3. Sorghum

(*Sorghum vulgare* Pers., Family: Poaceae)

1. Grain Smut

Economic Importance: It is also known as Covered smut/ Kernel Smut/short smut. The first time the Covered Smut of Sorghum was registered in Russia (1890). Severe losses are caused by this disease in regions where the crop is extensively grown and proper control measures are not adopted. Up to 25 per cent of plants have been found affected in certain areas. Seven smut diseases occurs in sorghum but four smuts are occurs in India *viz*., covered smut, loose smut, long smut and head smut.

Symptoms:

- The disease becomes apparently only at the time of grain formation in the ear, at which time smut sori are formed in the place of healthy grains. The size of varies with the variety but they are larger than the normal grain.
- The smut covered with the husk of the ash white is formed to the head.
- The length of the smut part seems to reach as much as 1cm and expanded long the seed.
- The husk tears at the generation latter term and a black smut spore is exposed.
- The causal organism of the young plant transmits the seed, germinates with the germination of the plant the smut spore, and is growing point infected.
- The individual grains are replaced by smut sori. Sori are covered with creamy skin.
- Sori can be localized at a particular part of the head, or can occur over the entire inflorescence.
- Ratoon crops exhibit a higher disease incidence.

Causal organism: *Sphacelotheca sorghi* (Link) Clinton, Basidiomycotina. **The pathogen of the disease in its development cycle forms teliospores (wintering stage of the fungus) and sporidia.** Teliospores are spherical or roundish, tinted, smooth, 4.8 to to 8.5 µm in diameter. At sprouting they form three- or four-cellular basidium with laterally and apically growing sporidia.

Sporidia are oblong, with slightly rounded ends, or spindle-shaped, 2.9 to 18.5 µm. The first signs of affection of sorghum with the Covered Smut are noticeable after ejection of inflorescences, when smut sori start to develop instead of the flower elements, reaching 0.5-1.0 cm in size. More often all ovaries of the inflorescences are affected, but occasionally part of them remains unaffected, and normal caryopses are formed. Diseased panicle does not hypertrophy, and glume shape and size remain unchanged. The sori are covered with a dense light capsule which collapses during harvest, thus releasing teliospores and polluting grain. The source of infection is the infected seeds. Contamination of the plants occurs only during the sprouting stage. The Fungus S. sorghi can grow and develop at temperatures from 10 to 32°C. The soil temperature 18-23°C and soil humidity 15-20% during the period of seed germination are optimal for the contamination of plants.

Disease Cycle: The pathogen is **externally seed borne** and seedling infection occurs at the time of germination and emergence of seedlings. *Cynodon dactylon* (Doob grass) was reported as alternate host of S. sorghi in 1995. Inoculation of sorghum seed with spores from the grass resulted in the infection of the sorghum plant. During threshing the sori are broken and the spores get lodged on the surface of healthy seeds. The remain dormant until the next season when they germinate with the germination of the seed. Seed subjected to a teliospores suspension coupled with partial vacuum and seed directly infested with dried teliospore result in maximum diseasesd penicles.

OR

The disease is **externally seed borne** and **systemic**. The spores germinate with the seed and infect the seed by penetrating through the radicle or mesocotyl to establish systemic infection that develops along the meristematic tissues. At the time of flowering, the fungal hyphae get converted into spores, replacing the ovary with the sori. If the diseased ears are harvested with the healthy ones and threshed together, the healthy grains become contaminated with the smut spores released from the bursting of the sori. The spores remain dormant on the seed until next season.

Disease Management:

- Seeds are immersed in 0.5% formalin for 2 hrs and dried quickly.
- Seeds are alternatively treated in 0.5-3.0% $CuSo_4$ solution for 10 min then dried and sown.
- Seed treatment with Carboxin (Vitavax) @ 2g/kg or Captan/Thiram 4g/kg of seed.
- Collect smutted ear heads in cloth bags and destruct by dipping in boiling water.
- Avoid rationing.
- Solar energy treatment of seed was recommended in 1947. (Seeds were soaked simple water 4hrs.and dried in sun light)
- Used resistant lines and varieties like; T 29/1, PJ 7K , SPV-104, 102,115,297,138,245, and RSV-1-R etc.

