

Different Smuts of Sorghum

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SORGHUM:

Sorghum Smuts: The fungus that causes sorghum smut grows into the ovaries of the plant and replaces the grain with a fungal structure full of spores, called a sori. Only four of the seven smut illnesses are present in India. The fungus responsible for the illness are members of the subdivision Basidiomycotina, order Ustilaginales, and family Ustilaginaceae. The damage is confined mostly to the heads or panicles, reducing both the grain yield and forage value.

(i) Covered Smut or Grain Smut of Sorghum

This smut is caused by *Sporisorium sorghi* (Link) Clint (syn: *Sphacelotheca sorghi*). Among all the sorghum smuts, it is thought to be the most harmful. Even up to 25% of the grain production has been damaged. In Maharashtra, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Gujarat, and Karnataka, it is very common when the seed is not fungicide-sanitized. The smut is more common where farmers use untreated seed. Seeds in a smutted head are converted into dark brown powdery masses of teliospores or chlamydospores. The smut spores are covered with a tough grayish white or brown membrane. This membrane is ruptured during harvesting and threshing and the spores are attached to the healthy grains where they remain attached till the seed is sown next year. The smut sori are smooth, oval or cylindrical or may be white, gray or brown.

When the infested seeds are sown, the teliospores which are 4-7 μ in diameter germinate along with the seed and a four celled promycelium bearing lateral sporidia is formed. The sporidia germinate and infect the developing seedling. Sometimes the teliospores germinate directly by producing germ tubes. The fungal mycelium grows systemically along with the plant but does not show any disease symptom until heading. While heading, the teliospores are formed and the whole seed is converted into smut sori covered with a membrane. During threshing time the membrane ruptured and the teliospores are fallen down on soil and also adhere to healthy seeds. The teliospores on soil normally do not cause any infection to seedlings. The optimum temperature for disease development is 25 C and the infection decreases at temperatures between 35-40 C. Several physiologic races of covered smut are known worldwide.

Etiology: pathogen:

Sphacelotheca sorghi [subdivision-Basidiomycotina, order-Ustilaginales, Family-Ustilaginaceae] • The fungus is systemic.

- The mycelium occupies the growing point of the seedling and continues to grow along the plant without producing any external symptoms until the earhead is put forth.
- The mycelium aggregates in the immature ovary and the chlamydospores are formed by the rounding off the mycelium.
- The sorus wall is formed mainly by the outer layer of the mycelium, and partly by the host tissue.
- The fungus is present in the form of sorus, which has a tough wall and a long, hard, central tissue called columellum.
- The columella is bulbous at the base and narrowed towards the tip.
- A dense mass of black to dark brown, smooth, thick-walled spores, which are mostly single and measure

5-9 μ in diameter, fill the space between the columella and sorus wall.

- They germinate immediately if moisture is available, usually by producing a four celled promycelium which buds off sporidia.

Disease cycle: 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.

Management: Use Disease Free Seeds.

- Grow resistant varieties like T 29/1, PJ 7K, PJ 23K, Nandyal and Bilichigan.
- Collect the smutted ear heads in cloth bags and dip in boiling water.
- Treat the seed with fine sulphur powder @0.5% or Captan or Thiram @0.3%.
- Follow crop rotation.

(Ii)Loose Smut Of Sorghum

This disease is caused by the fungus *Sporisorium cruenta* (syno: *Sphacelotheca cruenta* (Kuhn) Potter.). All seeds in an infected panicle are smutted. Some kernels are transformed into leafy structures and are escaped of infection. The seeds are converted into 2.5 cm long, pointed smut sori which are surrounded by thin grey membrane. This membrane is usually ruptured at the time when panicle emerges from the boot. Infected panicles emerge earlier than healthy ones. The smut sori contain dark brown to black teliospores which are blown away by wind leaving a long, black pointed conical and curved structure (columella) in the center. Some of the teliospores (6-10 μ in diameter) adhere to the surface of healthy kernels on nearby plants and carry with the seed. The affected plants are stunted with unusual excessive tillering and have thin stalks as compared to healthy plants.

When infested seeds are sown, the teliospores germinate along with the seed through a thick four celled promycelium bearing lateral sporidia. The sporidia germinate and infect the seedling. The infection occurs at a temperature 20-25 C with a wide range of humidity. The fungus grows systemically with the plant without showing any visible symptoms. The symptoms appear only when the head emerges. The normal seeds are replaced by long, black and pointed smut galls or sori. Teliospores in soil are not important for infection. The major difference between covered and loose smuts is that the plants affected by loose smut are stunted, have thin stalks and heads emerge earlier than healthy plants and also abundant tillering was observed with loose smut infection.

(iii)Head smut of sorghum

Head smut is caused by *Sporisorium holci-sorghii* (syn: *Sphacelotheca reiliana* (Kuhn) Clinton). This fungus attacks both sorghum and corn but both the hosts are attacked by different physiological races. Smutted plants have weak root systems and are more susceptible to stalk rot and root rot fungi.

Infection first appears even when the heads are still in boot. The heads are completely converted into a large smut galls covered by a thick whitish membrane. The membrane ruptured before the heads are emerged and dark brown to black teliospores are exposed. The teliospores are intermingled with a network of long, thin, dark broom like filaments of vascular tissue. The heads are totally smutted with characteristic “witches

broom” (many small, rolled leaves coming out from heads of suckers at the nodes). The affected plants remain dwarfed or stunted. The teliospores are blown off by wind or rain to the soil and plant debris and survive there till the next crop is sown. The parts of the panicle left out from infection show sterility and proliferation of individual florets. Occasionally smut galls may develop on leaves and stem of sweet sorghum.

When sorghum seeds are sown the teliospores (9-14 μ in diameter) which are already in the soil germinate along with the seed producing a four celled branched promycelium that bears sporidia terminally near the septa. The sporidia sprout by producing yeast-like secondary sporidia or may germinate directly by producing a germ tube that penetrates meristematic tissue of seedlings. The sporidia germinate faster at a temperature of 27-31 C in moist soil. The infection of seedlings can also take place by teliospores already adhered to seed during the last season. The healthy soil thus can be infected through seed infection. Apparently, seed infection is not important in causing infection.

(iv) Long smut of sorghum

The disease is caused by *Tolyposporium ehrenbergii* (Kuhn) Pat. The spores are covered into a solid ball. The surface of spores is echinulate. The spores germinate by the formation of promycelium. Numerous sporidia are formed singly or in chains. The spores are soil borne. The sporidia produced by soil borne spores are wind borne and reach to buds and initiate a systemic mycelium which later expresses in the head. The ovary is converted into smut sorus. The primary inoculum may be introduced from alternate hosts. Since the infection is air-borne, control is difficult.

Control of sorghum smuts

Covered and loose smuts are easily controlled by seed treatment with a protectant fungicide. Since physiological races of the three smuts can hybridize with one another, it is extremely difficult to develop highly resistant or immune hybrids, varieties or cultivars. However, resistant varieties have been developed for example in India SPV 104, 115, 102, 245 etc have been found resistant against covered smut in Maharashtra. Some sweet sorghum varieties are resistant to Head smut. Other seed treatments like soaking seed in Formalin (0.5%) or copper sulphate 0.5-3.0 % solution for 10-15 minutes, seed dressing with mercurial fungicides like Agrosan GN (1:500) are effective to control smuts. Collect the smutted ear heads in cloth bags and dip in boiling water.