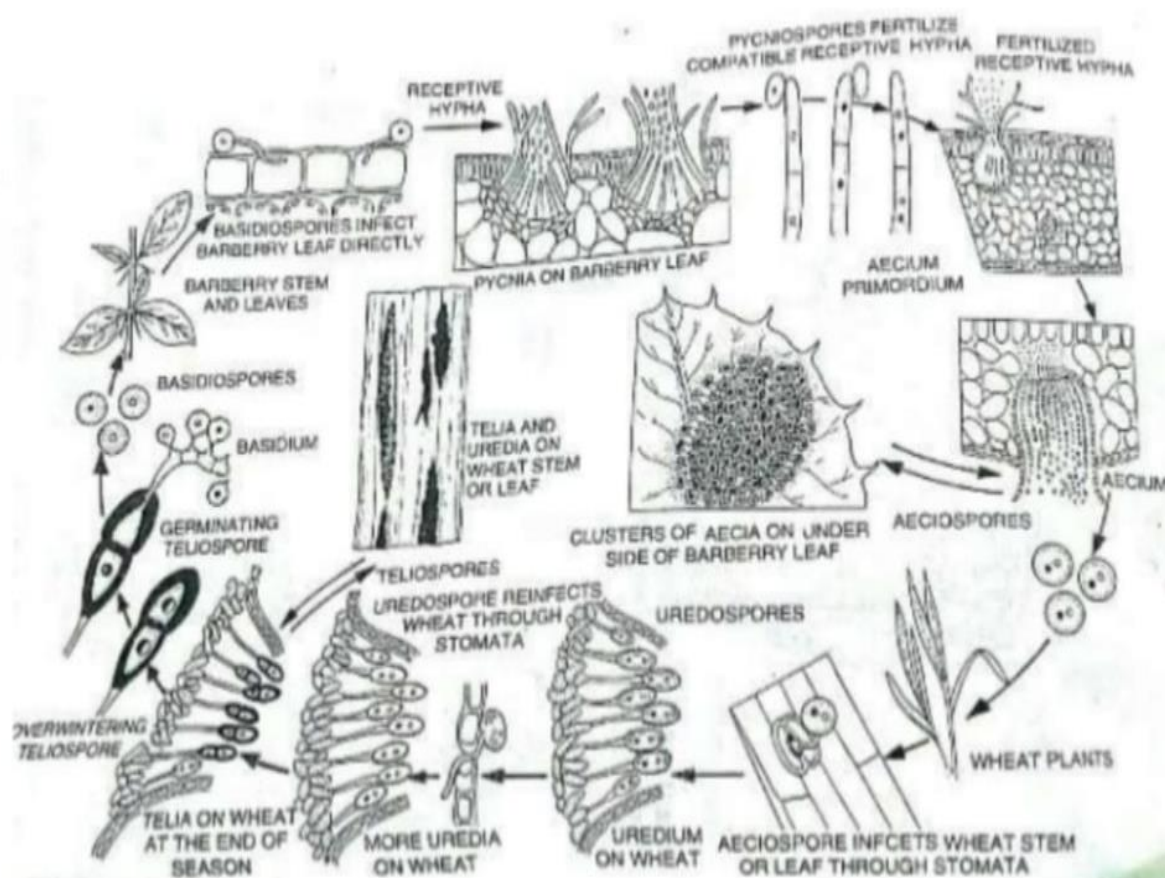
- ❖ Stem rust is favored by hot days (25-30°C/ 77-86°F), mild nights (15-20°C/59-68°F), and wet leaves from rain or dew.
- ❖ It appears in the month of March in Northern India. In Southern and Peninsular India it appears very early in the 4th week of November.
- ❖ Both aeciospores and uredinospores require free water for germination like other spore stages.
- ❖ Infections occur through stomata.
- ❖ Primary spread - Uredinospores and aeciospores are wind borne.
- ❖ Secondary spread - Rain is necessary for effective deposition of uredinospore involved in regional spore transport.
- ❖ Teliospores remain with the straw.



## Disease cycle:

- ❖ Urediniospores and teliospores occur on Wheat.
- ❖ Fungus gains entrance to host through stomata.
- ❖ Early spring, aeciospore infects Wheat to start infection.
- ❖ Spore stage gives plant its characteristic rusty color.
- ❖ Uredio spore stage is "repeater stage". Continually re infects wheat into late summer.
- ❖ Late summer, uredium converts to telium and produce telio spores.
- ❖ Telio spore are thick-walled, with two cells and black.
- ❖ Teliospore over winters.
- ❖ Following spring, germinates to produce basidia and basidiospores.
- ❖ Basidiospores Convert into sporangium.
- ❖ Then sporangium converts into aeciospores and the cycle continues.

# Disease cycle



### **Management of Disease/Disease control:**

- ❖ Adjustment of sowing dates.
- ❖ Growing short and long duration crops.
- ❖ Applications of balanced fertilizers to the crop.
- ❖ Eradication of barberry trees around the wheat field.
- ❖ Cultivation of Rust Resistant Varieties: NP 718, NP 710 and NP 770.
- ❖ Lerma Rojo, Safed Lerma, Choti Lerma and Sonalika are highly resistant to all three rusts in the field.
- ❖ Use of Fungicides Including Antibiotics:
  - Practically no variety is resistant for a long period due to emergence of new physiological races.
  - Zineb and Maneb control wheat rusts effectively. {Grewal and Dharam Vir (1959), Mathur et. al (1961) and Tandon et al (1968)}
- ❖ chemicals like RH-124 and Plantavax have as well given quite encouraging results.
- ❖ Application of para toluene sulfonyl amide to the soil at the rate of one gram per square meter is effective.
- ❖ Actidione has been recommended to be a useful antibiotic as a fungicide for the control of rusts plus zinc sulphate at fifteen days interval from the first week of February are quite effective.

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