When these differential varieties are inoculated with uredospores of the collection of a group of rust fungus, different types of infection occurs specific to different physiologic races.

Varieties are given latin names and physiologic races are designated by Arabic numericals. *Puccinia graminis tritici*a races 15 means race 15 of the variety *tritici* of the species *Puccinia graminis*. There are over 300 physiologic races of *Puccinia graminis tritici*.

(c) **Third level of specialization is within a physiologic race and they are termed as biotypes.** They differ from the main race only in-slight variation in the infection type produced on the host. This is an extreme type of specialization in parasitism and these are denoted by an epithet like 42A, 42B; etc.

Physiologic specialization is considered as an adaptation to parasitism. The rust fungus not only shows various physiologic races, there are other parasitic fungi like *Erysiphae*, causing powdery mildew, also exhibit physiologic specialization.

6.6. SMUT DISEASES

Smuts are fungal diseases in plants caused by the members of family Ustilaginaceae of Division Basidiomycota. The disease is caused by the species of *Ustilago* in cultivated cereals and millets like barley, wheat, corn, oats, and sugar canes. Smut means the matters that soils or blackens. Smuts are particles of soot. Since the disease results in marked transformation of plant parts into dark black masses of spores, the disease is called **smut disease.**

There are two types of smut diseases:

(a) Loose smuts (b) Covered smuts

Different species of *Ustilago* cause different smut diseases. The species that normally cause the loose smut will not produce the covered smut and *vice versa*.

List of *Ustilago* species and their host with type of smut disease

Loose smut		Covered smut	
Pathogen	Host	Pathogen	Host
1. *Ustilago avaene*	Oats	1. *Ustilago kolleri*	Oats
2. *U. nuda*	Barley	2. *V. hordei*	Barley
3. *U. tritici*	Wheat	3. *Tilletia caries*	Wheat
4. *U. zeae* *U. maydis*	Corn		
5. *Sphacelotheca cruenta*	Sorghum		
6. *U. Scitaminae*	Corn		

Smuts can develop on affected leaves, stems, flowers and some times storage organs. This disease cause great loss to the production.

Symptoms

6.6.1. Loose Smut

In loose smut disease basically the mass of black sooty spores are exposed and blown away by wind. The disease symptoms vary depending on the host plant.

The major symptom of loose smut is the smutted grain heads. They contain masses of black or brown spores where the grain would have been normally. The spores completely replace the grain head, so grains are not harvested from infected plants.

The infected plants get taller than the normal plants in the field and easily identified. These plants also mature little earlier.

In wheat plant every head of the attacked plants is converted to a black powdery mass of spores. The disease is recognized in the field only when the plant produces ears. In some variety of wheat, yellow chlorotic streaks may develop on flag leaves before emergence of ears. Usually in an infected plant all the ears, all spikelets and kernels of each ear are smutted. The infected spikelet is first covered by a delicate greyish membrane which soon bursts and sets the spores free. After the disposal of spores by wind current, the rachis is left naked.

In corn, the symptoms are slightly different. The disease is caused by *Ustilago maydis* (or *U. zeae*). The disease is easily recognizable by the presence of large sooty swellings galls called **smut galls** or **tumors.** These galls develop on the ears or stalks. They also develop on the leaves and male flowers. The galls at the early stage are light coloured and covered with a firm shining membrane which is greenish white in colour. When matured, the tumors turn sooty due to spore formation inside. The covering membrane gradually dries up and bursts open to expose the mass of spores. In this case the disease is localized but not systematic.

In sugarcane the disease is caused by *Ustilago scitamineae*. The infected plant is recognized by its long whip-like black shoot much curved on itself. The powdery mass of teliospores on this whip like structure is contained first by a fine membrane which later exposes the black sooty mass by rupturing itself. The lateral shoots developing from the eyes on the infected cane may develop similar structures after infection.

Fig. 6.11 gives the graphic representation of the life cycle of a smut fungus causing loose smut in wheat.

6.6.2. Covered Smuts

Generally in the covered smut diseases the spore mass remain covered by the wall of the grain. They are not exposed. They are only liberated during threshing when the wall of the grain ruptures by the threshing methods.

In covered smuts the infected plants do not show symptoms until heading. Kernels are replaced by masses of dark brown smut spores. The smutted heads are

Covered smut of barley ... be stunted.