

Physiological Specialization in *Puccinia graminis***Disease:** Black stem rust of wheat**Causal organism:** *Puccinia graminis tritici* (basidiomycetous fungus)**Primary host:** Wheat (*Triticum aestivum*)**Alternate host:** Barberry (*Berberis vulgaris*)

- The genus *Puccinia graminis* is an **obligate parasitic fungus**. It is a **heteroecious fungus** as it requires two hosts to complete its life cycle. Its primary hosts are the grasses (cereals) while the alternate hosts are members of family Berberidaceae.
 - The hosts on which the uredinial and telial stages occur are called the **Primary host** while the hosts on which the aecidial and spermogonial stages occur are called the **Alternate host**. The segregation of the stages occurs after the aecidial stage. In contrast, **autoecious** species complete their entire life cycle on one host plant.
 - The genus *Puccinia* is the largest, having about 4000 species. The species is composed of several varieties and numerous physiological races. *Puccinia graminis* shows very high degree of specialised parasitism.
 - For example, *Puccinia graminis*, causes rust disease in several cereal crops like wheat, barley and oats, but the strain which infects wheat plants, does not infect barley or oats. This is due to the fact that each strain has some metabolic specificity towards the different host species.
 - **The phenomenon** where within a species, there are different individuals who are morphologically same but differ physiologically from others depending on their pathogenicity towards different hosts, is called **physiological specialization**. Hence these physiologic species or biological species or physiologic races or mostly called varieties or *formae specialis* (*f.sp.*) be regarded as a morphologically similar organisms or strains that differ in their ability to produce infection in different hosts, host morphology, biochemical properties, cultural variability, spore germination and ecological relationship. The phenomenon of physiological specialization was first noted by Schroeter (1879).
 - The physiological races of *Puccinia graminis-tritici* have been identified using eight hosts (varieties of *Triticum aestivum*). Each *Puccinia graminis* strain specializes on a particular host genus or species, e.g.
 - (i) *P. graminis f.sp. tritici* is able to attack only wheat
 - (ii) *P. graminis f.sp. secalis* on rye
 - (iii) *P. graminis f.sp. avenae* on oats
 - (iv) *P. graminis f.sp. agrostidis* on *Agrostis*
- Thus each *formae specialis* (variety) specialises on its own host or group of hosts and differ from each other slightly in shape & size of their spores.
- Further, each strain has several physiological races. For example, *Puccinia graminis-tritici* has over 300 **physiologic races**. Races are designated by roman numbers (**Race1, Race2, Race3...& so on**). Physiologic races arise through hybridization and/or mutation.
 - These **rust races** can be further divided into subdivision-the **biotypes**. A biotype is a population of individuals, which is genetically identical.

- **The hosts also show different responses to infection like:** Immune (0); Extremely resistant (1); Moderately resistant (2); Moderately susceptible (3) and completely susceptible (4).
- Thus some show resistance, some susceptibility, others intermediate reaction. Spores from other race may show different reactions.

Key words: biotype, physiologic races, *Puccinia*, rust species.

Suggested reading for this topic:

Sethi, I.K. and Walia, S.K. (2018). *Text book of Fungi and Their Allies*. (2nd Edition), Medtech Publishers, Delhi (Chapter 22 for Unit 5)