

# Rust Disease of Wheat

(Symptom, Disease cycle -spermogonium )

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## Introduction :

The disease occurs in all wheat growing countries of the world. In India it appears at different times of the year in different parts of the country. 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

The stem rust is a serious threat to wheat in India. It causes serious damage in moist areas and moist season. The nature and extent of damage varies from slight to almost complete failure of the crop.

## Symptoms on the wheat plant

- Elongated pustules or streaks appear chiefly on the stem and leaf bases, leaf sheaths and even on the glumes. These are the uredia or uredosori.
- Each uredosorus contains a mass of reddish brown or rusty red, one-celled, binucleate uredospores.
- They are exposed by the rupture of the leaf epidermis. The torn epidermis forms a collar-like structure around the oblong sorus.
- The uredospores are produced by the dikaryotic or secondary mycelium parasitizing the tissue of the host.
- This spore stage of the parasite is called the red rust or summer stage. Later in the season the sori turn black. This is due to the appearance of two-celled, black teleutospores or teliospores in the place of uredospores in the old uredia.
- When the grains are almost ripe, new and independent oblong to linear teleutosori make their appearance on the stem of the host. They are smooth and dark brown or black in colour. The overlying epidermis is ruptured and the spores are exposed.

- The stems at this stage are dry and cracked. The teleutosori contain masses of black two-celled spores called the teleutospores. The plants fail to develop normal ears in the case of a severe attack.

#### **Symptoms on Barberry Host:**

- The infected barberry leaves show small circular, slightly elevated, yellowish or orange yellow spots on the upper surface.
- Each spot is dotted with an indistinct pimple, an ostiole of the spermogonium.
- A sticky liquid begins to exude through the ostiole.
- On the lower side of the leaf there appear cup shaped aecidia or- aecial cups. They usually appear opposite the spermogonial or pycnidial spots.
- The aecidial cups are orange yellow in colour.
- Each one of them contains a mass of orange coloured, binucleate spores called the aecidiospores or aeciospores. The infection causes no serious damage to the Barberry host.

#### **Causal Organism:**

*Puccinia graminis tritici* Erikss. and Henn. (*P. graminis* Pers.,). Host -*Triticum vulgare*

It is a heteroecious parasite which completes its disease cycle in two hosts namely **wheat** and **barberry (Berberis)** or Mahonia. *Puccinia graminis tritici* is a polymorphic species as it produces a succession of different types of spores

#### **Disease Cycle :**

- Teleutospores are the overwintering structures . They are carried from the distant high altitude hills by wind.
- After the usual resting period the teleutospores germinate in situ (on wheat stem and stubbles in the field).
- Each cell produces a short promycelium (epibasidium) into which the synkaryon migrates .
- Each synkaryon undergoes meiosis in the promycelium or the epibasidium.
- Segregation of the sexual strains takes place. Walls are laid between the haploid nuclei so that each promycelium or epibasidium becomes septate and four-celled .It is called basidium.

#### **Formation and germination of basidiospore :**

- Each cell of the basidium produces a single, uninucleate haploid basidiospores at the end of a sterigma.
- Of the four basidiospores thus produced two are of plus strain and two minus strain.
- The basidiospores are disseminated by air currents. While floating in the air they may chance to fall on young barberry leaves.
- If temperature and moisture conditions are favourable the basidiospores germinate.
- Each basidiospore develops a germ tube or a primary hypha . It penetrates the cuticle directly and brings about infection of the new host.
- Within the host tissue the primary hypha branches freely to form a monokaryotic or haplomycelium.and ramify in the intercellular spaces between the mesophyll cells.
- The cells are uninucleate. The nuclei in the mycelium are either of plus strain or minus strain depending upon the nature of the germinating spore.
- The mycelium feeds and grows vigorously.
- Eventually it enters the reproductive phase and forms thick mats of hyphae here and there beneath the upper and lower epidermis. The hyphal mats beneath the upper epidermis function as primordia of spermogonia.
- In about a week's time the primordia beneath the upper epidermis produce small flask-shaped fruiting bodies called the spermagonia
- Those beneath the lower epidermis function as primordia of aecidia or aecia.

### **Spermagonium :**

They are embedded in the tissue in orange yellow spots on the upper surface of the leaves of barberry bush (E). Each spermagonium opens to the outside through a small aperture called an ostiole which projects above the surface of the leaf.

### **The spermagonium contains three types of hyphal threads:**

#### **1. Periphyses:**

These are slender sterile, hyphae guarding the ostiole and projecting through it.

#### **2. Spermatiophores:**

These are numerous, fine, elongated hyphae arising from the interior of the swollen portion of the spermagonium. They abstrict small, hyaline spermatia at their tips in succession. The abstricted spermatia lie free in the cavity of the spermagonium.

#### **3. Receptive or Flexuous Hyphae:**

These are the fine, hair-like hyphal threads seen interspersed between the periphyses. They extend out through the ostiole and project much beyond the periphyses.

- The contents of the spermatium are entirely plus or minus according as the spermatium has developed from a plus or a minus mycelium.
- The spermatia emerge in a viscous sugary liquid through an ostiole to the leaf surface along with the flexuous hyphae.
- Sexual union or spermatization, as it is called, takes place between spermatia of one strain and flexuous hyphae of the other strain.
- The intervening walls between the spermatium and the flexuous hypha dissolve at the point of contact.
- The spermatium nucleus passes into the receptive or flexuous hypha through the pore.
- The spermatium nucleus now passes down the receptive hypha through the septal pores and reaches the basal cell which becomes binucleate or dikaryotic.
- The dikaryotic cell develops into a secondary or a dikaryotic mycelium.
- The transference of spermatia from leaf to leaf is the work of insects. They are attracted by the nectar and visit one spermatium after another.