2. Anthracnose:

Economic Importance: Sorghum anthracnose was first reported in 1902 from Togo, West Africa (Sutton, 1980), and has since been observed in most of the regions of the world where sorghum is grown. However, it is more prevalent in warm, humid areas (Tarr, 1962; Pastor-Corrales and Frederiksen, 1980), where grain yields from susceptible cultivars may be reduced by up to 50% during severe epidemics (Harris and Cunfer, 1976).

Symptoms

- The term anthracnose literally means 'like coal' and is used in an aetiological sense for diseases caused by species in the genus *Colletotrichum*.
- Anthracnose on sorghum can affect the leaves, stems, peduncles, panicles and the grain, either separately or all together.
- The symptoms vary with cultivar and the prevailing weather. The foliar phase may occur during any plant stage but usually appears on leaves of 30 to 40 days plants.
- Small (0.1 to 0.25 inch), circular, red lesions with a distinct margin may appear on susceptible leaves in midsummer and cause defoliation.
- In severe cases, plants may die before maturation thus reducing growth and delaying development of plants or even premature death of plants.
- These lesions can enlarge slightly in humid weather.
- The stem infection is often referred to as red-rot, since it is associated with reddening of the stem tissues.
- Tan spots with red-purple margins may develop on upper portions of stalks.
- The inside of these stalks will be brick red interspersed with the normal white color of healthy tissue.
- Diseased stalks lodge at the point of infection, and yields may be reduced.
- Often these different aspects of anthracnose appear to be different diseases, and some authors speculate that they are caused by different strains of pathogen.

Midrib Infection Midrib infection often occurs and is seen as elongate-elliptical red or purple lesions. If midrib and foliar infection occur together, leaf damage, defoliation, and reduction of yield may be greater.

Causal organism: *Colletotrichum graminicola*

Disease cycle

- Primary Infection : Fungus present in Seed and Infected Plant Debris, Collateral host: Johnson grass, Sudan grass, maize, barley and wheat
- Secondary Infection : Wind born Conidia

Management

- Destruction of infected plant debris and collateral hosts
- Crop rotation with non-host crops
- Grow resistant varieties like SPV 162, CSV 17, Texas Milo and Tift sudan etc
- Treat the seeds with Captan or Thiram @3 g/kg.
- Spray the crop with Mancozeb @0.25% or carbendazim@0.1%

Comparison of the characters of four smuts of sorghum found in India

Character	Grain smut	Loose smut	Long smut	Head smut
Organism	*S. sorghi*	*S. cruenta*	*T. ehrenbergii*	*S. reilianum*
Ear infection	All or most grains smutted	All or most grains smutted	Only about 2 per cent of grains are infected	Entire head smutted into a single sorus
Sori	Small, 5-15 × 3-5 mm	Small, 3-18 × 2-4 mm	Long, 40 mm × 6-8 mm	7.5-10 cm × 2.5-5 cm
Columella	Short columella present	Long columella present	Columella absent, but 8-10 vascular strands present	Columella absent but a network of vascular tissues present
Spores	In singles round to oval, olive- brown, smooth walled, 5-9 µ in diameter	In singles spherical or elliptical, dark-brown, spore walls pitted, 5-10 µ in diameter	Always in balls,globose or angular, brownish green, warty spore wall, 12-16 µ in diameter	Loosely bound into balls, spherical or angular, dull brown, minutely papillate 10-16 µ in diameter
Viability of spores	Over 10 years	About 4 years	About 2 years	Up to 2 years
In culture	Yeast-like growth with sporidia	In colonies with sporidia and resting spores 40× 50 µ in diameter	In colonies with masses of sporidia	In colonies germ tubes and sporidia
Spread	Externally seed-borne	Extremely seed-borne	Air-borne	Soil borne and seed-borne